Journal of Applied Economic Sciences

Quarterly Journal

JAES

Journal of Applied Economic Sciences

Volume IV
Issue 4(10)

Winter 2009

I.S.S.N. 1843-6110

JOURNAL

of Applied Economic Sciences

Publisher:

European Research Center of Managerial Studies in Business Administration
Email: jaes_secretary@yahoo.com

*J*ournal of *A*pplied *E*conomic *S*ciences

***J*ournal of *A*pplied *E*conomic *S*cience** is a young economics and interdisciplinary research journal, aimed to publish articles and papers that should contribute to the development of both the theory and practice in the field of Economic Sciences.

The journal seeks to promote the best papers and researches in management, finance, accounting, marketing, informatics, decision/making theory, mathematical modelling, expert systems, decision system support, and knowledge representation. *This topic may include the fields indicated above but are not limited to these.*

*J*ournal of *A*pplied *E*conomic *S*ciences be appeals for experienced and junior researchers, who are interested in one or more of the diverse areas covered by the journal. It is currently published quarterly with three general issues in Winter, Spring, Summer and a special one, in Fall.

The special issue contains papers selected from the **International Conference** organized by the **European Research Centre of - anagerial Studies in Business Administration** and **Faculty** of **Financial Management Accounting Craiova** in each October of every acad emic year. There will prevail the papers containing case studies as well as those papers which b ring something new in the field. The selection will be made achieved by:

- Conference Session Chairs
- Editorial Board Members

***J*ournal of *A*pplied *E*conomic *S*cience** is indexed in CEEOL - www.ceeol.org, EBSCO www.ebsco.com, IndexCopernicus www.indexcopernicus.org and in RePEc www.repec.org databases.

The journal will be available on-line and will be also being distributed to several universities, research institutes and libraries in Romania and abroad. To subscribe to this journal and receive the on-line/printed version, please send a request directly to jaes_secretary@yahoo.com

Journal of Applied Economic Sciences

ISSN 1843-6110

Table of Contents

A PRACTICAL APPROACH TO MODEL BANKING RISKS USING LOSS DISTRIBUTION APPROACH (LDA) IN BASEL II FRAMEWORK

Raquel **BARREIRA**, Tristan **PRYER**, Qi **TANG**
Department of Mathematics,
Sussex University, **UK**
raquelbarreira@gmail.com, tmp20@central.susx.ac.uk, q.tang@sussex.ac.uk,

Abstract:
In Basel II Capital Accord, the Advanced Measurement Approaches (AMA) is stated as one of the pillar stone methods for calculating corporate risk reserves. One of the common yet cumbersome methods is the one known as loss distribution approach (cf. [Chernobai A S, Rachev S T and Fabozzi F J, (2007)]. In this article, we present an easy to implement scheme through electronic means and discuss some of the mathematical problems we encountered in the process together with proposed solution methods and further sought on the issues.

Keywords: loss distribution approach, corporate risk, Basel II principles

JEL Classification: C, P

1 Introduction

In Basel II Capital Accord, the use of top-down or bottom-up method to calculate risks provisions are recommended as the ways to model and compute corporate risk value (VaR - values at risk). The top down approach relies on general business income/cash flow side of the business, for example, a percentage of the total net cash managed. The bottom up approach relies on gathering loss data from within the company and carry out statistical analysis of these data to arrive at a figure. Bottom-up methods are regarded as more refined. Once bottom-up methods are adopted, it is no longer permitted to retreat to top-down approach.

Within the bottom-up approach, there are process based models, actuarial models and proprietary models.

The process based model splits banking activities into simple business steps, the management evaluates the situation according to these steps to identify risks. This is mainly a time series type of model. Regressional analysis tools are often used when there are multi-factors in the problem (cf. [Alexander and Pezier, (2001); Allen, Boudoukh and Saunders, (2004); Giudici, (2004); Marshall, (2001), and Neil and Tranham, (2002)].

The actuarial models or statistics models are generally parametric statistical models. Various statistical fitting techniques are used (see extensive discussions in [Chernobai, Rachev and Fabozzi, (2007)]. In this article, we present an efficient, direct way for this approach and we also discuss some of the technical difficulties that need to be solved. The implementation of this method is based on a carefully designed algorithm. In places where mathematics computations encounter difficulty, management judgement is requested in the form of inputting parameters in programmed interfaces. We also set default should management is unwilling to make judgments. These default settings are carefully set with discussion with management before implementation.

The advantage of our actuarial model is that once it is set, the model itself will give results very close to historic expected total loss. It is also possible to carry out extensive Monte-Carlo disturbance to the multi-parameter model on various levels of the organization and simulate a complicated business operation. It can also incorporate features such as management control impact on reduction of losses. We only discuss the general philosophy of algorithm design but not the details of how to implement various technical control issues. Our final program operates in the world-wide-web environment. A free test version can found by opening a trial account through www.care-web.co.uk. The background programming is in C.

The proprietary models in risk management are mainly developed by major financial service companies. The approach involves a variety of bottom-up, top-down and qualitative analysis schemes. It is mainly spreadsheets based. It was mentioned in [Chernobai, Rachev and Fabozzi, (2007)] that the currently available proprietary software include Algo OpVantage by Algorithmics Inc, Six Sigma by

Citigroup and GE Capital, and Horizon by JP Morgan Chase and Ernest & Young. Interested readers should go to the internet search engines to obtain more information.

Our model is different from the existing ones as we incorporated a much more flexible adjustment mechanism and the aims of the prediction are very concentrated. In the following, we will discuss step by step the various features of the program and the mathematical thinking behind. We are required by a management consultancy firm to implement these details. We believe that although it makes the running of the program more technical (there is a large data file to prepare), but it does have more features and give more flexibility in modelling and predicting the VaR.

The content of this paper is as follows:

1) Description of the modelling approach and algorithm (see Section 2)
2) How to give different weight to different year's data (see Section 3).
3) How to deal with insufficient number observations (see Section 4).
4) How to deal with near misses (see Section 5).
5) Incorporating [excluding] high impact, lower probability events when they are not in [already in] the data table (see Section 6).
6) Management intervention and cost/improvement comparison (see Section 7)
7) Problems arising from designing Monte-Carlo simulations (see Section 8).

2 The modelling approach

In order to describe the loss profile of a corporate entity, it is important to collect the past data from the company. If the company has accumulated enough data over the past three to five years, then we can use the method defined in this section to model the company risk. The method falls into the general category of LDA but without the parts of estimating parameters and fitting to an existing distribution function, the model is based on direct modelling of the existing loss data.

The reasons for using direct modelling rather than fit onto an existing probability distribution are as follows:

1) Computational techniques make the handling of thousands of data automatic and instant, it can also highlight many critical issues automatically (such as few observations among some risk classes, very high loss values in a risk class etc) to alert the management in a mechanical manner.

2) The estimate of the loss value and frequency can now be done by Monte-Carlo simulation. When hundreds or thousands of data are involved, the Monte-Carlo simulation of the business operation becomes much closer to real life situations.

In this article, we discuss LDA and use frequency as vertical axis against actual loss as horizontal axis. Time is only used as background information (see Section 3). This is based on the observation that a detailed time series analysis of the risk events may not be very useful in this particular setting because businesses run in cycles. Accounting periods and many management factors could have intervened in the reporting system that results in inaccuracies in terms of report timing of the risk events. Many operational risks have a build up period and risk releasing period. This is one of the fundamental differences between business risk measurement and equity / derivative price movement measurement. By assuming that management is pro-active, we have also involved the feature that gives differentiation to the importance of past data depending on how far the event has happened from current time. For example, three-year-old data will be given less weight compared to one-year-old data.

Our discussions are based on real industrial consultancy experience, the modelling problems / challenges mentioned are real world situations. In each subsequent section, we concentrate on one particular issue at a time, give the background information on why these issues are arising, what is the expectation of the company management and what we can do to build a robust mathematical model.

Before going into further discussion, we first introduce the notations and basic concepts.

It is a common agreement that the risks faced by a company should be classified according to the hierarchy of

Company
Business Departments
Individual risk events

At the lowest level, it is common now to give a label to each individual risk event (just an example) in the way of

110 corresponding to "Default on payment"
320 corresponding to "Falsified identity"

etc. To simplify the discussion, these events are regarded as probabilistically independent events for the business.

Of course, they can also be treated as dependent events, then the aggregation of different probability distribution functions will be different from what we present now. In Section 8, we will highlight some of the possibilities. To keep things simple for management consultancy companies, we avoided using too complicated modelling techniques.

The business departments within a company will be directly responsible to a number of risk events. It is a common practice not to let different departments to share same risk events. So the structure looks like

Department 1	Department 2	●●● ●●●
Risk 110	Risk 210	●●● ●●●
Risk 120	Risk 220	●●● ●●●
●●● ●●●	●●● ●●●	

It is common that risk are analysed per risk event and aggregated back to departmental and company level. The labelling of the risks provides a convenient way for the assessment and analysis using internet forms and programmed algorithm.

2.1 The data collection system

A web based reporting system installed across the business's offices, departments should provide a reporting form as

Table 2.1. Example of risk report form from a web reporting system

Risk No	Date reported	Loss value
110	02/02/2003	312,227.71
210	03/07/2003	0
300	07/10/2003	536.24

The reported event with loss value "0" in the report form is called a "near-miss" event, where an event has happened against the interest of the company and has been observed, but there is no immediate observable money loss. However, it cannot be excluded that hidden loss has happened or will happen.

The meanings of the quantities involved in the table are as follows:

- Risk No – an identity number given to the risk event.
- Time reported – the time when the report of the loss is made OR the actual date when this event happened.
- Loss value – the actual recorded value of loss – this may be inconclusive as hidden losses may appear later.

It is assumed that each accident is reported in this format. We use "time reported" rather than "time happened" for convenience. Considering the annual business (accounting and management checking) period, this is a reasonable assumption.

Of course, real life risk management requires more information regarding the nature and quantification of risk events. In the actual simulation, additional information will need to be provided before the data have been fed. They are:

• Total number of risks and risk numbers distinguishing different risk events: they do not have to be pre-assigned, they can be any number string. But the total number of different risk numbers has to be known so that the data loading process can be carried out without errors.

• Number of years in table: this will tell the program the prediction is based on the combination of how many years of past data.

- Number of groups, their labels and the risk numbers they contain: This will tell the program that the simulation is done on how many groups, while each risk number is allowed to belong to only one group.
- Initial year of data: the program will understand how old the data are.
- Confidence level: the confidence level of predicted loss values, usually 95%.
- Loss impact and probability of occurrence for each risk number: these are management perceived quantities. Impact and probability are classified as V (very high), H (high), M (medium), L (low) and E (extremely low).
- Loss range: for each particular risk number j, a loss range is given to impact (not probability) factor V, H, M, L and E. These can be different for different risk numbers. For example, for risk 1289, its impact is M, its loss range could be (100000,300000), but for risk 22369, it is also M, but its loss range could be (1000,2000).
- Cash related indicator: some losses are not cash related, but could have implicit impacts. Numerical simulation can include them by assigning cash value or exclude them according to the indicator = 1 or 0.
- Management factor: This is a factor between 0 and ∞, but usually between 0 and 1. This is again a management judgement. If certain management measures are expected to reduce (or exacerbate) the loss, then this factor can be taken <1 (>1) accordingly. This is risk number dependent, default value =1.
- Final information is annual weight: it is customary in management to regard older data as less relevant. We give the flexibility for management to assign different weight to data from different years. These weights are also risk number dependent.

When numerical simulation is finished, we have a number of information given in an exit report (issued after simulation) in parallel to the numerical results

1) If actual loss has happened and the real loss is out-of range for that risk number significantly (ie, risk is regarded as H, and range is (100000, 1000000), but there is a recorded loss event with value 2000000), then the management perception of loss range may need modification, our program will send a warning to the exit report.
2) Long tail risk: if V or H impact, L or E probability event has no recorded loss in data table, a mock loss event will automatically be added, with a message in the exit report on the nature and magnitude of the added event.
3) If a risk number contains only near misses, a warning will be given in exit report.
4) If a risk number contains high frequency loss event (a single loss value recorded many times repeatedly), a warning will be issued in exit report.

2.2 Construction of probability distribution frequency/loss value

Local probability distribution for a single observed cash loss value: Based on the reporting system described above, we can accumulate and sort all data for Risk No 10, for example, we list all loss data in increasing order (here time factor has been ignored, it could also be ordered according to the time when it happens), if the loss observation x_j has occurred p_j (≥ 1) times, the associated frequency will be p_j. The loss observations will be in the following format

Table 2.2: Observations for risk No k

Date reported	Loss sum	Frequency
02/2007	x_{k1}	p_{k1}
…	…	…
01/2004	x_{ks}	p_{ks}

We can then construct a local probability distribution around each loss value, say

$g_s(\mu_s, \sigma_s)$ at (x_s, p_s)

where g_s is a probability density function, μ_s is the "assigned" expected loss and σ_s is the "assigned" spread of the loss (risk of the loss). The strategy for computing these parameters should be by using neighbouring loss data.

For example, if loss x_s is one of the actual loss observations, to construct the probability distribution $g_s(\mu_s, \sigma_s)$, we can use loss values

$x_{s-p} < x_{s-p+1} < \ldots < x_s < \ldots < x_{s+q}$

together with corresponding frequencies

$p_{s-r}, p_{s-r+1}, \ldots p_s, \ldots, p_{s+q}$

to calculate the expected loss and risk (spread):

$$\mu_s = (x_{s-r} p_{s-r} + x_{s-r+1} p_{s-r+1} + \cdots + x_{s+q} p_{s+q}) / (p_{s-r} + \cdots + p_{s+q})$$

$$\sigma_s^2 = ((x_{s-r} - \mu_s)^2 p_{s-r} + (x_{s-r+1} - \mu_s)^2 p_{s-r+1} + \cdots + (x_{s+q} - \mu_s)^2 p_{s+q}) / (p_{s-r} + \cdots + p_{s+q} - 1)$$

here loss observations are from the same risk number.

Note that there are some cases where left data or right data are missing. For example, x_1, the smallest observed loss value has no left loss values. In this case, minor adjustment is carried out using any reasonable method, this will usually not affect the overall risk profile.

For risk numbers containing single observation, we will have to use the impact bounds to help us to decide expected loss and risk.

In a similar way, we may construct higher order moments. Once we have these moments, we can construct a local probability distribution for the loss value x_s.

Remark:

1) The local distribution function can be normal, gamma or any other appropriate function. For example, if normal distribution is used, truncation at 0 (loss values are all regarded as positive) and re-weighting is necessary.

2) The assigned expected loss and assigned spread of the loss will depend on the neighbouring loss values as shown above.

3) This requires that the parameters are calculated "locally", eliminating the need for estimating the parameters of the overall probability distribution.

4) The "localization method" can give large rare loss a large associated spread (risk), therefore smoothing the local probability distribution at that point. It will also concentrate sharply where large number of losses are observed within a relatively compact range.

Example: In the case of normal distributions, the local distribution at (x_s, p_s) is

$$f_s = \begin{cases} \frac{1}{\sqrt{2\pi}\sigma_s} \exp\left(-\frac{(x-\mu_s)^2}{2\sigma_s^2}\right) / \int_0^\infty \frac{1}{\sqrt{2\pi}\sigma_s} \exp\left(-\frac{(x-\mu_s)^2}{2\sigma_s^2}\right) dx & x > 0 \\ 0 & x < 0 \end{cases}$$

<u>Probability distribution for a risk number</u>: After constructing the local probability distribution for losses in each risk number, the global probability loss distribution for a given risk number can then be constructed using weighted sum, the weight is the frequency of s^{th} loss value (the number of times it appeared) over the total frequency in that risk number. The aggregation formula is

$$f_{risk\ i} = \frac{\sum_s p_s f_s}{\sum_s p_s}$$

where s is summed over all observations in risk number i. To simplify notation when no confusion we simply re-label $f_{risk\ i}$ as f_i.

Remark: The fact that the actual loss value is a random quantity is compensated by the recognition that its frequency is a random variable. It is easy to check that if the loss distribution thus constructed for risk number *i* is f_i, we have

Expectance of $[f_i] \approx$ Expectance of frequency $\times$ Expectance of Loss

Here we do not have equality because of truncation and re-weighting errors. These errors are usually very small. This conforms to the insurance risk modelling principle.

The probability distribution for the entire company or a group of risk numbers: events in different risk numbers are treated as independent, we simply aggregate the distribution functions for risk numbers

$$f = \frac{\sum_i (total \quad frequency \quad for \quad risk \quad i) \quad f_i}{\sum_i (total \quad frequency \quad for \quad risk \quad i)}$$

The index i is taken for all risk events in a designated simulation group. The resulting probability distribution gives the basis of modelling of company risk.

Remark: In fact, these "total frequency" may need to be changed from true figures. We will gradually discuss cases where frequencies need to be re-assigned (for near-misses, for older data etc).

Finally, random perturbations can be given to each loss value and its frequency. The perturbed model will exhibit rather complicated behaviour and resembles to a real business operation. The perturbation pattern can be decided by the company need. After many simulations, an estimated loss interval can be extracted using certain confidence level.

3. Give different weights to different years of data

Background: Assuming that the management system is reasonably efficient, gradual improvements will be in place for controlling high / medium impact losses. Considering the delay in time in the management process, it is anticipated that j-year-old data will have less impact on current operation than (j-1)-year-old data for any j.

Considerations: The weight for different years should apply to frequency only. The reason is that the loss observations are used in calculating expected loss and risk (spread) of the distribution functions, therefore the actual loss observations will affect the distribution pattern of the losses and should not be altered lightly. The application on frequency will give a desirable rebalance of importance and is viewed as acceptable within our discussions.

Solutions:

1) Management controlled re-weighting: The re-weighting factor are imported from the data table, we use five-year as an example in the following:

Table 3.1. Re-weighting factor.

Year from current time	1	2	3	4	5
Re-weighting factor	A_1	A_2	A_3	A_4	A_5

where $A_j \geq 0$ for j=1,2,3,4,5, except for exceptional circumstances, we should have $A_1 \geq A_2 \geq A_3 \geq A_4 \geq A_5$.

Remark: It is OK for some of the A_js to be bigger than 1, for example, the choice $(A_1, A_2, A_3, A_4, A_5) = (1.4, 1.0, 0.7, 0.4, 0.2)$ is perfectly OK. Let $a=1.4+1+0.7+0.4+0.2=3.7$, the real weight thus assigned are: $(1.4/3.7, 1.0/3.7, 0.7/3.7, 0.4/3.7, 0.2/3.7)$

In the data table (see beginning of Section 2.2)

Date reported	Loss sum	Frequency
02/2007	x_{k1}	p_{k1}
…	…	…
01/2004	x_{ks}	p_{ks}

the program can apply suitable factors in the frequency column. Say we are modelling year 2008, hence 2007 is the closest year, after applying annual weight, the data table is reformulated to

Date reported	Loss sum	Frequency
02/2007	x_{k1}	A_1 p_{k1}
…	…	…
01/2004	x_{ks}	A_4 p_{ks}

2) Regression re-weighting approach (when there is considerable history in reliable data recording)

We can use the best fitting AR(5) model (autoregressive model)

$$y_t = A_1 y_{t-1} + \cdots + A_5 y_{t-5} + \varepsilon_t$$

to decide the coefficients A_j. The "total number of losses" (taking into account of near-misses and non-cash losses to a certain degree) for each risk number is used as one observation, regression is carried out over all risk numbers.

Note that t is the current year where the total loss is supposed to be known. The final probability distribution, using previous notations is

$$f = \frac{\sum_{j=1}^{5} p_j A_j f_j}{\sum_{j=1}^{5} p_j A_j}.$$

Since the management controlled re-weighting is more straightforward to understand, we use it as our default setting. Whether to choose management controlled re-weighting or regression re-weighting should be a simple matter of preference. However, in implementing regression re-weighting, a safeguard has to be implemented to invalidate the model when $\sum_{j=1}^{5} p_j A_j = 0$ (unlikely but possible) and switch back to approach 1).

4. Insufficient number of observations

Background: because of subdivision of risk into categories such as business lines and risk types, it is often that in the construction of the probability loss function, we end up having just a few observations or no observations at all. Recall that to construct loss distribution function, we need neighbouring data to define local data spread (risk) and expected loss. Few neighbouring data means that the reliability of analysis is reduced.

For example, if 4 neighbouring (different) observed loss values are needed to calculate expected losses and data spread (risk), and there are only three different loss values observed in that category, then we have to compromise the way we compute these quantities.

Considerations: Any reasonable way of calculating expected loss, data spread (risk of a loss, the possibility a new loss appears near this old loss and/or how neighbouring losses are related) will require a number of different observed loss values for the calculation/estimate to be carried out.

Solutions: Again here, management participation is necessary. It is understood that in the <<Impact>> column of the report form (see Table 1.1 and the bulleted explanation below that table), the indicator V, H, M, L and E have their corresponding "loss range". This is the management judgement of possible range of loss for events in this particular risk. If the recorded loss falls inside this range, then the end data of this range, some interpolation of them and the actual loss(es) can be used as "additional data" to form a computational strategy. We do not construct local probability distribution for the end data and their interpolation but we use them for computing expected returns and risks.

It has to be pointed out that these "range" boundary values are usually very wide and may not be as precise as desirable. It is often that the management will require some fine tuning of their values based on the actual loss values. It is also possible that the observed loss values falls significantly outside this range. If this is the case, we still carry on as usual but the program will issue a warning in the exit report that the range has been "broken" for the risk number concerned. Management need to review the situation and make further decisions.

In the reporting table, there is a column containing a statement that the probability for this risk number is regarded by the management as V, H, M, L or E. This should be ignored in our construction of probability distribution. The fact that there are few observations speaks for itself. They are used for other purposes described later.

5. Near-misses

Background: Near-misses are observed events that have led to no quantifiable immediate losses. Near-misses are actually quite frequently reported in real life. In the institutions we worked with, as many as about 8% of total reports are about near-misses. The near-miss data also spread over many different risk numbers.

Considerations: When an actual cash loss is reported, its loss value is very likely to be different from other reported loss values. In the case of near-misses, not only they do not have a real loss value attached to, the frequency is actually large. So we have a double problem to solve:

1) How to deal with events that have loss value = 0.
2) How to deal with events with large frequencies (say more than 20% of total frequency for that risk number)

Solutions:

5.1 Loss value = 0

To design a probability loss distribution, we can use a fixed percentage of the expected loss in that risk number category. The actual number should be decided by the management.

Correspondingly, a reduction in the total number of observations must also be applied.

After computation, an exit report is issued stating the likely contributory effect of these near-misses.

5.2 Single loss value with large number of observations

From risk assessment point of view, we should view this with certain suspicion. The interpretation of this phenomenon is that either the fraudsters find this particular value attractive, or in the reporting procedure, the reporter simply added the various losses and took an average. So the loss values should be given more spread than other loss values.

In our approach, if such an event happens, the program will automatically detect it and apply an adjusting factor $f(m)$ to the risk (spread) factor. This adjusting factor $f(m)$ is a function of m, the total number of observations for this particular loss value in consideration.

That is, if σ is the standard risk (spread) for the probability distribution for this loss, the adjusted risk (spread) is $f(m)\sigma$. We used $f(m) = m^{\phi}$ for some $\phi \in (0,1)$, a constant to be decided and tested by the management. Of course, in the actual process of simulation, the program will simply go on using our default setting which is to let $\phi=1/8$. An explanation has been added in the exit report explaining that such a high concentration event has happened. If the user is not happy with the current simulation result, he/she can ask the programmer to change the value of ϕ.

6. Incorporating very high (V) and high (H) impact, low (L) and extremely low (E) probability event

Background: It is often true that if a risk number is labelled as having V or H impact (in terms of value of loss) and L or E probability (in terms of appearance frequency), we may find that in the period of data collection, there is no actual observation of such event (notice here that this no-observation must have happened for the entire time period of observations where computation is based upon, say over the whole 3-5 years).

Considerations: If this happens, the management may want to add an artificial loss event. With this imagined event in the probability distribution, the subsequent Monte Carlo simulation process will take it into account to give predictions for the company reserve level including a perturbation of this "artificial" data.

Solutions: First, a detection mechanism should be in place to warn that such an event has got no observations in the time interval concerned. In our program, if such a no-observation event happened, the program will automatically insert an imagined event with frequency 1 and a magnitude depending on the loss range of the risk number. In the exit file, a report will be issued clarifying the insertion and its likely impact.

7. Management intervention and cost/improvement comparison

One of the interesting factors we have introduced in our prediction of risk capital reserve is a management control factor which applied a factor to the existing loss data.

Usually this is a reduction factor in terms of both loss sums and frequency of losses.

If the management is interested in testing a management improvement measure with a cost X, they have a perceived reduction in number of losses.

We have a system of introducing control factor (loss reduction factor) based on risk numbers. That is, risks in the same risk number will be reduced by the same amount in terms of loss amount, frequency and loss spread (risk), but different risk numbers can have different control factors (loss reduction factors). Say for risk number 320, we apply reduction factors ($amount_{320}$, $frequency_{320}$, $spread_{320}$) = (a_{320}, f_{320}, s_{320}), then take a typical function

$$f_s = \begin{cases} \dfrac{1}{\sqrt{2\pi}\sigma_s}\exp\left(-\dfrac{(x-\mu_s)^2}{2\sigma_s^2}\right) \Big/ \displaystyle\int_0^\infty \dfrac{1}{\sqrt{2\pi}\sigma_s}\exp\left(-\dfrac{(x-\mu_s)^2}{2\sigma_s^2}\right)dx & x > 0 \\ 0 & x < 0 \end{cases},$$

we have

$$f_s = \begin{cases} \dfrac{1}{\sqrt{2\pi}\sigma_s s_{320}}\exp\left(-\dfrac{(x-\mu_s a_{320})^2}{2\sigma_s^2 s_{320}^2}\right) \Big/ \displaystyle\int_0^\infty \dfrac{1}{\sqrt{2\pi}\sigma_s s_{320}}\exp\left(-\dfrac{(x-\mu_s a_{320})^2}{2\sigma_s^2 s_{320}^2}\right)dx & x > 0 \\ 0 & x < 0 \end{cases}.$$

The factor f_{320} will be applied in the aggregation process in a similar pattern.

This gives the management the maximum flexibility in estimating perceived improvements in implementing perceived management measures. It will also be straightforward to look at the financial impact of improvements in comparison to cost.

To simplify the process, in our program, we unify the three parameters into a single management factor by assuming that $a_{320} = f_{320} = s_{320}$.

8. Issues arising from Monte-Carlo simulations

In the Monte-Carlo simulations, we perturb the observed loss values and the associated frequencies. We repeat the simulation many times and pick the confidence interval. This approach agrees with the BASEL II requirement that the simulations must be based on models using true company data.

In our program, we have designed a concept called risk groups. This is an intermediate level between risk numbers and the entire company. In the input file, the total number of groups N, the risk numbers each group contains and the label for each group should be given. The program will automatically model and simulate the N groups and give out N simulations results and N exit files. In management terms, these groups correspond to the certain section of the business (such as departments) that the management is interested in looking at the performance. The only restriction is that each risk number should belong to no more than one group (when a risk number is in no group, it does not participate in modelling and simulation overall).

The aggregation of the model from risk number case up to groups (departments or business lines) or whole company can also be done in different ways, thus affecting the simulation results.

1) Simply combine the distribution functions for each risk numbers using weighted sum. The underlying assumption is that different risks are statistically independent events.

2) Combine the observation data from different, but relevant risk numbers to form a new data pool, and reconstruct the distribution function. This is assuming that the underlying events are statistically relevant.

3) A combination of 1) and 2). Regroup the data into different really independent sets, each set may contain one or more risk numbers, and treat data within each group as dependent, treat data on inter-group level as independent.

We point out that the approach 3) makes the programming much more human intervention dependable, but could have the advantage when coming to simulate management improvement measures. It is often true that a prescribed management measure will affect a number of risks rather than just one risk. This points to interdependence of the risks under that particular context.

To simplify the structure of the input file, our program uses approach 1).

Remark: There are many ways of predicting the future capital reserve of the business simulated. We relied on Monte-Carlo simulation because we think our model has incorporated enough details for a meaningful simulation. If we use other statistical prediction methods such as regression, we will not be able to incorporate very fragmented information we have been requested to implement such as

1) Giving different weight to different year's data but different risk numbers may have different weight: Say for Risk No 10, weight are given as follows:

Year 1	Year 2	Year 3	Year 4	Year 5
1	0.9	0.8	0.7	0.6

But for Risk No 110, we are required to implement

Year 1	Year 2	Year 3	Year 4	Year 5
1	0.8	0.8	0.75	0.66

2) Applying management factors: if a management measure reduces the impact of Risk No 10 by 20%, it may only reduce the impact of Risk No 110 by 5%.

9. Example, exit report and conclusions

The following is the probability distribution of "frequency against loss" constructed using part of the data file received from a company (no name disclosed for confidential reasons) and its 1000 Monte-Carlo simulations averaged. It is not the whole picture as the range goes from zero to positive infinity, there are some other concentration areas further beyond the range we plotted. But the effects are smaller.

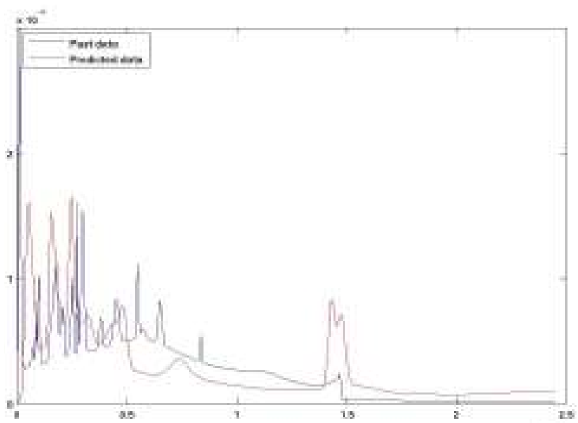


Figure 1. The actual loss frequency distribution (vertical axis) against lost values (horizontal axis)

In summary, based on a consistent web reporting system, our algorithm has the following advantages:

1) It is numerically very efficient to construct a probability distribution and calculating various statistical summaries.

2) The Monte-Carlo simulation can highlight distribution anomalies (say the jump around 15K loss value in the demonstrated example), and smooth out large number of small losses (say the peak appeared near 0).

3) The form of the probability distribution is fully adapted to the past situation of the company.

4) It is easy to decide what impact people give to distant past data, what to do with near-misses and the Monte-Carlo simulation is highly similar to real life situations.

5) Due to the algorithm used, although the final probability distribution combined thousands or more probability distributions at each individual loss observation, the computation speed can be almost instant (to complete one cycle, the time consumed is < 10^{-2} seconds on an ordinary PC). It is

therefore possible to carry out tens of thousands of Monte-Carlo simulations to identify confidence interval.

6) The program can simulate over the whole interval, can simulate over some pre-indicated loss value interval, it can also simulate on any arbitrary group of risk numbers, can incorporate imagined large loss events or reduce the scale of an unexpected large loss observation which is unlikely to happen again.

In addition to the standard loss probability distribution function and predicted loss values, we have an exit file reporting the following events:

1) Very high and high impact, low and extremely low probability events that have no observations.

2) Large concentration of single observations (a single loss value that appeared many times).

3) Some risk numbers that have actual events with loss values much larger than the management perceived upper bound. This implies that the impact of this risk number needs to be re-assessed.

References:

[1] Alexander C and Pezier J, (2001), *Taking control of operational risk*, Futures and Options World.

[2] Allen L, Boudoukh J and Saunders A, (2004), *Understanding Market, Credit, and Operational Risk: The Value-at-Risk Approach*, Blackwell Publishing, Oxford.

[3] Chernobai A S, Rachev S T and Fabozzi F J, (2007), *Operational Risk, a Guide to Basel II Capital Requirements, Models and Analysis*, Wiley Finance.

[4] Cizek P, Hardle W and Weroneds R, (2005), *Statistical Tools for Finance and Insurance*, Springer, Heidelberg.

[5] Giudici P, (2004), *Integration of qualitative and quantitative operational risk data: A Bayesian approach*, in M G Cruz ed., Operational Risk Modelling and Analysis, Theory and Practice, RISK Books, London, pp 131-138.

[6] Marshall C L, (2001), *Measuring and Managing Operational Risk in Financial Institutions: Tools, Techniques, and Other Resources*, John Wiley & Sons, Chichester.

[7] Neil M and Tranham E, (2002), *Using Bayesian Network to Predict Op Risk*, Operational Risk, August 2002, pp 8-9.

[8] Rosenberg J V and Schuermann T, (2004), *A general approach to integrated risk management with skewed, fat-tailed risks*, Technical Report, Federal Reserve Bank of New York.

[9] Silverman B W, (1986), *Density Estimation for Statistics and Data Analysis*, Chapman & Hall, London.

THE KNOWLEDGE MANAGEMENT – NECESSITY FOR THE MODERNIZATION OF THE ORGANIZATIONS

Adina **BĂLAN**
University of Craiova, **Romania**
Economic and Business Administration Faculty
adinaburicea@yahoo.com

Abstract

If individuals and technologies can harmonize their intelligence under various forms, only the intelligent organizations will have the capacity to transform and coordinate these abilities for their own advantage by using informational technologies, by combining the most advanced software technologies with the newest management instruments in order to produce extremely efficient organizations.

The information excess is a chronic phenomenon for the modern organization, so that the lack of the capacity to filter and use relevant information is a consequence of the inefficiency to manage the knowledge fund, of the lack of a clear strategy with a common purpose for personnel and team. Today, almost the intelligent organizations must manage and apply the entire knowledge fund, they must use instruments and technologies in order to build an informational architecture, having as a purpose the competitiveness in a turbulent and changing environment. The apportion of the information and knowledge of the organization, the exchange of information between employees, departments and even other companies are facilitated by the information and communication technology. Not all information are valuable, but in order to establish what information respond to the questions What? Where? How? When? and Why? instruments of knowledge management are needed in order to determine what knowledge is qualified to be intellectually active.

Within the organization of Romania the information still circulates on unclear routes, it is considered a good which should be restrained for certain employees. The rigid, bureaucratic structure and the closed communicational system must be excluded from the perspective of the organization modernization. The best solution is the collaboration and transversal communication between employees, the apportion of information using the new technologies which could allow the accumulation, stocking and finding again the information at the adequate moment. The Internet and the new technologies will allow the knowledge exchange, the information filtering, the improvement of communication, and the professional instruction of employees, will increase the knowledge availability, the autonomy level at the level of the employee, modifying at decisional level the communication opportunity. The intelligent organization is an open system that uses decision support systems, collaborative networks, innovation, social networks, knowledge management and intelligent instruments to accomplish the managerial performance (business intelligence) in order to manage the accumulated information and knowledge, the current and past operations for the prediction of future business operations.

Keywords: knowledge, knowledge management, intelligent organization, informational technologies, knowledge exchange, collaborative networks, apportion intelligent instruments.

JEL Classification: D83

1. Introduction

Usually, intelligence is a characteristic of the individual and of the individual action, but in an ever more complex world, it becomes a value of the public space, without it performance cannot be taken in discussion without the „organizational intelligence" and the „intelligent organization".

In the world we live in, which is in a changing of depth and extremely rapid, organizations evolve in a turbulent social environment, so that the adjusting capacity of the organizations through innovation and creation remains the only way of development. The innovative, creative, intelligent management is really performant, the organizations become communicative and basically they are intelligent organizations.

Thus, the source of "organizational intelligence" can be refound in the communication degree of organizations, and communication between entitites becomes facile and efficient if it takes place in a virtual environment.

2. Main text

In order to stand against the changes of the environment any organization must become competitive using the basic concepts specific to the new economy: innovation – as engine of the economic change and that of the "organization that learns" through the efficient management of the entire background of past, present knowledge for future predictions.

In the modern knowledge-based economies, the organisations "increased the individual and collective knowledge as the major factor of the economical performance" [Constantinescu, (2008)].

The objective of knowledge management is to create value and competitive advantage for the organization on a global market in continuous change.

Knowledge management is the attempt of the manager to organize tens of thousands of people and to make them feel as an organization of eight [Abell, (2001)].

In the competitiveness environment the manager is forced to use continuously and maximum available human potential, all the intelligent resources of the organization. In order to survive, the organzation must cover the gap created by the difference between „*what each person knows*" and „*what each person does*" in an organization through the apportion of knowledge.

Regarded as a "social system in which and through which individuals interact (cooperate, collaborate) for the accomplishment of common purposes or "social entities that appear as systems of activities oriented to the accomplishment of objectives, deliberately structured and having identifiable limits" "[Iacob, (2003)], the modern organization in the actual informatized society, will have to respond and to continuously adapt in an environment permamently submitted to changes, using instruments of competitive, innovative, creative, intelligent management.

The tendencies that influence more the organizational changes are: globalization, the raise of the environment turbulence, of the competitiveness, the introduction of new informational technologies that accentuate the importance of knowledge and innovation, the major demographic changes at the level of the population, generally and of human resource, especially, so that we speak more and more about the fact that "the intelligent organization" [Quinn, (1992)], is „the organization that learns" [Senge, (1999)].

The intelligent future organizations will have to adapt permanently to the change, simultaneously with the transformation of the external environment, taking into account the individual needs of every one.

The modern organization that Romania needs in this moment is the one that will be created around the problems that need resolution, problems solved by individuals with different specializations, for which managers will only have a connection role between the links of the system, so that the order be taken by teams of specialists, by those most capable to solve problems without having a certain rank.

If all the existing data in an organization would be at hand for managers to take correct, opportunistic, efficient and rapid decisions, positive effects would be found at all levels of the organization.

The knowledge definition (Table no 1) from different perspectives is surprised by *de Maryam Alavi in her paper* "*Knowledge Management and Knowledge Management Systems: Conceptual Foundations and Research Issues",* but also the implications of knowledge management (KM) and knowledge management systems (KMS).

3. What is knowledge management and which is its role in an organization?

If the fundamental good that needs to be managed, knowledge – the key of the XXIst century, is the fundamental success factor for all the organizations, the knowledge management appears as a reaction to the raise of competitional markets caused by the information excess and by the need of useful information.

Knowledge management has a variety of descriptions, is a "collection of processes which govern creation, dissemination and use of knowledge" [Newman, (1991)] is „the process through which the organization generates value using the knowledge base and the intellectual actives.

If we accept that knowledge management refers to the entire process of discovery, creation and use of knowledge, then we will be strongly determined to accept the fact that knowledge management is much more than technology, that these elements are refound in each individual`s work [Newman, (1991)].

Table 1. Knowledge definition *adapted by Maryam Alavi* [Alavi, (2001)]

Knowledge definition		Implications of Knowledge Management (KM)	Implications of Knowledge Management Systems (KMS)
Knowledge over data and information	♦ *Data are unprocessed facts, numbers* ♦ *Information represent data processed and interpreted* ♦ *Knowledge is personalized information*	*KM concentrates on the exposure of individuals to the possible useful information and ease the assimilation of information.*	KMS are not fundamentally different from the Informational Systems, but can be extended to offer help to users in the information assimilation process.
State of mind	♦ *Knowledge is state of knowledge and understanding*	KM concentrates on the exposure of individuals to the possible useful information and ease the assimilation of information.	It is impossible to mechanize the state of knowledge The role of ITC is moreover the provision of ***sources of knowledge***, rather than actually knowledge.
Object	♦ *Knowledge is the object to be stored and handled*	The key problem of KM is the construction and management of the knowledge stock.	The role of ITC implies the gathering, coding and storage of knowledge.
Process	♦ *Knowledge is the process of application of expertise*	The center of the KM process are the knowledge flow and the knowledge creation, separation and distribution process	The role of ITC is to provide the connection between the sources of knowledge and to create much larger knowledge flows.
Access to information	♦ *Knowledge is a condition for access to information*	The KM target is to organize the access to recover the knowledge content.	The role of ITC is to provide search and real recovery mechanisms for the tracing of relevant information.
Capacity	♦ *Knowledge is the potential to influence the action*	KM is the construction of competences and the understanding of the strategic Know-how.	The role of ITC is to intensify the intellectual capital by supporting the development of individual and organizational competences.

Knowledge management (KM) is the management of organization regarding the continuous renewal of the organizational knowledge base by creating support organizational structures, having as objective the creation of *facilities for the members of the organization by using ITC instruments* with focus on team work and knowledge spreading (for instance Groupware) in a work point.

KM is not technology or "computer work", it is the capacity to manage "knowledge" having the same significance as the term Information Management, which means "information" gestion so that the organization needs modalities for the gestioning of knowledge, techniques and methods for analyzing the knowledge sources in an organization. Using these techniques we can accomplish the knowledge analysis and planning.

In order to analyze knowledge we must start from its source so that we can analyze its utility, weaknesses or weak points, as well as its opportunity within the organization [Newman, (1991)].

The knowledge analysis is a necessary step for the capacity to manage knowledge. At the same time with knowledge analysis we can use modellation techniques for knowledge acquisition.

If an organization analyzed its knowledge, it will be able to conceive a plan for the future, it will be able to develop an annual plan through which its knowledge resources to be developed, either by *instructing its human agents*, or by developing *knowledge based systems* in order to support the human agents, which should allow the organization to stay competitive. But this is possible if the organization uses techniques and methods from the field of Artificial Intelligence: expert systems and decision support systems that will support human agents.

The complete use of information and data, together with the potential, abilities of the individuals, competences, ideas, intuitions, levers, meccanisms of learning will bring flexibility, power and competitive advantage to the organization.

However, knowledge centered on innovation and technologies remains the most neglected good, although it offers the ability to answer to new situations. If it were included to all the organizational levels, it would bring additional value to the business processes.

4. The Impact of Information and Communication Technology in accomplishing the knowledge background

Only the technological and organizational changes will increase the knowledge potential of the organization by using software products and platforms that will modify the actual organizational structures of organizations, and here I am talking about advanced analytical applications (including planning, budgets establishment, prognosis, sales and marketing), in order to help to the identification of the main business tendencies and to the simulation of complex scenarios, they will stimulate team work, collaboration networks, in which specialists will apportion their knowledge, so that all the ideas, concepts will be integrated and managed in a single architecture "organizations need to develop enterprise information architecture" [Malhotra, (2003)]

But these ideas will exist if the organization is one that "learns", has the capacity to create knowledge, can selfinstruct using previous experiences, but also the capacity to extract information about the past experience, which can be analyzed and used in current and future situations.

The processingof organizational experience is insufficient to assure managerial performance, so that the modern organization must be identified with the intelligent organization (figure 1), it needs more than ever to be an open system, intelligent, which interacts and uses decision support systems, collaborative networks, innovation, social networks, *knowledge management,* business intelligence – the totality of abilities, technologies, applications and practices used for managerial performance, as well as the totality of information and knowledge gathered, OLAP technologies (Online Analytical Processing) that manage operations in the past, current, as well as prediction of future business operations. All these instruments of Business Intelligence (OLAP, Analytics, Data Mining, Business Performance Management, Benchmarking, Text Mining, and Predictive Analytics) must be integrated in the informational architecture of the organization for the analysis of the business data, which assure trend analyses and sophisticated modellation of data, becoming rapidly the fundament of intelligent solutions.

Subsequently, knowledge management must be concentrated on cooperation instruments regarding the exchange of knowledge, team work and knowledge portals, so that the organizations efficiently coordinate a big volume of information, filter the essential content and obtain access to corporative knowledge.

The sharing of organizations knowledge requires not only "exchange files, but rather direct access to data, software, computers and other resources" [Pupezescu, (2008)] on a collaborative platform for solving problems.

If individuals and technologies can harmonize their intelligence under various forms, only the intelligent organizations will have the capacity to transform and coordinate these abilities for their own advantage by using informational technologies, by combining the most advanced software technologies with the newest management instruments in order to produce extremely efficient organizations.

But in order to do this knowledge and its management is needed. Organizational knowledge can be acquired from external sources or can be generated from the inside. Even if knowledge becomes available from external or internal sources, they only arise from the interior of the individuals, teams or organizational processes [Wild, (2008)].

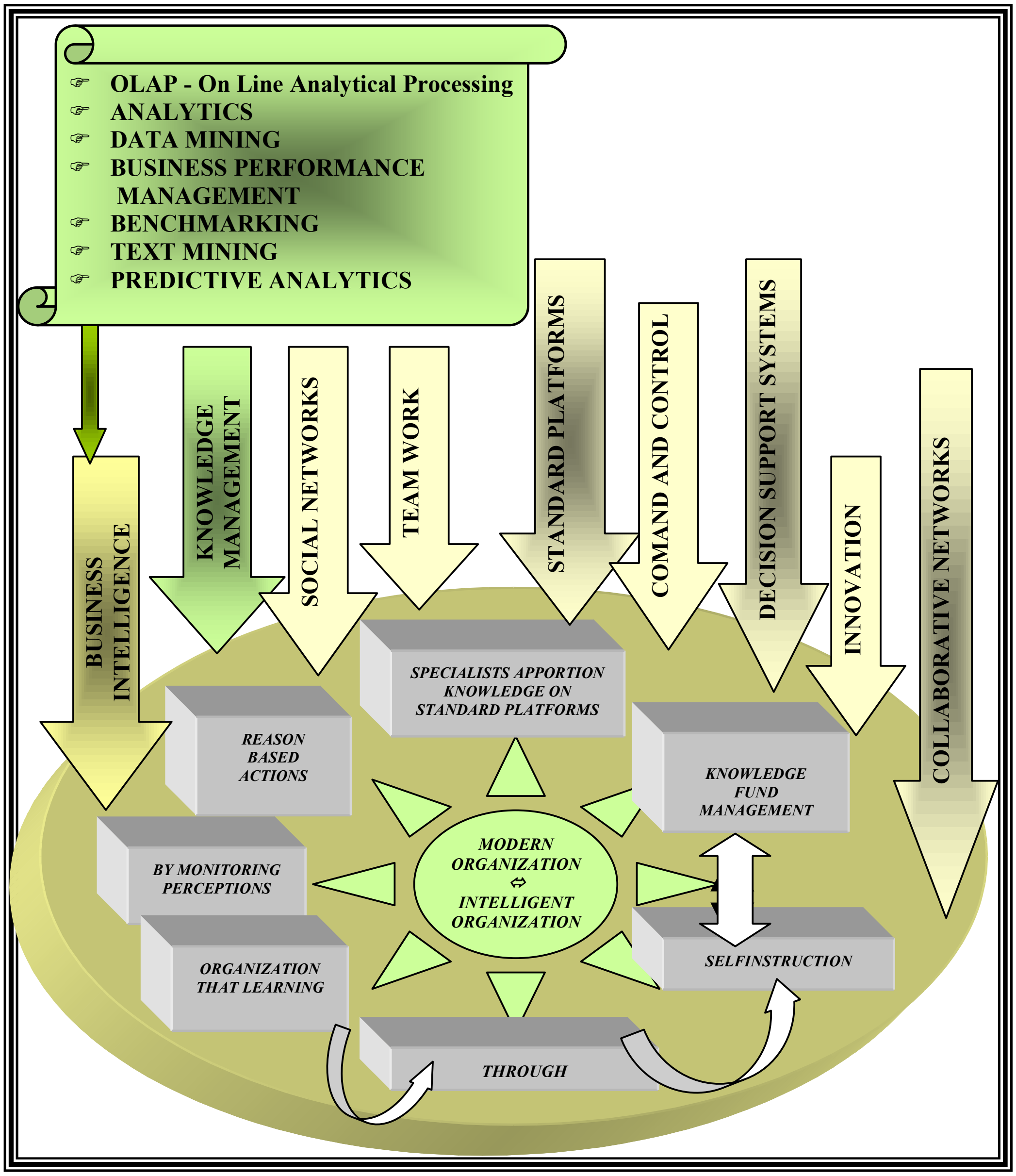


Figure 1. Intelligence organization and knowledge management

Organizations can evaluate the productivity of their knowledge using virtual applications and machines, and in order to be part of the collaborative networks, they have to integrate their technologies on a standard platform having as objective the simple, efficient knowledge supply in a virtual environment with high availability.

And because the entire environment of the on-line community is seen as a fertile land for all the types of business opportunities to be planted and raised organizations should promote the use of web technologies in order to facilitate the knowledge exchange with groups of experts in an extended virtual community.

An efficient virtual platform will have to be available for thousands of global organizations with high degree of security. Using technologies of information migration in real time, the modern organization will be able to move its virtual servers and applications that run between physical machines without interruption.

According to a study made by Gartner [18], in 2009 the conclusion is that due to the lack of information, processes and instruments, in 2012 more than 35% of the top companies at world level will fail if they do not take decisions in order to bring significant changes in their activity, and those that will survive will give 40% of the total budgets to the applications of business intelligence.

5. Why does the modern organization have to apply knowledge management?

In order to keep her customers, the organization has to improve the product or service, has to operate with a minimum of fix actives, has to reduce the development time of the product or service, has to give responsibility to employees, has to use innovation so that to deliver products or services of high quality and the information and knowledge catching should increase the adaptment and flexibility of the organization on the market. And in order to do this she needs "intelligent actives".

But this is not possible without a continuous concentration on the creation, update, availability, quality and use of knowledge by all the employees, teams, at the work place and on the market.

Starting from the importance of knowledge, the modern organization must have the capacity to adapt to the change, to change her methods, instruments and techniques in order to efficiently manage her knowledge, so that they become available also to other organizations.

Today, the organizations are overwhelmed with the explosion of information. The piece of information has to be available, there where is needed, for all those that are authorized to receive it, it has to enter the system only once, to be archived and apportioned by all the members of the organization, in a standardized form, accessible to everyone. But for this intelligent management systems are needed which should transform information in knowledge, and implicitly the management of the individual`s knowledge, so that the organization has to be involved in the improvement of individual abilities of each employee, in the knowhow in the practice and research of the employee.

The knowledge management has as a purpose the catching of knowledge that the employees really need in a central repository and filter out the surplus [Bair, (1997)] The new businesses need a reconceptualization of knowledge management, and the informational architecture musta take the form of a model characterized by change in order to assure to the organization a lasting competitive advantage [Malhotra, (2009a)].

The traditional model based on plans and objectives has to be replaced with an adequate one, relatively stabile and predictable in the business environment. However, in the virtualization era, this model needs a continuous reevaluation of the business processes; it has to be adapted to the e-business era [Kalakota, (2001)].

The evolution of information processing in the last four decades in order to build information and manage the change in the business functions and processes progressed, starting from *automation*, which has as an effect: the raise of operations efficiency, continued with the simplification of procedures and elimination of blockings, for the increased efficiency of operations and continues with the radical reprojection of business processes using intensive technology in the reprojection of work flows and processes (Re-Engineering).

The process of information catching, organization, classification and spreading in the whole organization must have as a purpose the availability of the information for those who need it [Malhotra, (2009] without being lost in a data base of a company.

The identification of the knowledge categories necessary to support the global business strategy, of evaluation of the actual stage of the company knowledge and of transformation of the base of actual knowledge in a new and stronger knowledge base by covering knowledge lacks [Gopal, (1995)]

Technology will help companies to organize their data stocked from multiple sources, supplying to the user only relevant, using key instruments for their stocking and distribution through intranet, groupware, data warehouses, networks technologies with direct access to on-line and off-line information sources, for the instruction, guidance of the users with access instruments to knowledge; of monitoring besides news also information [Maglitta, (1996)].

If organizations will use modern technologies and if they will change and reproject the organizational knowledge management systems, they will really become "successful".

In his book "*Making Supply chain management work: design, implementation, partnerships, technology and profit"*, James B. Ayers demonstrates that technologies, the stystems that support knowledge management:

- Cannot decide which is the right person at the right place and in the right moment in order to supply correct information;
- Cannot stock human intelligence and experience;
- Cannot distribute human intelligence.

The fact that information is found archived in a data base does not mean that individuals will see and use this information, it is only archived on technological supports, it is only static knowledge without content [Ayers, (2002)].

In the last 20 years, the USA industry invested trillions of dollars in technology with insignificant effects in improving the knowledge fund of workers.

Because there is a dangerous perception that knowledge management blends with technology [Ayers, (2002)], „*knowledge management is in danger of being perceived as so seamlessly entwined with technology that its true critical success factors will be lost in the pleasing hum of servers, software and pipes*" [Hildebrand, (1999)].

Subsequently it is essential to focus its attention on those interested in knowledge, because within the organization matters the way the user reacts to a collection of information and not how this information is archived [Malhotra, (2000b)].

Therefore, *„knowledge is a fluid mix of framed experiences, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information. It originates and is applied in the minds of knowers. In organisations, it often becomes embedded not only in documents or repositories but also in organisational routines, processes, and norms*" [Davenport, (1998)].

We demonstrated that the growing importance of knowledge management in an organisation is given by the exponential growth of the available knowledge and the informational and communication technologies will facilitate this process through applications and systems that are capable to ensure the interconnection in the World Wide Web era.

6. Conclusions

Organizations, confronted with an extremely uncertain environment, must approach processes of organizational change based on models that could facilitate the management of the innovation and change process. Those that will not succeed to manage innovation and the knowledge background will create uncompetitive products and services and with a high degree of moral usage, and will lose market quotes.

The only way to obtain performance is the transformation of the organization into an organization that can facilitate knowledge exchange, apportion and management using informational and communicational technologies.

The organization must manage her organizational knowledge processes, she must use the entire knowledge background using managerial strategies in order to create an architecture of the knowledge flow for the knowledge acquisition, transmission, use, exchange and transformation in the entire system of the organization. Innovation, the use of intelligent applications, of the IT services in the business and management knowledge processes will assure the success of the organization.

The modern organizations must focus on knowledge because on a more and more unstable market only those that are the most informed survive, help in taking the best decisions, and knowledge management can master change.

7. Acknowledge

The presented work has been conducted in the context of the GRANT-PCE-II-2008-2-IDEAS-450, *The Management of Knowledge for the Virtual Organization. Possibilities to Support Management using Systems Based on Knowledge* funded by The National University Research Council from Romania under the contract no 954/2009.

6. **References:**

[1] Abell, A., Oxbrow, N., (2001), *Competing with knowledge: The Information Professional in the Knowledge Management Age*, London: TFPL and Library Association Publishing.

[2] Alavi E. M., Leidner D. E. (2001), *Knowledge Management and Knowledge Management Systems: Conceptual Foundations and Research Issues*, in: *MIS Quarterly- Management Information System Quarterly***,** Vol. 25 No. 1, March 2001, pp. 107-136.

[3] Ayers J.B.**,** (2002), *Making Supply chain management work: design, implementation, partnerships, technology and profi*t **-** Best Practices series 2, Publisher Auerbach.

[4] Bair, J., (1997), *Knowledge management: the era of shared ideas*, in *Forbes, The Future of IT supplements*, September 22, Vol. 1 No.1.

[5] Constantinescu M., (2008), *Knowledge management through the lens of innovation and labour productivity in a knowledge based economy*, in: *Journal of Applied Economic Sciences*, Vol 3, Issue 2(4)_Summer 2008, pp. 85-101.

[6] Davenport Thomas., Prusak Laurence*,* (1998), *Working Knowledge: How Organisations Manage What They Know,* in: *Harvard Business School Press, Boston, Massachussettes, pp. 5.*

[7] Gopal, C., Gagnon, J. (1995), *Knowledge, information, learning and the IS manager*, in: *Computerworld Leadership Series*, Vol. 1 No.5, pp.1-7.

[8] Hildebrand, C., (1999), *Does KM=IT?,* in: *CIO Enterprise Magazine*, Sep. 15, 1999. Online version accessible at *http://km.brint.com/malhotra/KMandIT.html.*

[9] Iacob D., Cismaru D, (2003), *Organizația inteligentă - zece teme de managementul organizațiilor,* Publisher comunicare.ro, București, *in Romanian.*

[10] Kalakota R., Robinson M., (2001), *E-business 2.0: Roadmap for Success*, Publisher: Addison-Wesley.

[11] Maglitta, J., (1996), *Know-How Inc.,* in: *Computerworld*, Vol 30, no 1, January 15.

[12] Malhotra, Y., (2000a), *Knowledge Management & New Organization Forms: A Framework for Business Model Innovation*, in: *Information Resources Management Journal*, January - March 2000, Vol 13, Issue 1, pp. 5-14.

[13] Malhotra**,** Y., (2000b), *Knowledge management and virtual organizations***,** Publisher Idea Group.

[14] Malhotra, R., (2003), *Developing the enterprise information architecture using meta modelling knowledge management*, http://www.decisionsciences.org/Proceedings/DSI2008/docs/271-2989.pdf.

[15] Newman, B., (1991), *An Open Discussion of Knowledge Management*, www.km-forum.org/what_is.htm.

[16] Pupezescu V, Ionescu F, (2008), *Advances in Knowledge Discovery in Databases,* in: *Journal of Applied Economic Sciences*, Vol 3, Issue 4(6), Winter 2008, pp.444-451.

[16] Quinn, J.B., (1992), *Intelligent enterprise: a knowledge and service based paradigm for industry*, in *New York: Free press.*

[17] Senge P. M., (1999), *The Fifth Discipline: Art and Practice of the Learning Organization (Century Business)*, Edited by Prentice Hall.

[18] Wild R., Griggs K., (2008), *A model of information technology opportunities for facilitating the practice of knowledge management*, in: *VINE: The journal of information and knowledge management systems*, Vol. 38 No. 4, pp. 490-506.

[19] http://www.gartner.com/it/page.jsp?id=1096712.

COMPETITON AND GROWTH IN AN ENDOGENOUS GROWTH MODEL WITH EXPANDING PRODUCT VARIETY WITHOUT SCALE EFFECTS REVISITED[1]

Dominique **BIANCO**
University of Nice-Sophia-Antipolis
GREDEG (CNRS), **France**
dominique.bianco@gredeg.cnrs.fr

Abstract:

This paper shows that the results of Bianco (2006) depend critically on the assumption that there are no difference between the intermediate goods share in final output, the returns of specialization and the degree of market power of monopolistic competitors. In this paper, we disentangle the market power parameter from the intermediate goods share in final output and the returns to specialization. The main result of this paper is the death of the inverted-U shape relationship between competition and growth. Indeed, we find a decreasing relationship between competition and growth which is due to the composition of two negative effects on growth : resource allocation and Schumpeterian effects.

Keywords: endogenous growth, horizontal differentiation, technological change, imperfect competition.

JEL Classification: 031, 041

1. Introduction

Bianco (2006) studies the impact of competition in the intermediate goods sector on growth. He uses the Gancia and Zilibotti (2005) model in which he introduces a different assumption concerning the production of intermediate goods. Indeed, unlike Gancia and Zilibotti (2005) which assumes that one need one unit of final good to produce one unit of intermediate good, Bianco (2006) does the hypothesis that the firm has to use one unit of labor. This assumption which is called "resource allocation effect" implies that labor can be allocated between three sectors: final good, intermediate goods and research. The interplay between this effect and the traditional Schumpeterian effect allows us to obtain an interesting result. Indeed, Bianco (2006) finds an inverted-U relationship between competition and growth. For low value of competition, more competition is beneficial to growth since it allows a better allocation of resource without hampering that much innovation incentives. In this case, the resource allocation effect is bigger than the profit incentive effect. On the other hand, for high value of competition, more competition reduces strongly growth because of the reduction of profit. In this case, the profit incentive effect is bigger than the resource allocation effect.

Among the assumptions used by Bianco (2006) to derive this result is that there are no differences between the intermediate goods share in final output, the returns to specialization and the degree of market power of monopolistic competitors. This leads to the natural question whether making such a difference to the model changes its predictions. In this note, we show that including this difference into the model developed by Bianco (2006) eliminates the result mentioned above.

2. The model

The model developed is based on Bianco (2006)[2]. The economy is structured by three sectors : final good sector, intermediate goods sector and R&D sector. The final output sector produces output that can be used for consumption using labor and intermediate goods. These are available in A varieties and are produced by employing only labor. The R&D sector creates the blueprints for new varieties of intermediate goods which are produced by employing labor and knowledge. These blueprints are sold to the intermediate goods sector.

[1] I would like to thank, without implicating R. Dos Santos Ferreira, J-L. Gaffard, C. Le Van, P. Musso and L. Punzo for useful suggestions and comments on an earlier draft of this paper. This article is a part of my Phd thesis. The usual disclaimer applies.

[2] We use the notations of Bianco (2006) in order to have a direct comparison with his model.

2.1. The final good sector

In this sector, atomistic producers engage in perfect competition. Following Bianco (2007), the final good sector produces a composite good Y by using all the *ith* type of intermediate goods x_i and labor L_Y. Production is given by :

$$Y = A^{\gamma-\lambda(\frac{1}{\alpha}-1)}\left[\int_0^A x_i^\alpha di\right]^{\frac{\lambda}{\alpha}} L_Y^{1-\lambda} \quad , \tag{1}$$

where α, λ and γ Є]0,1] are three parameters. This production function allows us to disentangle the competition measured by the degree of market power of monopolistic competitors in the intermediate sector ($\frac{1}{\alpha}-1$), the intermediate goods share in final output λ and the degree of returns from specialization γ. In this sense, this model is a generalization of Bianco (2006) model. Indeed, we obtain the Bianco (2006) model by introducing the following constraints γ=1-α, $\lambda=\alpha$ in our model.

If we normalize to one the price of the final good, the profit of the representative firm is given by:

$$\pi_Y = A^{\gamma-\lambda(\frac{1}{\alpha}-1)}\left[\int_0^A x_i^\alpha di\right]^{\frac{\lambda}{\alpha}} L_Y^{1-\lambda} - \int_0^A p_i x_i di - w_Y L_Y , \tag{2}$$

where w_Y is the wage rate in the final good sector and p_i is the price of the *ith* intermediate good. Under perfect competition in the final output market and the factor inputs markets, the representative firm chooses intermediate goods and labor in order to maximize its profit taking prices as given and subject to its technological constraint. The first order conditions are the followings:

$$\frac{\partial \pi_Y}{\partial x_i} = \lambda A^{\gamma-\frac{\lambda}{\alpha}+\lambda}\left[\int_0^A x_i^\alpha di\right]^{\frac{\lambda}{\alpha}-1} L_Y^{1-\lambda} x_i^{\alpha-1} - p_i = 0 , \tag{3}$$

$$\frac{\partial \pi}{\partial_{L_Y}} = (1-\lambda) A^{\gamma-\frac{\lambda}{\alpha}+\lambda}\left[\int_0^A x_i^\alpha di\right]^{\frac{\lambda}{\alpha}} L_Y^{-\lambda} - w_Y = 0 . \tag{4}$$

Equation (3) is the inverse demand function for the firm that produces the *ith* intermediate good whereas equation (4) characterizes the demand function of labor.

2.2 The intermediate goods sector

In the intermediate goods sector, producers engage in monopolistic competition. Each firm produces one horizontally differentiated intermediate good and has to buy a patented design before producing it. Following Grossman and Helpman (1991) and Bianco (2006), we assume that each local intermediate monopolist has access to the same technology employing only labor l_i :

$$x_i = l_i \tag{5}$$

We suppose that firms behavior which produce intermediate goods is governed by the principle of profit maximization at given factor prices under a technological constraint. The profit function of firms is the following:

$$\pi_i = p_i x_i - w_i l_i \ , \tag{6}$$

where w_i is wage rate in the intermediate goods sector. Using the first order condition, we obtain the price of the *ith* intermediate good:

$$p_i = \frac{w_i}{\alpha}. \tag{7}$$

At the symmetric equilibrium, all firms produce the same quantity of the intermediate good x, face the same wage rate w and by consequence fix the same price for their production p. The price is equal to a constant mark up over the marginal cost w.

Defining by $L_i \equiv \int_0^\infty l_i di$, the total amount of labor employed in the intermediate goods sector and under the assumption of symmetry among intermediate goods producers, we can rewrite the equation (5) as follows :

$$x_i = \frac{L_i}{N}. \tag{8}$$

Finally, the profit function of the firm which produces the *ith* intermediate good is:

$$\pi_i = \lambda(1-\alpha)A^{\gamma-1}L_i^{\lambda}L_A^{1-\lambda}. \tag{9}$$

2.3 The R&D sector

There are competitive research firms undertaking R&D. Following Dinopoulos and Thompson (1999), we assume that new blueprints are produced using old blueprints A, an amount of R&D labor L_A and the labor force L :

$$\frac{\partial A}{\partial t} = \frac{AL_A}{L}. \tag{10}$$

This formulation of the R&D production function allows us to eliminate easily scale effects. Because of the perfect competition in the R&D sector, we can obtain the real wage in this sector as a function of the profit flows associated to the latest intermediate in using the zero profit condition:

$$w_A L_A = \frac{\partial A}{\partial t} P_A, \tag{11}$$

where w_A represents the real wage earned by R&D labor. P_A is the real value of such a blueprint which is equal to:

$$P_A = \int_t^\infty \pi_i e^{-r(\tau-t)} d\tau, \tau > t, \tag{12}$$

where r is the real interest rate.

Given P_A, the free entry condition leads to:

$$w_A = \frac{AP_A}{L}. \tag{13}$$

2.3. The consumer behavior

The demand side is characterized by the representative household who consumes and supplies labor. Following Grossman and Helpman (1991), we assume that the utility function of this consumer is logarithmic[3] :

[3] This specification of the utility function does not alter the results.

$$U=\int_0^{\infty} e^{(n-\rho)t}\log(c)dt\,, \tag{14}$$

where $c=\dfrac{C}{L}$ is per capita private consumption, $\rho>0$ is the rate of pure time preference. The representative household is endowed with a quantity of labor L which grows at a constant rate n. The flow budget constraint for the household is:

$$\frac{\partial a}{\partial t}=w+(r-n)a-c\,, \tag{15}$$

where a is the total wealth of the agent (measured in units of final good), w is the wage rate per unit of labor service. From the maximization program of the consumer, the necessary and sufficient conditions for a solution are given by the Keynes-Ramsey rule:

$$g_c=r-\rho\,, \tag{16}$$

and the transversality condition:

$$\lim_{t\to\infty}\mu_t a_t=0\,. \tag{17}$$

where μ_t is the co-state variable.

3. The equilibrium and the steady state

In this section, we characterize the equilibrium and give some analytical characterizations of a balanced growth path.

3.1 The equilibrium

It is now possible to characterize the labor market equilibrium in the economy considered. On this market, because of the homogeneity and the perfect mobility across sectors, the arbitrage ensures that the wage rate that is earned by employees which work in the final good sector, intermediate goods sector or R&D sector is equal. As a result, the following three conditions must simultaneously be checked:

$$s_Y+s_i+s_A=1\,, \tag{18}$$

$$w_i=w_Y\,, \tag{19}$$

$$w_i=w_A\,, \tag{20}$$

where s_Y, s_i and s_A represent the shares of the total labor supply devoted respectively to final, intermediate goods production and research activity.

Equation (18) is a resource constraint, saying that at any point in the time the sum of the labor demands coming from each activity must be equal to the total available fixed supply. Equation (19) and equation (20) state that the wage earned by one unit of labor is to be the same irrespective of the sector where that unit of labor is actually employed.

We can characterize the product market equilibrium in the economy considered. Indeed, on this market, the firms produce a final good which can be consumed. Consequently, the following condition must be checked:

$$Y = C. \tag{21}$$

Equation (21) is a resource constraint on the final good sector.

3.2 The steady state

At the steady state, all variables as Y, C, A, L_Y, L_i, L_A and L grow at a positive constant rate.

Proposition 1: *If L grows at a positive and constant rate, then all the over variables grow at a positive rates:*

$$g_Y = (1-\lambda)g_{L_Y} + \lambda g_{L_i} + \gamma g_A, \tag{22}$$

$$g_Y = g_C, \tag{23}$$

$$g_A = \gamma s_A. \tag{24}$$

Proof. *We substitute equation (8) into equation (1) then we log-differentiate the equation (1) and finally we obtain the equation (22). From the equilibrium on the product market, given by the equation (21), it's easy to find the equation (23).From the definition of the R&D production function given by the equation (10), we obtain the equation (24).*

Using the previous equations, we can demonstrate the following steady state equilibrium values for the relevant variables of the model [Bianco (2009)][4]:

$$r = n\gamma((\alpha-1)\lambda+1) + \rho - \gamma(\rho + (\alpha-1)\lambda(\rho+1)), \tag{23}$$

$$s_i = \alpha\lambda(\rho + 1 - n), \tag{24}$$

$$s_Y = (\lambda-1)(n-\rho-1), \tag{25}$$

$$s_A = (\alpha-1)\lambda n + n - \rho - (\alpha-1)\lambda(\rho+1), \tag{26}$$

$$g_Y = n((\alpha-1)\lambda\gamma + \gamma + 1) - \gamma(\rho + (\alpha-1)\lambda(\rho+1)). \tag{27}$$

According to the equation (23), the real interest rate is constant. Equation (24), (25) and (26) give the amount of labor in each sector at the equilibrium. Equation (27) shows that the growth rate is a function of technological, preference parameters γ, ρ, n and competition α.

3.3 The relationship between product market competition and growth

In this section, we study the long run relationship between competition and growth in the model presented above. Following most authors, we use the so-called Lerner Index to gauge the intensity of market power within a market. Such an index is defined by the ratio of price P minus marginal cost CM over price. Using the definition of a mark up $P = Markup * CM$ and Lerner Index $\frac{P-CM}{P}$, we can use the equation (7) to define a proxy of competition as follows[5] :

$$(1 - LernerIndex) = \alpha. \tag{28}$$

We show that our simple generalization of Bianco (2006) model that consists in having the monopolistic mark-up in the intermediate goods sector, the intermediate goods share in the final

---

[4] In order to have all variables positive, we assume that $n < \rho < \frac{n - n\lambda - \alpha\lambda + \lambda + n\alpha\lambda}{\alpha\lambda - \lambda + 1}$.

[5] This is the same measure of product market competition used by Bianco (2006) and Bianco (2007) for the most recent articles.

output and the returns to specialization treated separately, the inverted U relationship between competition and growth no longer exists.

Proposition 2: *The relationship between competition and growth is negative for all positive values of* ρ, η, L and γ and λ ∈]0,1[.

Proof. *The proof is obtained by differentiated the equation (27) with respect to* α *:*

$$\frac{\partial g_Y}{\partial \alpha} = \gamma\lambda(n-\rho-1). \qquad (29)$$

As $\gamma > 0$ et λ ∈ [0, 1] *then the sign of the derivative is the same as the sign of* $n-\rho-1$. *Or,* $\rho > n > 0$ *then* $n-\rho-1<0$.

In order to illustrate this result, we plot the equation (27) for different values of competition α, and returns to specialization γ[6] :

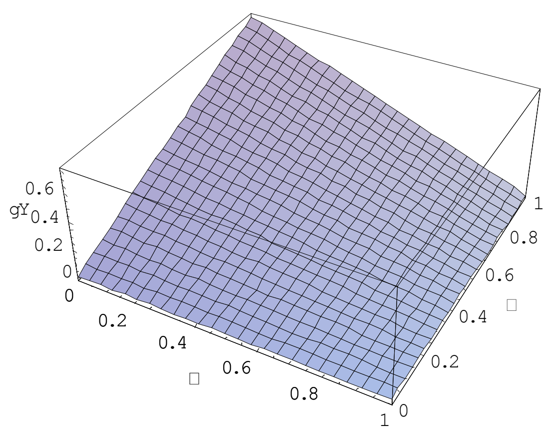


Figure 1: Relationship between competition α, returns to specialization γ and growth g_Y

According to the profit incentive effect, an increase of competition α reduces the price of the intermediate good and profit, what determines the incentives to innovation. Therefore, the profit incentive effect seems to predict an unambiguously negative relationship between product market competition and growth along the entire range of competition intensity. Unlike Bianco (2006), an increase of competition reduces the amount of labor devoted to the research sector L_N along the entire range of competition intensity. Moreover, an increase of competition has no effect on the amount of labor allocated to the final good sector L_Y and increases the amount of labor in the intermediate goods sector L_j. This means that the resource allocation effect seems also to predict an unambiguously negative relationship between product market competition and growth. Finally, we always have as we can see on the above figure a decreasing relationship between competition and growth.

4. Conclusion

In this paper, we presented a generalization of Bianco (2006) model in which we disentangle the monopolistic mark-up in the intermediate goods sector, the intermediate goods share in the final output and the returns to specialization. Our main finding is that the result of the Bianco (2006) model that close in an inverted U relationship between competition and growth depends critically on the assumptions that there are no differences between these three parameters. Indeed, for all values of parameters except to $\lambda = \alpha$, we could remove the inverted-U relationship between competition and growth. This result is due to the interplay of two effects: Schumpeterian and resource allocation effects. In our model, we find that the resource allocation effect is always negative which reinforces

[6] In drawing Figure 1, we take the same value of parameters like Bianco (2006) in order to be as close as possible to his model : ρ=0.03, n=0.01 and λ=0.75.

the Schumpeterian effect on growth. Consequently, we find a decreasing relationship between competition and growth.

5. References:

[1] Bianco, D., (2006), *Competition and Growth in an Endogenous Growth Model with Expanding Product Variety without Scale Effect*, in: *Brussels Economic Review/Cahiers Economiques de Bruxelles*, Volume 49, No3, pp. 191-202.

[2] Bianco, D., (2007), *An inverted-U Relationship between Product Market Competition and Growth in an Extended Romerian Model: A Comment*, in: *Rivista di Politica Economica*, September-October, pp. 177-190.

[3] Bianco, D., (2009), *Competition and Growth in an Endogenous Growth Model with Expanding Product Variety without Scale Effect Revisited*, MPRA, Working Paper 16670.

[4] Dinopoulos, E. and Thompson, P., (1999), *Scale Effects in Schumpeterian Models of Economic Growth*, in: *Journal of Evolutionary Economics*, Volume 9, No 2, pp. 157-85.

[5] Gancia, G. and Zilibotti, F., (2005), *Horizontal Innovation in the Theory of Growth and Development*, in: *Handbook of Economic Growth*, Volume 1, pp. 111-170. Elsevier Science, Amsterdam, North Holland.

[6] Grossman, G. M. and Helpman, E., (1991), *Innovation and growth in the global economy*. MIT Press, Cambridge and London.

FIRM'S FINANCING AND INDUSTRIAL STRUCTURE IN THE LESS DEVELOPED REGIONS OF THE SOUTH ITALY

Anna **GIUNTA**, Domenico **SARNO**
Department of Economics, Università ROMA TRE, **Italy**;
Department of Law and Economics, Seconda Università di Napoli, **Italy**
agiunta@uniroma3.it, domenico.sarno@unina2.it

Abstract

The paper shows that there is a relationship between firm's financial condition and the industrial specialization model of the Italian Mezzogiorno, that is the least developed area of the country. In order to analyze the financial status of the firms, the approach of the theory of the finance is adopted. The empirical model proposed by the Gibrat law literature is used to produce the estimates of the relationship between firms' growth and cash flow. Then, the indices measuring the "financial dependence" on the internal finance or the "financial constraints" to the firm growth of the Mezzogiorno's industries are compared to those of the other Italian regions. Finally, the analysis of the between the emerging financial condition of the firms and both the firm side distribution of the individual industries and the composition of the manufacturing of the South Italy is proposed. Our econometric analyses, carried out on a representative sample of manufacturing firms, confirm that there is a robust relationship between financial status of the firms and the specialisation model of manufacturing of the Italian Mezzogiorno.

Keywords: financial constraints, internal finance, growth-*cash flow* relationship.

JEL Classification: L20, G31, G32

1. Introduction

The aim of the paper is to show that in the Southern regions of Italy, that is in the so called *Mezzogiorno*, the least developed area of the country, in which financial markets are not properly developed, firm's growth is highly dependent on internal finance since access to external financial resources is more difficult and its cost higher. Moreover, a nexus may be found between the development of the financial system and the industrial structure; this could explain the lower rate of firms' growth in the *Mezzogiorno* and the high, persistent level of specialization in traditional industries.

The theory of finance, especially the analysis of firm's growth related to its financing sources, provides the main theoretical reference to the present work. It is well known that this stream of literature revolves around the implications of the Modigliani-Miller propositions. Generally, the empirical literature seeks to verify whether there is a significant relationship between firms' growth and internal finance and, in particular, whether investment is sensitive to cash flow: a significant relationship indicates that firm's growth is "financial dependent" on resources produced by the same firm. Alternatively, one could say that the growth faces financial constraints since growth is strictly subordinated to firm's capacity to internally supply the financial resources. In order to test this relationship, we use the empirical model proposed by Gibrat's law, instead of the standard models of the investment function based on the q function or Euler's equation. In our paper, the model of Gibrat's law will be enriched through the introduction of a variable representing internal finance. For firms belonging to the various manufacturing industries, this will enable us to verify whether growth is significantly correlated to internal finance, and hence appreciate the different degree of "financial dependence" on internal resources.

The model is used to measure the contribution of *cash flow* to growth in Southern Italian firms compared to firms localized in other Italian regions in order to identify the industries in which the growth-internal finance relationship differs in the South from that of other regions of Italy. Then, the industrial composition is compared to the firm size distribution and to the industrial specialisation of the Southern manufacturing. The paper uses data of a representative sample of Italian manufacturing small and medium sized enterprises.

2. Financial development, economic growth and financial dependence of the firms

There is unanimous agreement that the development of financial markets is a determinant of the growth: it has been extensively verified empirically that between the degree of development of the financial system and economic growth are positively linked and that the degree of financial market development is a good indicator of future growth [King, Levine, (1993); Levine, (1997)][1]. The well-known theoretical foundation of this literature is that the development of financial institutions mitigates the problems deriving from information and transaction costs, and promotes economic growth by mobilizing savings and improving efficiency. The function of financial institutions is to gather information and use it to select and monitor the investment plans of firms so as to reduce the effects of information asymmetries. In this regard, the theory suggests that information problems make it more difficult for firms to access external financial sources. Hence, the main role of the financial system is to promote company access to external finance. More developed financial markets tend to remove the obstacles in the provision of the external resources and to relax the financing constraints[2].

This framework is used in many empirical works to verify explicitly the thesis that firms belonging to industries that are more dependent on external finance grow fastest in economies with more developed financial markets [Rajan, Zingales, (1998), (2001); Cetorelli, Gambera, (2001); Beck, Levine, (2002); Carlin, Mayer, (2003)][3].

The finance approach to firm growth concerns the analysis of the relationship between growth and firm's capital structure and, particularly, the investment expenditure related to its financing sources. The theories proposed are represented, on one side, by the Modigliani-Miller theorem, which defines the irrelevance of the capital structure with regard to firm growth [Modigliani, Miller, (1958), (1961)] and, on the other, by the opposite thesis of the *pecking order*, which states that external finance does not perfectly substitute the internal finance. In according with this, there is a wedge between external and internal resources, and internal resources are costless; therefore, firm's growth is not independent of internal finance [Myers, Majluf, (1984); Myers, (1984)].

Since the work of Fazzari, Hubbard and Petersen [Fazzari *et al*., (1988)], the empirical literature has been concerned with analysing the relationship between the investment and a set of variables representing the capital structure of the firm, particularly of the internal finance. These works have tested the implications of the MM propositions and the findings have generally pointed out that there is a significant relationship between investment and *cash flow*. These results have sustained the thesis of the presence of financial constraints to firm's growth[4]. Such constraints arise when the firm is unable to generate the internal resources which growth requires [amongst others, Fazzari *et al*., (1988);

---

[1] The literature on the finance-growth nexus is very extensive. We restrict ourselves to a few general references and do not refer to the vast empirical literature recently produced about the law-finance-growth approach [for example, La Porta *et al*., (1998); Demigürc-Kunt, Maksimovic, (1998) and for Italy, Sarno (2008a)].

[2] In this regard the conclusions emerging from the empirical analysis of the relationship lending are important. It is ascertained that the presence of the lending relationships tend to reduce the financial constraints since the undesirable effects of information asymmetries of the firms are reduced [Berger, Udell, (1995, 1998); Petersen, Rajan, (1994)].

[3] The idea that differences in the degree of financial dependence of the various industries are pronounced is well grounded. The industries in which the degree of technical and financial indivisibility of investment is higher should be more dependent on external finance compared to traditional industries in which investments are incremental and do not require large financial effort. Therefore, the main determinant of the relationship is the size of the plant in the various industries. In industries with smaller firms there will be a lower dependence on external finance compared with the industries in which larger firms are prevalent. The difference in the financial dependence degree is affected by other engineering factors: the length of product life-cycle, the speed of obsolescence of the equipment and so on.

[4] As is well known, these conclusions have been criticized by Kaplan and Zingales [Kaplan, Zingales, (1994, 2000)], who state that the relationship between investment and cash flow is not necessarily indicative of financial constraints, but can indicate better investment opportunities for the firm. Therefore, empirical analyses have tested this thesis through Tobin's q theory approach or Euler's equation approach for firms' subgroups according to a variable which should discriminate *ex ante* between financially and non-financially constrained firms (dividend payout, size, age, etc.). On these issues see the paper by Chirinko [Chirinko, (2004)] and the most recent paper by Saltari [Saltari, (2004)]. A major review of this literature may be found in Hubbard [Hubbard, (1998)].

Devereux, Schiantarelli, (1990); Hoshi *et al*. (1991); Whited, (1992); Bond, Meghir, (1994); Gilchrist, Himmelberg, (1995); Hubbard *et al*., (1995)][5].

This theoretical approach would appear appropriate for analyzing the issues related to the financing of the growth of small and medium enterprises (SMEs). There are many factors indicating that the dependence degree on internal finance is higher for small firms. Thus, on the one hand, the conditions of informative opacity characterizing the relationship of the firms with the financial markets make difficult the access to external sources and the provision from the banking system. This means that the wedge of the user cost of the external and the internal finance is larger and that it is cheaper to use internal finance as a primary source of financing firm growth[6]. On the other hand, since in most cases management and ownership coincide, the dilution effect discourages the equity issue. These stylized facts are well explained by the *pecking order hypothesis* which states that information asymmetries drive firms to use finance sources that minimize ownership dilution, with internal finance being used first.

There is robust empirical evidence confirming that the growth of smaller firms is more sensitive to the internal finance [amongst others, Oliner, Rudebush, (1992); Westhead, Storey, (1997); Cressy, Olofsson, (1997); Audresch, Elston, (2002) and for Italy, Bianco, (1991), Galeotti *et al*., (1991), Bagella *et al*., (2001), Saltari, Travaglini, (2001), Sarno (2005, 2008b)].

3. Data and methodology

The data used in this paper come from the last three surveys on Italian manufacturing firms by the Mediocredito Centrale and by Capitalia. They refer respectively to the three-year periods 1995-97, 1998-2000 and 2001-03.

The samples used in the analysis has been extracted from the above surveys in accordance with the employee criterion adopted by the EU Commission[7]. To identify the small and medium sized enterprises the criterion establishes a number of employees of 250 units[8].

The *data base* of the econometric analysis is formed by the information of these selected firms: it is a pooled sample because the observations come from different surveys[9].

The sample was subsequently divided into the manufacturing industries corresponding to the subsections of economic activities according to the ATECO91 classification (two digit). Here we consider 18 of the 22 two-digit manufacturing industries. This difference is explained as follows: a) the Tobacco industry (code 16) and Petroleum industry (code 22) are excluded because the observation number was not satisfactory; b) the Electric Machines industry is obtained by the aggregation of the Office Machines and Other Electronic Systems industry (code 30) and Other Machines industry (code 31); c) the Vehicles and Motors industry is obtained by aggregating the

---

[5] The list of the references is largely incomplete; more exhaustive reviews are in the already cited works by Hubbard and Saltari and in that by Schiantarelli [Schiantarelli, (1996)].

[6] In all the main models of credit rationing the rationing likelihood is not independent of firm size; it rises when the size decreases [Stiglitz, Weiss, (1981)]. The findings of empirical analysis confirm that smaller and younger firms are more likely to be subject to credit rationing since the lenders have poor information regarding firm management skills and investment opportunities [see, for example, Petersen, Rajan, (1995)].

[7] Although the issues about the financing of larger firm growth are more complex, larger firms (>250 employees) are left out of the sample as the degree of statistical significance is unsatisfactory.

[8] In actual fact, the criterion suggested by the EU Commission is more complex since it indicates both sales and employee thresholds. The Recommendation published in 1996 (OJ L 107 – 30/04/1996) defines medium sized firms as those with 50-250 employees and with sales below 40 million euros, small firms as those with 10-49 employees and with sales below 7 million euros, micro-firms those with less than 10 employees. This criterion was changed in 2003 (OJ L 124 – 25/05/2003). With effect from 2005, the sales threshold has been raised to 50 million euros for medium sized firms and to 10 million euros for small firms; the sales threshold for micro-firms is less than 2 million euros.

[9] The construction of the *data set* for the econometric estimate causes a loss of the data referring to the last year of any survey; this is because in the *cash flow* measures we include the variation of the fund represented of the annual provision of settlement for those leaving employment and net earnings, a main source of liquidity for the firm. Consequently the *data set* is formed by data of two-year observations related to the single surveys. In all, the data base is constituted by three samples of observations referring to three different two-year periods. Hence, there are observations distributed over six years

Vehicles industry (code 34) and Other Means of Transport industry (code 35); d) the Furniture industry (code 36.1) is extracted from the Furniture and Other Manufacturing industry (code 36).

The composition of the sample is shown in the Table 1. It includes 18,498 observations, 26% of which were extracted from the first survey (referring to the three years 1995-'97), about 40% from the second survey (1998-2000) and the remaining 34% from the last survey (2001-'03). In each case, the subgroups relating to individual industries consist of a significant number of observations: the smallest subgroups are the Electronics industry (326 obs) and Instrument industry (352 obs), the largest are the Mechanical industry (2584 obs) and Food and Drink industry (2512 obs).

Table 1. DATA-SET COMPOSITION

The table contains numbers of observations per survey and industry. CODE = ATECO91 classification code; INDUSTRY =Economic activity subsection (two digit code); 1995-'97 = number of observations extracted from the 1995-'97 Mediocredito Centrale survey; 1998-'00 = number of observations extracted from the 1998-2000 Capitalia survey; 2001-'03 = number of observations extracted from 2001-2003 Capitalia survey; TOTAL = number of observations per industry; MEZZOGIORNO = Number (n°) and percentage (%) of the southern firm observations per industry.

CODE	INDUSTRY	1995-'97	1998-'00	2001-'03	TOTAL	MEZZOGIORNO	
		[1]	[2]	[3]	[1]+[2]+[3]	n°	%
15	FOOD AND DRINK	572	672	1268	2512	700	27.9
17	TEXTILE	566	658	484	1708	104	6.1
18	CLOTHING	128	266	208	602	176	29.2
19	LEATHER AND SHOE	186	382	230	798	102	12.8
20	LUMBER	158	248	168	574	62	10.8
21	PAPER	204	208	164	576	48	8.3
22	PRINTING, PUBLISHING	114	260	148	522	54	10.3
24	CHEMICALS	232	390	324	946	138	14.6
25	RUBBER AND PLASTICS	326	392	330	1048	148	14.1
26	BUILDING MATERIALS	310	436	360	1106	252	22.8
27	IRON AND STEEL	284	234	190	708	96	13.6
28	METAL PRODUCTS	326	1068	786	2180	296	13.6
29	MECHANICAL EQUIPMENT	784	1006	794	2584	126	4.9
30+31	ELECTRICAL MACHINES	152	288	218	658	70	10.6
32	ELECTRONIC	60	198	94	352	52	14.8
33	PRECIS. INSTRUMENTS	56	168	102	326	12	3.7
34+35	VEHICLE AND MOTORS	154	196	112	462	110	23.8
36.1	FURNITURE	154	400	282	836	94	11.2
	TOTAL	4766	7470	6262	18498	2640	14.3
	(%)	25.8	40.4	33.9	100.0		

Source: Mediocredito Centrale and Capitalia data (several years)

There are 2640 observations for Southern firms; they are the 14.3% of the total sample. The percentages of the Southern observations on the individual industrial subgroups are significant, with a few exceptions: for a few cases it is below 10% (Textile, Paper, Mechanical Equipment, Precision Instruments), while elsewhere it achieves values from 25% to 30% of total industry observations (Food and Drink, Clothing, Building Materials, Vehicles and Motors).

The *data base* contains the control variable, two dependent variables and an independent variable. The dependent variable (firm size) is the average number of firm employees and is directly available from the surveys. The independent variable are the same variable of the previous year and the variable representative of the internal finance condition; the latter is a *cash flow* index defined by the ratio of *cash flow* to net assets.

The OLS estimate included only the observations with positive *cash flow* value; the estimates produce White coefficients[10].

4. The empirical model

In order to analyse the internal finance–growth nexus the Gibrat model is used. According to Gibrat's law, firm growth rate is dependent on the random variable ε_t

$$Y_t - Y_{t-1} = \varepsilon_t Y_{t-1} \text{ or } Y_t = (1 + \varepsilon_t) Y_{t-1}$$

If $\log(1 + \varepsilon_t) \approx \varepsilon_t$, then

$$\log Y_t = \log Y_{t-1} + \varepsilon_t$$

The empirical specification is

$$\log Y_t = \alpha + \beta \log Y_{t-1} + \mu_t$$

It is well known that the value of β is approximately equal to unity[11].

The explanatory capacity of the model is enhanced by the inclusion among the independent variables of a *cash flow* variable representing the flow of the internally generated resources. Through this model, the statistical importance of the relationship between internal resources and firm growth will be verified. In addition, it will be ascertained whether the contribution of internal finance to the growth of Southern firms differs from that of firms from other Italian regions.

The empirical equation is

$$EMP_t = \alpha_i + \beta\ EMP_{t-1} + \delta^N\ NORCASH_t + \delta^M\ MEZCASH_t + \mu_t$$

where EMP is the average number of firm employees in the t and t-1 years and α_i are time dummies. The other two variables are based on the *cash flow* index, that is the *cash flow*/net assets ratio: NORCASH is the variable obtained through combination of the *cash flow* index by the dummy variable which assigns a value of one to the observations of the other Italian regions, zero to Mezzogiorno observations; MEZCASH is the variable obtained from the *cash flow* index by the dummy variable which instead assigns a value of one to observations from Southern Italy, zero otherwise. All the variables are transformed in logarithm values.

The estimates concern the SME subgroups of the 18 industries. The *data set* is organised as pooled samples of both cross-section and time observation taken from the single surveys. The regression equations are heteroskedasticity-corrected OLS.

The Table 2 shows mean annual growth rates of employees in the three periods for the various industries and confirm the considerable growth of small firms in Southern Italy in the years after the middle 1990s and then the dramatic break in recent years. Southern growth rates of employees are higher compared to the national rates; this positive trend chiefly affected many industries of the intensive scale and of the specialized suppliers sectors.

Table 2. ANNUAL GROWTH RATES OF EMPLOYEES

The table contains the mean percentage change in total employees per survey and industry. CODE = ATECO91 classification code; INDUSTRY =Economic activity subsection (two digit code); 1995-'97 = growth rate of total employees in 1995-'97; 1998-'00 = growth rate of total employees in 1998-2000; 2001-'03 = growth rate of total

[10] The coefficients are corrected for heteroskedasticity according to the White methodology. The presence of heteroskedasticity is a typical problem arising from analysis since the growth rates of the small firm are systematically higher than those of larger firms. This can yield the inconsistency of the OLS estimate. White coefficients are produced through the correction of the variance-covariance matrix

[11] For a state-of-the-art survey of the Gibrat law, see Sutton [Sutton, (1997)].

employees in 2001-’03; 1995-‘03 = growth rate of total employees in 1995-2003; ITALY= growth rates of employees for the whole of Italy; MEZZ. = growth rates of *Mezzogiorno* employees.

CODE	INDUSTRY	1995-'97		1998-'00		2001-'03		1995-‘03	
		ITALY	MEZZ.	ITALY	MEZZ.	ITALY	MEZZ.	ITALY	MEZZ.
15	FOOD AND DRINK	1.49	1.76	5.32	6.17	-0.72	-0.63	1.35	2.06
17	TEXTILE	0.30	-0.29	1.12	2.73	0.00	-1.15	0.39	1.05
18	CLOTHING	3.01	5.43	4.68	9.18	0.20	-0.89	2.31	4.45
19	LEATHER AND SHOE	2.00	8.44	-0.56	4.76	0.11	0.09	0.39	0.49
20	LUMBER	0.81	2.08	3.79	3.71	-0.54	0.00	1.19	5.51
21	PAPER	3.30	10.36	4.43	3.41	-0.58	-1.45	2.24	5.07
22	PRINTING, PUBLISHING	-1.75	-1.13	6.66	9.06	-0.11	0.15	1.36	-0.40
24	CHEMICALS	1.77	4.38	2.93	4.77	-0.80	-1.50	1.20	1.22
25	RUBBER AND PLASTICS	3.04	5.83	3.67	3.66	-0.68	-1.63	1.68	2.38
26	BUILDING MATERIALS	0.46	-0.67	2.31	3.23	-0.45	-2.03	0.63	-0.42
27	IRON AND STEEL	4.14	11.20	2.84	3.88	-0.88	-1.88	1.99	4.32
28	METAL PRODUCTS	3.69	6.29	3.94	4.59	-0.64	-1.97	1.48	3.58
29	MECHANICAL EQUIPMENT	3.10	6.06	2.41	3.83	-0.05	3.76	1.62	3.51
30+31	ELECTRICAL MACHINES	0.08	-11.17	6.56	5.73	-0.32	2.53	1.73	-2.89
32	ELECTRONIC	4.98	28.23	3.19	6.53	0.33	1.66	2.63	8.51
33	PRECIS. INSTRUMENTS	1.06	-0.85	4.66	7.74	-0.24	0.00	1.62	3.77
34+35	VEHICLE AND MOTORS	-0.17	0.93	3.20	4.45	-0.04	0.18	1.01	1.21
36.1	FURNITURE	3.37	16.51	4.93	4.00	-0.49	0.31	2.14	7.37
	TOTAL	2.03	3.73	3.31	5.44	-0.31	-0.79	1.39	2.55

Source: Mediocredito Centrale and Capitalia data (several years)

In the Table 3 the OLS estimates are presented[12]. The coefficients of the employees late variable are statistically significant in all cases; they are in the range between a minimum value of 0.91-0.92 (Iron and Steel, Clothing) and a maximum value close to 0.98 (Furniture, Paper, Rubber and Plastic, Lumber). The coefficients of the first *cash flow* variable (NORCASH) are always positive and are significant for 11 of the 18 industries; their value is low and they range from 0.01 to 0.02. Instead, the coefficients of the other *cash flow* variable (MEZCASH) are higher. They are positive in all cases and statistically significant for 16 of the 18 industries, with values ranging from close to 0.02 (Food and Drink, Vehicles and Motors) to 0.06 (Instruments, Lumber).

Table 3. GROWTH AND *CASH-FLOW* RELATIONSHIP

The table contains the OLS estimates of the growth-*cash flow* relationship. Dependent variable: log EMP=log of employees at time t for the i-th (i=1,…,18) industry. Independent variables: log EMP_{-1}= log of employees al time t-1; …CASH = cash flow/net assets ratio; NORCASH = variable obtained through the combination of the log(CASH) variable and the dummy variable assigning a value of one to Centre-North firms and zero to Mezzogiorno firms; MEZCASH = variable obtained through the combination of the log(CASH) variable and the dummy variable assigning a value of one to Mezzogiorno firms and zero to Centre-North firms; INDUSTRY =Economic activity subsection (two digit code). The constant was divided into 6 time dummies (not included). ESTIMATION PERIOD = Observations of the years 1996,1997,1999,2000,2002,2003; ESTIMATION METHOD: heteroskedasticity-corrected OLS (according to White procedure) (B-P=Breush-Pagan test with

[12] In the table there are not coefficients of the time dummies; they are always statistically significant, except in a few cases.

critical value at 5%=15.51). In square brackets there are standard errors; **,*** indicate the acceptance levels of 10%, 5% and 1%, respectively.

Dependent variable: EMP

INDUSTRY	EMP_{-1}	NORCASH	MEZCASH	R^2(cor)	F	B-P	N° OBS
FOOD AND DRINK	0.945***	0.014***	0.020*	0.937	3577.4	1362.0	1940
	[.015]	[.004]	[.005]				
TEXTILE	0.965***	0.020***	0.047*	0.973	7588.0	1482.9	1708
	[.008]	[.004]	[.016]				
CLOTHING	0.923***	0.005	0.045***	0.919	854.4	365.9	602
	[.017]	[.011]	[.018]				
LEATHER AND SHOE	0.933***	0.022***	0.025*	0.933	1389.3	501.5	798
	[.014]	[.008]	[.018]				
LUMBER	0.966***	0.002	0.013	0.960	1739.9	770.6	574
	[.017]	[.007]	[.012]				
PAPER	0.977***	0.020***	0.035***	0.971	2417.6	259.9	576
	[.008]	[.008]	[.013]				
PRINTING AND PUBLISHING	0.941***	0.012	0.027**	0.942	1056.8	218.6	522
	[.013]	[.009]	[.012]				
CHEMICALS	0.966***	0.008***	0.014*	0.970	5079.9	484.5	1246
	[.007]	[.005]	[.006]				
RUBBER AND PLASTICS	0.976***	0.019***	0.043***	0.973	4639.2	503.7	1048
	[.006]	[.005]	[.008]				
BUILDING MATERIALS	0.972***	0.019***	0.020***	0.967	4034.7	896.2	1106
	[.010]	[.005]	[.005]				
IRON AND STEEL	0.906***	-0.003	0.007	0.877	631.6	2490.1	708
	[.034]	[-.013]	[.029]				
METAL PRODUCTS	0.961***	0.002	0.036***	0.956	5882.5	1245.4	2180
	[.009]	[.004]	[.009]				
MECHANICAL EQUIPMENT	0.974***	0.016***	0.036**	0.972	ND	666.0	2584
	[.004]	[.004]	[.011]				
ELECTRIC MACHINES	0.957***	0.022***	0.053**	0.957	1850.1	353.6	658
	[.010]	[.008]	[.022]				
ELECTRONICS	0.963***	0.008	0.031*	0.960	1051.0	163.9	352
	[.013]	[.063]	[.013]				
PRECISION INSTRUMENTS	0.948***	0.014	0.059*	0.960	965.8	251.1	326
	[.016]	[.009]	[.030]				
VEHICLE AND MOTORS	0.958***	0.025***	0.023***	0.967	1654.4	291.9	462
	[.016]	[.007]	[.008]				
FURNITURE	0.978***	0.013***	0.063***	0.974	3069.3	443.2	836
	[.006]	[.006]	[.009]				

Source: Processing on Mediocredito Centrale e Capitalia data (several years)

5. Financing for firm's growth in the manufacturing industries

The findings of the analysis of the previous section can be summarized as follows. First of all, there is a positive relationship between growth of the employees and *cash flow* in most manufacturing industries. This confirms the *pick order hypothesis* by which the user cost of internal finance is lower than that of external finance, especially for smaller firms. As a result, the firm prefers to use internal finance as its main financing source of growth.

Then, it is confirmed that the growth of the Southern Italian firms is more dependent on the flow of internal resources. The coefficients of the observations related to Southern firms (MEZCASH) is systematically higher than that of firms based in the remaining regions of Italy (NORCASH) in every industry (with the one exception represented by the Vehicle and Motor industry). This means that the contribution of internal finance to firm growth is larger and that a higher user cost of the external finance explains larger sensitivity of the growth on internal resources.

In order to appreciate this different sensitivity of the growth on internal finance, the Table 4 contains in the first column the absolute values of the difference between the two coefficients (MEZCASH – NORCASH) and in the next column Student's t values with the corresponding level of statistical significance. As can be seen, the difference among the coefficients is not significant for only 4 of the industries.

Table 4. DIFFERENCES IN FINANCIAL DEPENDENCE INDEXES BETWEEN CENTRE-NORTH AND MEZZOGIORNO REGIONS

(In the table there are the absolute differences (DCASH) and the t Student test (t) in order to verify the statistical significance of the difference between the MEZCASH coefficient and the NORCASH coefficient. CODE = ATECO91 classification code; INDUSTRY =Economic activity subsection (two digit code); D = MEZCASH – NORCASH; t = Student's t test; *, **,*** indicate levels of acceptance of 10%, 5% and 1%, respectively. Coefficient's value is 0 when the coefficient is not significant.)

CODE	INDUSTRY	DCASH	t
15	FOOD AND DRINK	0.006	1.32*
17	TEXTILE	0.027	6.26***
18	CLOTHING	0.045	3.05***
19	LEATHER AND SHOE	0.003	0.27
20	LUMBER	n.a.	n.a.
21	PAPER	0.015	1.78**
22	PRINTING, PUBLISHING	0.015	1.56*
24	CHEMICALS	0.006	1.24
25	RUBBER AND PLASTICS	0.023	4.34***
26	BUILDING MATERIALS	0.001	0.29
27	IRON AND STEEL	n.a.	n.a.
28	METAL PRODUCTS	0.034	6.92***
29	MECHANICAL EQUIPMENT	0.020	4.71***
30+31	ELECTRICAL MACHINES	0.031	3.14***
32	ELECTRONIC	0.031	1.69**
33	PRECIS. INSTRUMENTS	0.059	4.39***
34+35	VEHICLE AND MOTORS	-0.001	-0.17
36.1	FURNITURE	0.049	7.41***

Source: Mediocredito Centrale and Capitalia data (several years)

We will illustrate these findings extensively in order to evaluate the relative importance of the growth-*cash flow* nexus for the different industries. We assume the estimate coefficients as a "financial dependence" indices of firm growth from internal financing resources. The same indices are a measure of "financial constraints" that we define as the limit of the firm in producing internal resources to finance the growth. A higher value of the coefficient means greater financial dependence of growth upon internal finance or stronger financial constraints to the growth.

The Table 5 lists the coefficient values classified in decreasing order. There are two main blocks: in the first are the NORCASH coefficients, in the second the MEZCASH coefficients.

We can consider the first arrangement measures as the length of the financial dependence related to the single industries because the share of sample's firm belonging on Centre-North regions is predominant. We note that the index of the industries where generally prevails larger plant size has values below average, while the coefficients of the industries in which investment tends generally to be lower because is prevailing smaller size are close to average or above it. In particular, the index of the most traditional industries is above average.

These findings contrast with the order of the second block; here the mean is much higher and a asymmetric effect is operating. The MEZCASH coefficients are higher in relation to industries which had previous values below average, i.e. industries in which the plants of the firms are frequently larger; the same coefficients show values below average for industries when smaller size prevails, which previously had values above average. Now in the most traditional industries the coefficients are significantly lower than average[13].

Table 5. INDICES OF INTERNAL FINANCIAL DEPENDENCE

The table lists in decreasing order the coefficients of cash flow variables for industries. CODE = ATECO91 classification code; INDUSTRY =Economic activity subsection (two digit code); NORCASH = internal financial dependence index for Centre-North' firms; MEZCASH = internal financial dependence index for *Mezzogiorno'* firms. Coefficient's value is 0 when the coefficient is not significant.

CODE	INDUSTRY	NORCASH	CODE	INDUSTRY	MEZCASH
34+35	VEHICLE AND MOTORS	0.025	36.1	FURNITURE	0.063
19	LEATHER AND SHOE	0.022	33	PRECISION INSTRUMENTS	0.059
30+31	ELECTRIC MACHINES	0.022	30+31	ELECTRIC MACHINES	0.053
17	TEXTILE	0.020	17	TEXTILE	0.047
21	PAPER	0.020	18	CLOTHING	0.045
25	RUBBER AND PLASTICS	0.019	25	RUBBER AND PLASTICS	0.043
26	BUILDING MATERIALS	0.019	28	METAL PRODUCTS	0.036
29	MECHANICAL EQUIPMENT	0.016	29	MECHANICAL EQUIPMENT	0.036
15	FOOD AND DRINK	0.014	21	PAPER	0.035
33	PRECISION INSTRUMENTS	0.014	32	ELECTRONICS	0.031
36.1	FURNITURE	0.013		**average**	0.031
22	PRINTING AND PUBLISHING	0.012	22	PRINTING AND PUBLISHING	0.027
	average	0.009	19	LEATHER AND SHOE	0.025
24	CHEMICALS	0.008	34+35	VEHICLE AND MOTORS	0.023
32	ELECTRONICS	0.000	15	FOOD AND DRINK	0.020
18	CLOTHING	0.000	26	BUILDING MATERIALS	0.020
20	LUMBER	0.000	24	CHEMICALS	0.014
28	METAL PRODUCTS	0.000	20	LUMBER	0.000
27	IRON AND STEEL	0.000	27	IRON AND STEEL	0.000

Source: Mediocredito Centrale and Capitalia data (several years).

6. Internal finance dependence, firm size distribution and industrial pattern in Southern Italian manufacturing

Therefore, from the previous analysis a negative relationship between financial dependence and the size of the prevailing investment in the various industries seems to emerge. The sensitivity on internal finance is obviously lower when the investment shows technical and financial indivisibility and higher when the investment is largely divisible. The degree of dependence on the internal resources is significantly and systematically higher in Southern Italy and the differences among the coefficients related to the two different Italian macro-regions are short in relation to the industries prevailing the smaller size.

We would confirm this relationship through other argumentation and at the same time we would discuss the relationship between the financial dependence index and the specialisation of Southern Italian manufacturing.

For this purpose, we note that:

a) the size of the manufacturing firms in the Southern regions tend to be smaller compared to size of the firms belonging to the other regions of Italy. The negative externalities arising from unfavourable environment slow down the growth of the firms and consequently the corresponding equilibrium size is lower. In the Graph a) of the Table 6 this undersize of the Southern firm is represented through the Firm Size Distribution (FSD), the lognormal distribution of the size measured

[13] The correlation index between NORCASH and MEZCASH coefficients is -0,38.

by firm's employees[14]; the distribution of the size of the Southern firms is *right-skewed* compared to the size distribution of the Italian firms because the share of smaller firms is higher and the firms tend to place themselves in lower side of the distribution[15],

b) the pattern of specialization of the manufacturing in the Southern regions is oriented towards the traditional industries. The Graph b) of the Table 6 shows that the specialization index of the Southern is higher than the corresponding index of the Centre-North region in the traditional industries and lower in the other manufacturing industries[16].

Then, in order to analyze the relationship between financial dependence, firm size and specialization degree of the individual industries we consider:

1) the financial dependence indices as measured by the MEZCASH and ΔCASH coefficients (the last index is representing by the difference between MEZCASH and NORCASH coefficients);

2) the size index of the firm in the individual industries represented by the mean of the employees of the firm (of the plant) in Southern regions and in Italy obtained by 1991 and 2001 census data

$$SIZ_{i,t} = \frac{EMPLOYEES_{i,t}}{PLANTS_{i,t}}$$

where *EMPLOYEES* is the number of employees and *PLANTS* the number of plants in the *i*- industry (with $i = 1,\ldots,18$) for the years $t = 1991, 2001$;

3) the specialization index obtained as

$$SP_{i,t} = \frac{EMPLOYEES_{i,t,MEZ} \,/\, EMPLOYEES_{t,MEZ}}{EMPLOYEES_{i,t,ITA} \,/\, EMPLOYEES_{t,ITA}} - 1$$

where *EMPLOYEES* is the number of employees in the *i*-industry (with i=1,…,18) for the years $t = 1991, 2001$; *MEZ* and *ITA* are the Mezzogiorno and Italy, respectively.

Table 6. FIRMS SIZE DISTRIBUTION AND SPECIALIZATION OF SOUTHERN ITALY MANIFACTURING

The Table contains the graphs of the FSD and of the Composition of the Southern manufacturing .
In the Graphs a) are the Firm Size Distribution (FSD) for the South and Italy. The FSDs are calculated with the data regarding the mean employees of the firms in the samples of Mediocredito and Capitalia Surveys in 1995 and 2003 years.
In the Graph b) are the figures of the indices of specialization determined through the 1991 and 2001 census data. The indices are based on the following formula:

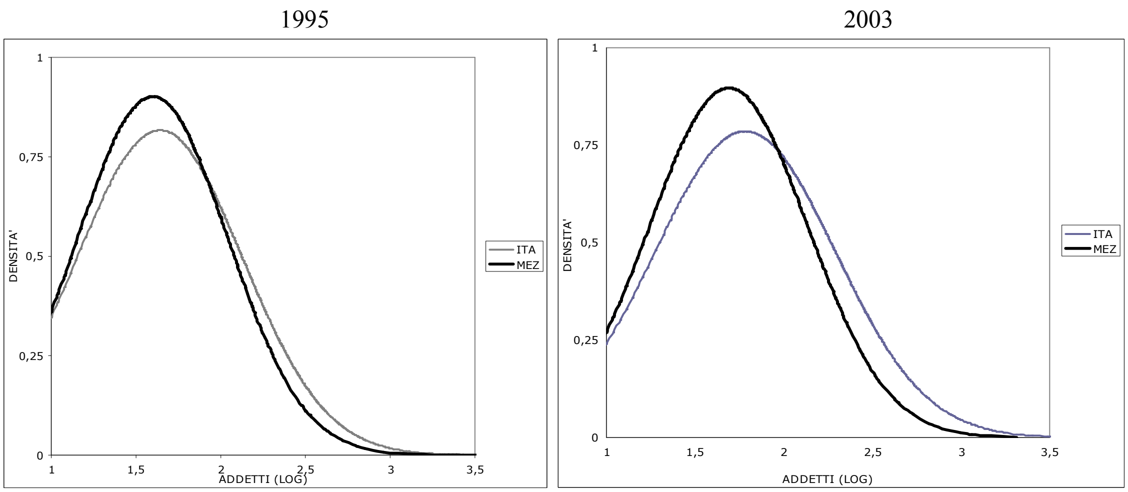
$$SPE_{i,t} = \frac{EMPLOYEES_{i,t,MEZ} \,/\, EMPLOYEES_{t,MEZ}}{EMPLOYEES_{i,t,ITA} \,/\, EMPLOYEES_{t,ITA}} - 1$$

[14] The Firm Size Distribution tends to lognormal distribution if Gibrat's Law holds. The skewness of the distribution rises (the asymmetries of the distribution rises) when firm size and growth are not independent and the firm population is not stable over the time; for example, a young firm population show a right-skewed distribution [see Cabral, Mata, (2003) and for Italy Angelini, Generale, (2008)]

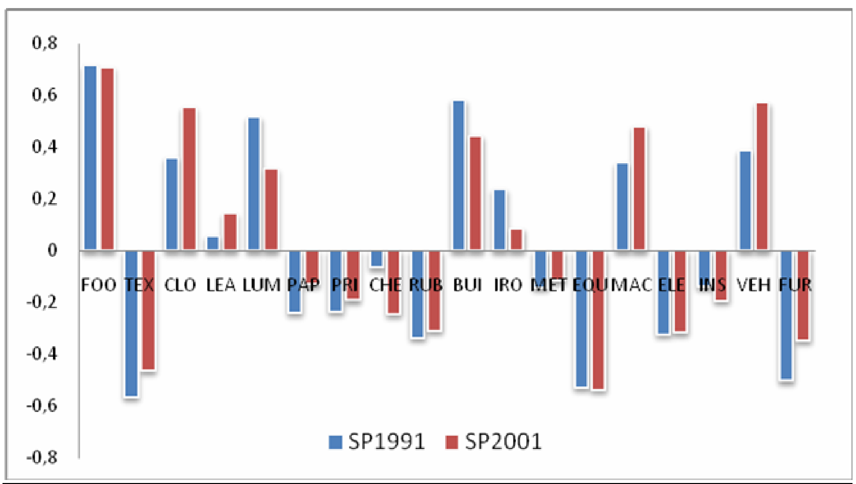
[15] The FSD are obtained using the Mediocredito Centrale and Capitalia data referred to the mean employees of the firm for the 1995 and 2003 years

[16] The specialization indices are obtained using the employees data of the 1991 and 2001 Census.

Graph a) – Firm Size Distribution



Graph b) – Specialization Pattern



Legend: FOO=FOOD AND DRINKS; TEX=TEXTILE; CLO=CLOTHING; LEA=LEATHER AND SHOE; LUM=LUMBER; PAP=PAPER; PRI=PRINTING AND PUBLISHING; CHE=CHEMICALS; RUB=RUBBER AND PLASTICS; BUI=BUILDING MATERIALS; IRO=IRON AND STEEL; MET=METAL PRODUCTS; EQU=MECHANICAL EQUIPMENT; MAC=ELECTRIC MACHINES; ELE= ELECTRONICS; INS=PRECISION INSTRUMENTS; VEH=VEHICLE AND MOTORS; FUR=FURNITURE

Source: Processing Mediocredito Centrale, Capitalia and ISTAT data (several years)

We analyze separately the relationship between internal finance dependence indices and firm size indices and then the relationship between internal finance dependence indices and specialization indices.

With regard to the first relationship the Panel 1 contains a table in upper side and two graphs in lower side. The Table is divided in two blocks; in the first block are reported the financial dependence indices (NORCASH, MEZCASH and ΔCASH), in the second are the size indices referred to the mean employees for plants in 1991 and 2001 census data (SIZ91 and SIZ01) and their mean (S91-01). In order to make our analysis more explanatory, the graphs represents the relationship between MEZCASH and ΔCASH indices, respectively, and the mean size index (S91-01). We note that in both the relationships negative tendencies prevail.

The first relationship show that the dependence on internal finance tend to decrease in the industries where the larger plants tend to prevail. Therefore, the mean size of the firm tends to rise when the financial index tends to decreases (correlation index=-0,45); the coefficient of the shape of the pooling line is statistically significant at established probability level (value=-416,44, standard error=209,11 and t=-1,99). We see with regard to the second relationship that in the industries where the mean size of the firm tends to be larger the difference in the financial dependence on the internal finance index tends to be lower (correlation index=-0,51); the shape of the pooling line is negative and statistically significant (value=-484,81, standard error=209,87 and t=-2,13).

The Panel 2 contains one table and two graphs related to the second relationship between financial dependence and specialization. With the block containing the financial indices in the table there is the block where the specialization indices are listed: the indices obtained by 1991 and 2001 census data (SP1991 and SP2001, respectively) and their main value (SP91-01). The graphs depict both the relationship between the financial indices (MEZCASH and ΔCASH), respectively, and the main value of the specialization index (SP91-01).

We see that a negative tendency prevails in the relationship between the MEZCASH index and the specialization SPE91-01 index. The specialization degree of the Southern industries tends to be higher where the dependence on the internal finance tends to be lower (correlation index=-0,53); the shape of the pooling line is negative and statistically significant (value=-14,35, standard error=5,66 and t=-2,53). The emerging relationship between the specialization SPE91-01 index and the financial ΔCASH index confirms this same tendency: the specialization index tends to be lower as much as the differential degree of the financial dependence tends to be higher. This negative relationship is measured by the significant value of the correlation index (-0,47) and confirmed by the negative and statically acceptable value of the shape of the pooling line (value=-13,08 with standard error=6,14 and t=-2,13).

7. Conclusions

The previous analysis tends to confirm that there is a robust correlation between the financial status of the firms and the structure of the manufacturing of the South Italy regions. We have considered the contribution of the internal finance to financing firm's growth and have measured it through a index. This index is devoted to measure both financial dependence of firm's growth on the internal finance and the length of the financial constraints to the firm's growth. Thus we sought to indicate the condition in which the growth process of the firm is dependent on, and at the same time limited by, the internally generated flow of financial resources devoted to this purpose. We have analyzed this financial status with regard to the industrial pattern of the Southern manufacturing considering the firm size distribution and the specialization degree of individual industries. We have observed that in the Southern regions is operating an asymmetric effect: while the industry indices showing generally higher dependence degree seem not to present large difference, those of the industries showing generally lower dependence degree tend to be more higher and the difference larger. Thus the analysis has confirmed that there is a significant tendency by this financial condition to show a negative correlation with both the size distribution and the industrial specialization model of Mezzogiorno manufacturing.

This followed from two different stages. The first stage generally confirmed that the Modigliani-Miller proposition does not hold in the case of smaller firms. Instead, the growth of SMEs is correlated significantly to *cash flow*; the strength of the relationship differs with regard to the various industries. This can be explained both with factors related to their structure (minimum efficient size, divisibility degree of the investment, product life cycle, capital turnover) and with the industrial cycle. The higher sensitivity of the growth of Southern Italian firms upon internal finance was re-stated in the second stage. This is because firms in the Italian *Mezzogiorno* are generally smaller and younger, show a more uncertainty in the growth trend, and face more systemic risk. All this makes access to external financing sources more difficult and, concurrently, reduces their advantage because they enlarge the wedge in the user cost between internal and external finance.

Panel 1. FINANCIAL DEPENDENCE AND FIRM SIZE

The table contains two groups of indices (financial dependence and size) and two graphs with tendency lines.
In the Table: CODE = ATECO91 classification code; INDUSTRY =Economic activity subsection (two digit code); NORCASH=financial dependence index for Centre-North firms; MEZCASH = financial dependence

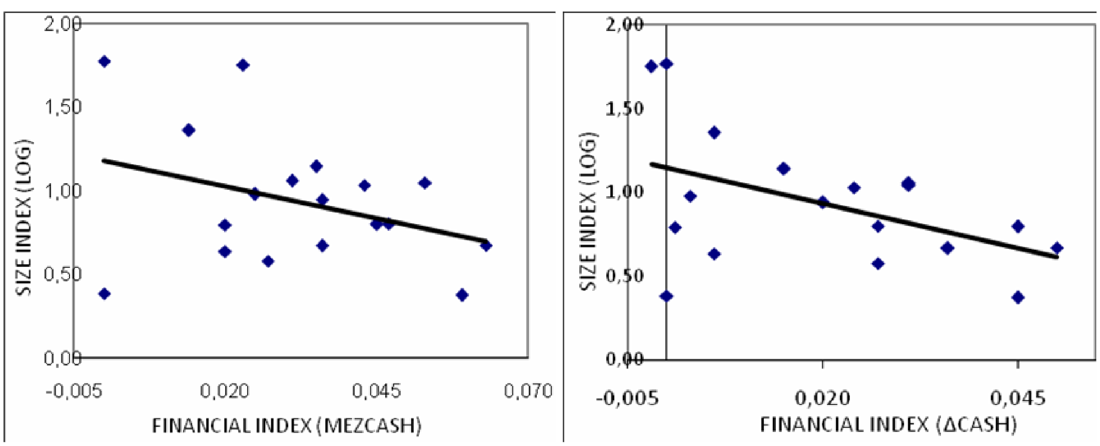
index for Mezzogiorno firms; ΔCASH = MEZCASH – NORCASH = difference between the two coefficients; SIZ1991 = mean employees for plants in 1991 year; SIZ2001= mean employees for plants in 2001 year; SIZ91-01= arithmetic mean of the SIZE indices obtained through the 1991 and 2001 census data. They are based on the following formula:

$$SIZ_{i,t} = \frac{EMPLOYEES_{i,t}}{PLANTS_{i,t}}$$

where t=1991, 2001, i=1…18, are the industries of the *Mezzogiorno* (Tobacco and Petroleum industries are excluded).

The graphs contain the positions of the single industries in the financial dependence–size space: the MEZCAZH-SIZ91-01 indices and ΔCASH-SIZ91-01 relationships, respectively.

CODE	INDUSTRY	FINANCIAL DEPENDENCE INDICES			SIZE INDICES		
		NORCASH	MEZCASH	ΔCASH	SIZ1991	SIZ2001	SIZ91-01
15	FOOD AND DRINK	0.014	0.020	0.006	4,65	3,99	4,32
17	TEXTILE	0.020	0.047	0.027	6,50	6,20	6,35
18	CLOTHING	0.005	0.045	0.040	6,36	6,20	6,28
19	LEATHER AND SHOE	0.022	0.025	0.003	10,32	8,75	9,53
20	LUMBER	0.002	0.013	0.011	2,29	2,56	2,43
21	PAPER	0.020	0.035	0.015	15,6	12,22	13,91
22	PRINTING AND PUBLISHING	0.012	0.027	0.015	4,03	3,59	3,81
24	CHEMICALS	0.008	0.014	0.006	28,62	17,03	22,83
25	RUBBER AND PLASTICS	0.019	0.043	0.023	10,68	10,78	10,73
26	BUILDING MATERIALS	0.019	0.020	0.001	7,14	5,37	6,25
27	IRONE AND STEEL	-0.003	0.007	0.010	76,17	41,97	59,07
28	METAL PRODUCTS	0.002	0.036	0.034	4,45	4,84	4,65
29	MECHANICAL EQUIPMENT	0.016	0.036	0.020	10,1	7,42	8,76
30+31	ELECTRIC MACHINES	0.022	0.053	0.031	14,14	8,09	11,11
32	ELECTRONICS	0.008	0.031	0.023	11,68	11,09	11,38
33	PRECISION INSTRUMENTS	0.014	0.059	0.045	2,26	2,47	2,37
34+35	VEHICLE AND MOTORS	0.025	0.023	-0.001	66,68	46,31	56,49
36.1	FURNITURE	0.013	0.063	0.049	4,16	5,24	4,70



Source: Processing Mediocredito Centrale, Capitalia and ISTAT data (several years)

Panel 2. FINANCIAL DEPENDENCE AND SPECIALIZATION

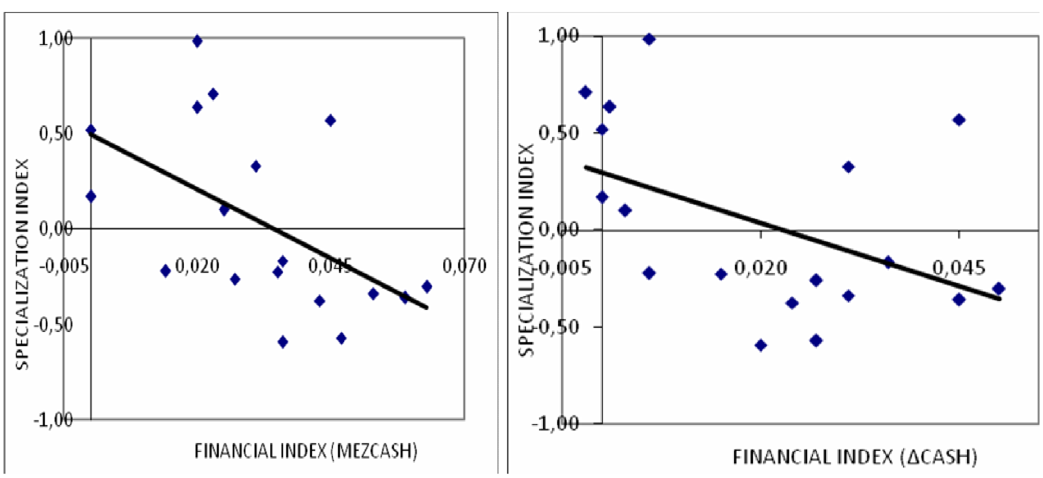
The table contains two groups of indices (financial dependence and size) and two graphs with tendency lines.

In the Table: CODE = ATECO91 classification code; INDUSTRY =Economic activity subsection (two digit code); NORCASH=financial dependence index for Centre-North firms; MEZCASH = financial dependence index for Mezzogiorno firms; ΔCASH = MEZCASH – NORCASH = difference between the two coefficients; SPE1991 = specialization index in 1991 year; SPE2001= specialization index in 2001 year; SPE91-01= arithmetic mean of the SPE indices obtained through the 1991 and 2001 census data. They are based on the following formula:

$$SPE_{i,t} = \frac{EMPLOYEES_{i,t,MEZ} / EMPLOYEES_{t,MEZ}}{EMPLOYEES_{i,t,ITA} / EMPLOYEES_{t,ITA}} - 1$$

where t=1991, 2001, i=1…18, are the industries, MEZ and ITA are Mezzogiorno an Italy, respectively (Tobacco and Petroleum industries are excluded).
The graphs contain the positions of the single industries in the financial dependence–specialization space: the MEZCAZH-SPE91-01 indices and ΔCASH-SPE91-01 relationships, respectively.

CODE	INDUSTRY	FINANCIAL DEPENDENCE INDICES			SPECIALIZATION INDICES		
		NORCASH	MEZCASH	ΔCASH	SPE1991	SPE2001	SPE91-01
15	FOOD AND DRINK	0.014	0.020	0.006	0,716	0,708	0,712
17	TEXTILE	0.020	0.047	0.027	-0,566	-0,463	-0,515
18	CLOTHING	0.005	0.045	0.040	0,359	0,553	0,456
19	LEATHER AND SHOE	0.022	0.025	0.003	0,055	0,143	0,099
20	LUMBER	0.002	0.013	0.011	0,515	0,315	0,415
21	PAPER	0.020	0.035	0.015	-0,240	-0,131	-0,186
22	PRINTING AND PUBLISHING	0.012	0.027	0.015	-0,235	-0,192	-0,213
24	CHEMICALS	0.008	0.014	0.006	-0,066	-0,245	-0,155
25	RUBBER AND PLASTICS	0.019	0.043	0.023	-0,337	-0,309	-0,323
26	BUILDING MATERIALS	0.019	0.020	0.001	0,581	0,442	0,511
27	IRONE AND STEEL	-0.003	0.007	0.010	0,237	0,084	0,161
28	METAL PRODUCTS	0.002	0.036	0.034	-0,142	-0,118	-0,130
29	MECHANICAL EQUIPMENT	0.016	0.036	0.020	-0,528	-0,537	-0,533
30+31	ELECTRIC MACHINES	0.022	0.053	0.031	-0,140	-0,194	-0,167
32	ELECTRONICS	0.008	0.031	0.023	0,338	0,480	0,409
33	PRECISION INSTRUMENTS	0.014	0.059	0.045	-0,323	-0,317	-0,320
34+35	VEHICLE AND MOTORS	0.025	0.023	-0.001	0,387	0,570	0,479
36.1	FURNITURE	0.013	0.063	0.049	-0,503	-0,347	-0,425



Source: Processing Mediocredito Centrale, Capitalia and ISTAT data (several years)

In short, through the findings emerging herein, we may confirm the general condition of the Southern industrial system in which structural weaknesses are interwoven with a more precarious financial status. Systematic evidences for the presence of the relation between financial condition and industrial structure and specialization reaffirm the importance of the questions related to the finance-growth nexus that remains decisive for regional economic growth after the restructuring of the Southern Italian banking system during the 1990s.

References:

[1] Angelini, P., Generale, A., (2008), *On the Evolution of Firm Size Distribution*, in: *American Economic Review*, Volume 98; pp. 425 – 438.

[2] Audretsch, D.B., Elston, J.A., (2002), *Does Firm Size Matter? Evidence on the Impacts of Liquidity Constraints on Firm Investment Behavior in Germany,* in: *International Journal of Industrial Organization*, Volume 20, pp.1 – 17.

[3] Beck, T., Levine, R., (2002), *Industry Growth and Capital Allocation: does having a market- or bank-based system matter?*, in: *Journal of Financial Economics*, 64: 147-180.

[4] Bagella, M. (ed.), (2004), *Finanza e crescita. Quali vincoli, quali rischi?*, Bologna, Il Mulino.

[5] Bagella, M., Becchetti, L., Caggese, A., (2001), *Financial Constraints on Investment: a Three-Pillar Approach Based on a Priori Identification*, in: *Research in Economics*, Vol. 55, pp. 219 – 254.

[6] Becchetti, L., Trovato, G., (2002), *The Determinants of Growth for Small and Medium Sized Firms. The Role of the Availability of External Finance*, in: *Small Business Economics*, Vol. 19, pp. 291-306.

[7] Berger, A.N., Udell, G.F., (1995), *Relationship Lending and Lines of Credit in Small Firm Finance*, in: *Journal of Business*, Vol. 68, pp. 351 – 382.

[8] Bianco, M., (1991), Vincoli finanziari e scelte reali delle imprese italiane: gli effetti di una relazione stabile con una banca, in Angeloni, I., Conti, V., Passacantando, F. (eds), "*Le banche ed il finanziamento delle imprese*", Bologna, Il Mulino, pp. 23 – 60.

[9] Bond, S., Meghir, C., (1994), *Dynamic Investment Model and Firm's Financial Policy*, in: *Review of Economic Studies*, Vol. 61, pp. 197 – 222.

[10] Cabral, L.M.B., Mata, J., (2003), *The Evolution of Firm Size Distribution: Facts and Theory*, in: *American Economic Review,* Vol. 91; pp. 1075 – 1090.

[11] Calcagnini, G., Iacobucci, D., (1997), *Small Firms Investment and Financing Decisions: an Option Value Approach*, in: *Small Business Economics*, Vol. 9, pp. 491 – 502.

[12] Carlin, W., Mayer, C., (2003), *Finance, Investment and Growth*, in: *Journal of Financial Economics*, 69:191 – 226.

[13] Cetorelli, N., Gambera, M., (2001), *Banking Market Structure, Financial Dependence and Growth: International Evidence from Industry Data*, in: *Journal of Finance*, 56:617 – 648.

[14] Chirinko, R., (1993), *Business Fixed Investment Spending: Modelling Strategies, Empirical Results and Policy Implications*, in: *Journal of Economic Literature*, Vol. 31, pp. 1875 – 1911.

[15] Cressy, R., Olofsson, C. (eds), (1997), *European SME Financing: An Overview*, Special Issue of Small Business Economics, in: *Small Business Economics*, Vol.9, pp.87 – 96.

[16] Demirgüç-Kunt, A., Maksimovic, V., (1998), *Law, Finance and Firm Growth*, in: *Journal of Finance*, 53: 2107 – 2137.

[17] Devereux, M., Schiantarelli, F., (1990), *Investment, Financial Factors and Cash Flow: Evidence from U.K. Panel Data*, in Hubbard, G.R. (ed.), *Asymmetric Information, Corporate Finance and Investment*, University of Chicago Press, Chicago, pp. 279 – 306.

[18] Fazzari, M.S., Hubbard, G.R., Petersen, B.C., (1988), *Financing Constraints and Capital Investment*, in: *Brooking Papers of Economic Activity*, pp. 141 – 195.

[19] Fazzari, M.S., Hubbard, G.R., Petersen, B.C., (2000), *Investment Cash Flow Sensitivities are Useful: a Comment on Kaplan and Zingales*, in: *Quarterly Journal of Economics*, Vol. 115, pp. 695 – 705.

[20] Galeotti, M., Schiantarelli, F., Jaramillo, F., (1991), *Decisioni di investimento e ruolo dell'indebitamento, delle attività finanziarie e del cash flow: evidenza empirica da un panel di dati italiani*, in Conti, V., Hamaui, R. (eds), *Operatori e mercati nel processo di liberalizzazione*, Bologna, Il Mulino, pp. 235 – 262.

[21] Gilchrist, S., Himmelberg, C.P., (1995), *Evidence on the Role of Cash Flow in Reduced-Form Investment Equations*, in: *Journal of Monetary Economics*, Volume 36, pp. 541 – 572.

[22] Hoshi, T., Kashyap, A., Scharfstein, D., (1991), *Corporate Structure, Liquidity and Investment: Evidence from Japanese Panel Data*, in: *Quarterly Journal of Economics*, Volume 106, pp. 33 – 60.

[23] Hubbard, G.R., (1998), *Capital-Market Imperfections and Investment*, in: *Journal of Economic Literature*, Volume 36, pp. 193 – 225.

[24] Hubbard, G.R., Kashyap, A., Whited, T.M., (1995), *International Finance and Firm Investment*, in: *Journal of Money, Credit and Banking*, Volume 27, pp. 683 – 701.

[25] Kaplan, S.N., Zingales, L., (1997), *Do Investment-Cash Flow Sensitivities Provide Useful Measures of Financing Constraints*, in: *Quarterly Journal of Economics*, Volume 112, pp. 169 – 215.

[26] Hubbard, G.R., Kashyap, A., Whited, T.M., (2000), *Investment-Cash Flow Sensitivities are not Measures of Financial Constraints*, in: *Quarterly Journal of Economics*, Volume 115 , pp. 707 – 712.

[27] King, R.G., Levine, R., (1993), *Finance and Growth: Schumpeter might be right*, in: *Quarterly Journal of Economics*, 108:717 – 738.

[28] La Porta, R., Lopez-de-Silanes, F., Shleifer, A., Visny, R., (1998), *Law and Finance*, in: *Journal of Political Economy*, 106:1113 – 1155.

[29] Levine, R., (1997), *Financial Development and Economic Growth: Views and Agenda*, in: *Journal of Economic Literature*, 35: 688 – 726.

[30] Modigliani, F., Miller, M., (1958), *The Cost of Capital, Corporation Finance and the Theory of Investment*, in: *American Economic Review*, Volume 48, pp. 261 – 297.

[31] Modigliani, F., Miller, M., (1961), *Dividend Policy, Growth and the Valuation of Shares*, in: *Journal of Business*, Volume 34, pp. 411 – 433.

[32] Myers, S.C., (1984), *The Capital Structure Puzzle*, in: *Journal of Finance*, Vol. 39, pp.575 – 592.

[33] Myers, S.C., Majluf, N.S., (1984), *Corporate Financing and Investment Decisions when Firms have Information that Investors do not have*, in: *Journal of Financial Economics*, Volume 13, pp. 187 – 221.

[34] Oliner, S., Rudebush, G., (1992), *Sources of the Financing Hierarchy for Business Investment*, in: *Review of Economics and Statistics*, 74, pp. 643 – 654.

[35] Petersen, M., Rajan, R.G., (1994), *The Benefits of Lending Relationships: Evidence from Small Business Data*, in: *Journal of Finance*, Volume 49, pp. 3 – 37.

[36] Petersen, M., Rajan, R.G., (1995*), The Effect of Credit Market Competition on Lending Relationships*, in: *Quarterly Journal of Economics*, Volume 110, pp. 407 – 443.

[37] Rajan, R., Zingales, L., (1998*), Financial Dependence and Growth*, in: *American Economic Review*, pp. 559 – 586.

[38] Rajan, R., Zingales, L., (2001*), Financial Systems, Industrial Structure and Growth*, in: *Oxford Review of Economic Policy*, 17: 467 – 482.

[39] Saltari, E., (2004), *Struttura finanziaria e decisioni di investimento. Una rassegna critica del lavoro teorico ed empirico*, in Bagella, M. (ed), *Finanza e crescita. Quali vincoli, quali rischi?*, Bologna, Il Mulino, pp. 51 – 78.

[40] Saltari, E., Travaglini, G., (2001), *Financial Constraints and Investment Decisions*, in: *Scottish Journal of Political Economy*, Volume 48, pp. 330 - 344.

[41] Sarno, D., (2005), *Liquidity Constraint on the Production of the Forms in Southern Italy*, in *Small Business Economics*, Volume 25, pp.133-146.

[42] Sarno, D., (2008a), *Financial and Legal Constraints to Firm Growth: the Case of Italy*, in: *Journal of Applied Economic Sciences*, Volume 3, pp. 293-305.

[43] Sarno, D., (2008b), *Capital Structure and Growth of the Firms in the Backward Regions of the South Italy*, in: *Applied Financial Economics,* Volume 18, pp. 821-833.

[44] Schiantarelli, F., (1996), *Financial Constraints and Investment: Methodological Issues and International Evidence*, in: *Oxford Review of Economic Policy*, Volume 12, pp. 70 – 87.

[45] Stiglitz, J., Weiss, A., (1981), *Credit Rationing in Markets with Imperfect Information*, in: *American Economic Review*, Volume 71, pp. 67 – 127.

[46] Sutton, J., (1997), *Gibrat's Legacy*, in: *Journal of Economic Literature*, Volume 35, pp. 40 – 59.

[47] Westhead, P, Storey, D.J., (1997), *Financial Constraints on the Growth of High Technology Small Firms in the United Kingdom*, in: *Applied Financial Economics*, Volume 7, pp. 197 – 201.

[48] Whited, T.M., (1992), *Debt, Liquidity Constraints and Corporate Investment: Evidence from Panel Data*, in: *Journal of Finance*, Volume 47, pp. 1425 - 1460.

MODELLING THE EVOLUTION OF REAL GDP PER CAPITA DURING THE TRANSITION FROM A SOCIALIST TO CAPITALIST ECONOMIC SYSTEM

Ivan O. **KITOV**
Institute for the Geospheres' Dynamics,
Russian Academy of Sciences, Moscow, **Russia**
ikitov@mail.ru

Abstract

The transition of former socialist countries to capitalist economic system is modelled. The transition is entirely defined by three empirical parameters and the model describes only the evolution of real GDP per capita since the start of the disintegration of socialism. It is found that the transition has practically finished in many Central and Eastern European countries and their economic evolution is driven by forces associated with capitalist system. In the long run, the future evolution of the former socialist countries has to follow the same path as observed in other developed countries in the past. Even in the case of perfect economic performance, the studied countries will never catch up the most advanced countries. In Russia and some countries of the Former Soviet Union, the transition process has not been completed.

Key words: socialism, capitalism, transition, economic modelling, GDP per capita.

JEL Classification: O12, P10, P27

1. Introduction

Several Central and East European countries joined the European Union in 2004 and some in 2007. These countries had an almost 40 year history of economic development governed by rules of socialist system. The countries of the Former Soviet Union (FSU) had an even longer period of socialism reigning in economic life. From the point of view of economics, it is of theoretical and practical interest to understand qualitatively and quantitatively what happened during these socialist years and during the transformation from socialism to current state. How far are these countries from a pure capitalist state and do they still bear some (economic) elements of socialism?

The socialist system has been disintegrating since 1989. This period is often referred to as the transition from socialism to capitalism and is characterized by some specific features, qualitative and quantitative, different from those observed in pure socialist or pure capitalist social systems. At any moment between the start of the process and its end, current social state is not just a mechanical sum of the socialist and capitalist portions. Economy is an important and inevitable component of modern society. Obviously, the isolation of economic behavior from other social phenomena and processes is not entirely feasible. Nevertheless, some quantitative relationships can show a high level of statistical reliability and, thus, be useful for the description of the sophisticated transition process. Moreover, any reliable relation might serve as a framework for quantitative and qualitative analysis and a solid basis for wider discussions and interpretations.

This paper demonstrates that such measured macroeconomic variable as real GDP per capita can be represented as a straight sum of two independent components: socialist and capitalist ones. In other words, one can predict separately the input of socialist and capitalist sub-systems to the overall GDP per capita. Unlike in phase transition processes observed in physics, for example, ice/water transition at $0C^o$, where the behavior of components is pre-determined by mass and energy conservation laws, the transition from socialism to capitalism permits a degree of freedom for both sub-systems. There must be some interaction and coordination between the processes of the socialist system disintegration and the construction of capitalism. Undoubtedly, pleasant features of capitalism attract people still living under the socialist economic rules of income earning; we consider personal income distribution as one of the most important, but likely not the only, process defining the difference between the economic systems; and force them to "jump off the cliff" into free market. On the other hand, some cumulated social guarantees and benefits provided by the old socialist system often prevail, and some people are very reluctant to drop out of the system of social care. Therefore, one can expect different types of individual and social behavior. Quantitatively, there is an absolute barrier between the systems in a given country: the number of people who have left the socialist system must not be *less* than the number of people who have entered the capitalist one. Our model obeys this "conservation" law.

The understanding of specific features and relationships created by the (unique in the history of the mankind) process of the socialism/capitalism economic transition is a big challenge to economics as a science. One has to describe the observed processes and to introduce new terms and relationships, when necessary. The principal question is - Whether it is possible to quantitatively predict the evolution of measured macro-variables during the transition process, i.e. to express the evolution in a functional form, or whether the transition is fully stochastic and can be described only in statistical terms?

The main goal of this study is to develop a quantitative model of the transition based on simple assumptions about the economic state during the transition period, and to predict the behavior of real GDP per capita during the last 20 years and in the future. Apparently, the transition period in many former socialist countries (FSC) has been not completed. We use data from major, and likely reliable, statistical agencies and databases, which provide original measurement of population and GDP.

The transition process has attracted attention of many economists and practitioners from the very beginning. In 1992, Brada and King [Brada, King, (1992)] argued that Czechoslovakia, Hungary, and Poland did not demonstrate commonly expected J-curve phenomenon, as induced by the initial decrease in economic performance and following gradual improvement due to the growth of the new system. They explained contemporary economic behavior by exogenous shocks to the balance of trade, to investments and to autonomous consumption. We think that this conclusion was premature and all FSC have demonstrated the J-curve behavior with a varying depth of the downturn.

Bezemer with co-authors [Bezemer, Dulleck, Frijters, (2003)] simulated the performance of the socialist and capitalist economic system using the difference in creation and destruction of contacts. Their general equilibrium model described the development of the technological gap between two systems and the transition process to capitalism. The authors also discussed how insider privatization and a civil society may impact on transition paths. The impact of foreign direct investment in post-communist society on economic performance was investigated by King [Kitov, (2005)] on the example of Hungary. Biegelbauer [Biegelbauer, (1996)] suggested some measures aimed at proper usage of industrial R&D for full realization of economic potential of Hungary. In general, we do agree that transition paths differ between the former socialist countries and this effect can be related to various exogenous and endogenous forces. However, we would like to stress again that no of these forces can disturb the form of defining equations, only relevant coefficients are different.

Hoelscher (2006) studied the evolution of income distribution and inequality during the transition change from socialism to capitalism and its effect on the overall performance. The following countries had been chosen: the Czech Republic, Hungary, Poland, and Russia with Germany taken as a benchmark. For the former three countries, income distribution remained relatively stable before and throughout the transition. Russia is characterized by a sharp increase in income inequality. In view of the importance of income distribution for the definition of economic system claimed above, this observation is in overall agreement with the behavior of real GDP per capita. Russia has been suffering a much deeper GDP downturn and a larger change in income distribution than that observed in Central European countries.

We have developed a microeconomic model for personal income distribution in developed countries and its evolution over time [Kitov, (2005)]. When aggregated over the population above 15 years of age, the model transforms into a macroeconomic model describing evolution of GDP and per capita GDP. The macroeconomic model characterizes the capitalist system which has no artificial limit to personal income. The limitation on personal income is a characteristic feature of socialist economic system and might indicate the source of its relatively lower GDP growth rate compared to that in the capitalist system [Kitov, (2006)].

Nonlinear dynamic analysis carried out in [Barkley Rosser, Vcherashnaya Rosser, (2004)] partially describes several episodes of discontinuity and turbulence during the transition process. We also observe some deviations of actual GDP trajectories from those predicted by our model. Apparently, these discrepancies need quantitative and qualitative explanation in a wider economic and social context. However, the deviations are measured relative to the predicted curves and it is the model what provides a reference. On the over hand, no model can pretend to exact prediction. The purpose of any model is to reduce the discrepancy to the lowermost possible level.

In this paper, we develop and validate a quantitative self-consistent model of the transition from a socialist to capitalist economic system. The model is comprehensive and describes the evolution of only one measured macroeconomic variable – real GDP per capita. Accordingly, at the given level of aggregation, the model disregards the influence of any other micro and macro- economic parameters: financial, institutional, social, demographic, and any other type of forces and/or processes on the evolution of GDP. However, empirical coefficients obtained during the modelling are country-dependent. This allows further interpretation of the coefficients as related to the parameters and processes. The functional form of the model, i.e. the set of defining equations, is the same for all former socialist countries. The development and validation of these equations is the principal target. Therefore, any interpretation of relevant coefficient in terms not related to the model is avoided. Nevertheless, we permit some brief discussion of the most prominent differences between the coefficients.

2. Per capita GDP in the former socialist countries between 1950 and 2007

There is a question one can promptly formulate about economic efficiency of the socialist system during the period of existence: What was the average rate of economic growth in these countries compared to that in the most successful capitalist countries? In order to simplify such analysis and to avoid potential geographic effects, only European developed countries and the United States are used in this comparison. Figure 1 displays mean growth rates of real GDP per capita for the period between 1951 and 1989. Original GDP data were obtained from the Conference Board [The Conference Board, (2008)] and are represented by PPP estimates in 1990 (Gary-Khamis) dollars. The complete set of annual GDP readings spans the period from 1950 to 2007 for the OECD members and some former socialist countries. Hence, the start date for the growth rate readings is 1951. The end of the averaging period is chosen to separate two principally different periods - the socialist period and the transition to capitalism. This is not an exact date, however. When modelling, we derive the start date of the transition numerically and use for each country separately. Therefore, the year of 1989 is a watershed between two epochs. We also constrain the comparison to continuous observations only and do not consider the countries with any data gaps between 1950 and 1989. As a result, the U.S.S.R, Poland, Hungary, Czechoslovakia, Bulgaria, Yugoslavia, and Romania are the only countries qualified for the analysis.

At first glance, the former socialist countries demonstrated relatively high rates of growth in real GDP per capita. The average rate of growth in the FSC is measured between 2% and 4% per year and lies (except for Poland and the U.S.SR) slightly above that in the most developed countries such as the U.S., Switzerland, the UK, etc. On the other hand, the average growth rate in less successful (in terms of per capita GDP) capitalist counties such as Greece, Spain, and Portugal exceeds 4% and is clearly higher than that in the FSC. This observation supports the concept of economic trend we developed in [Kitov, (2009); Kitov, Kitov, Dolinskaya, (2009)] and briefly discuss in Section 3: the larger real GDP per capita the lower the level of economic trend. Thus, the concept implies that the rate of growth in the FSC was consistently lower than that expected from real GDP per capita in these countries from 1950 to 1989. In other words, the socialist countries heavily underperformed compared to capitalist countries in the same range of GDP per capita. A sad side of this underperformance consists in the permanence of the lag behind and the impossibility to catch up developed countries. The opportunity of high growth rate, as related to low GDP per capita, has been completely misused. In any case, the transition to capitalism plays a positive economic role: when all traces of socialism as an economic system are completely removed from a given economy it has a chance to retain the cumulated lag (the difference in real GDP per capita) behind developed countries. Otherwise, the gap would have been increasing.

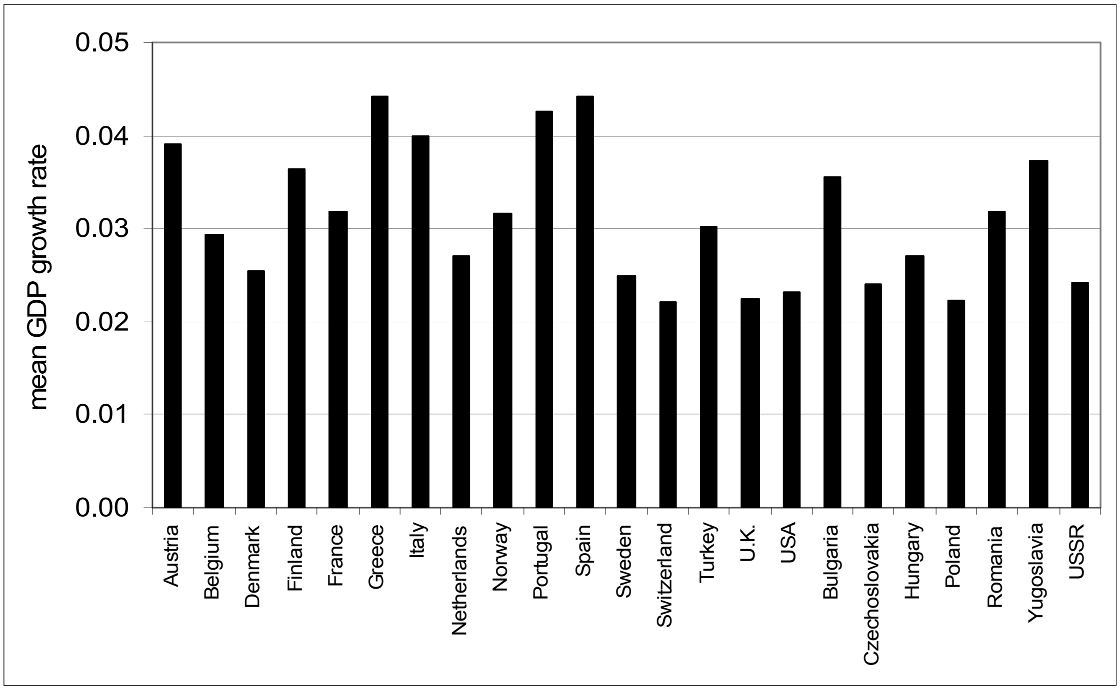


Figure 1. Average growth rate of real GDP per capita in some developed counties and the FSC for the period from 1951 to 1989. Greece, Portugal, and Spain have the highest average growth rate (Ireland is not presented). The rates in the FSC match the level in the countries with the highest GDP per capita.

Figure 2 displays the evolution of real GDP per capita in the FSC in comparison with the U.S., Japan, and Greece. During the entire period from 1950 to 2007, the FSC had GDP well below that in the U.S. in 1950. Greece represents a country which has been developing along the capitalist path but with some temporary difficulties, i.e. underperformed during extended periods. Except in the 2000s, the rate of economic growth in Greece was not high enough even to retain the absolute lag behind the U.S. In Section 4, we use the estimates of GDP per capita shown in Figure 2 in modelling the transition period. One can easily recognize J-curves after 1989 in the FSC.

By definition, the GDP per capita is determined as total GDP divided by total population. Because only people of 16 and above years of age contribute to the GDP or counted by official statistics as such, the per capita GDP has to be corrected for the ratio of the population above 15 years of age to the total population. This correction was of high importance for the analysis of the evolution of GDP in the U.S. [Kitov, (2009)]. In many countries, relevant population data are not available, however. Therefore, the per capita estimates based on total population are used instead. This substitution may result in a slightly biased prediction of the growth rate.

The underperformance of the FSC during the socialist era is obvious if we consider the relationship between the growth rate of real GDP per capita and the attained level of GDP per capita. From this observation, the following question arises:

What is the maximum theoretical rate of GDP growth that one could expect in the FSC if they would have been developing as capitalist countries?

Or:

How much did they lose during the socialist years?

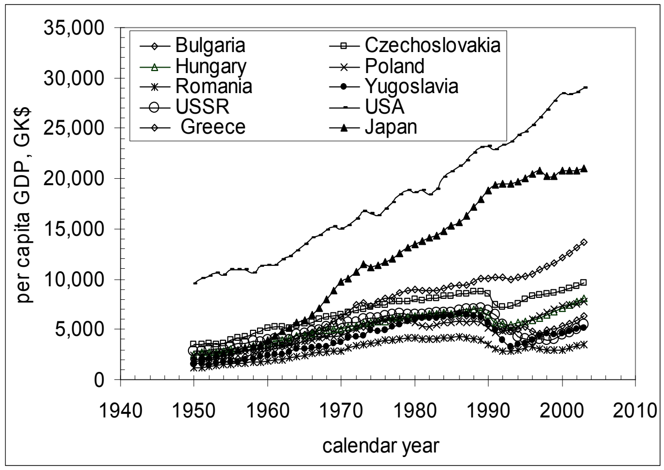


Figure 2. Evolution of real GDP per capita in the FSC in comparison with that in the U.S., Japan, and Greece for the period from 1950 to 2007. The absolute gap between the U.S. and other countries (except Japan) has been increasing over time and demonstrating a more efficient economy in the U.S.

3. Macroeconomic model for the evolution of capitalist system

The growth rate of real GDP per capita can be accurately represented as a sum of two components – a monotonically decreasing economic trend and random fluctuations related to the change in the number of people of some country-specific age [Kitov, (2006)]. The economic trend is modeled by an inverse function of real GDP per capita with a constant (but varying among countries) numerator for the largest developed economies. A through statistical analysis for the period between 1950 and 2004 has shown a negligible linear trend, both positive and negative, in the annual increment of GDP per capita for the largest economies: the U.S., Japan, France, Italy, and Spain [Kitov, Kitov, Dolinskaya, (2009)]. The fluctuations around these trends are characterized by a quasi-normal distribution with potentially Levy distribution for far tails.

Accordingly, the growth rate of real GDP per capita in the U.S. is defined by the following relationship:

$$dG(t)/(G(t)\cdot dt) = A/G(t) + 0.5dN_9(t)/(N_9(t)\cdot dt) \quad (1)$$

where $dG(t)/(G(t)\cdot dt)$ is the growth rate of real GDP per capita, A is an empirical constant, which is country-specific for developed economies, $N_9(t)$ is the number of 9-year-olds, which is the defining age for economic growth in the U.S.. As a consequence, the population independent economic trend, q(t), is numerically equal to the reciprocal value of the GDP per capita:

$$q(t) = A/G(t) \quad (2)$$

Figure 3 depicts the evolution of the annual increment (left panel) and growth rate (right panel) of real GDP per capita in the U.S. between 1960 and 2007 as a function of GDP per capita. This is a natural representation for Eq. (1) because both variables (the increment and the rate) depend only on GDP per capita and the number of 9-year-olds. In developed countries, the latter has a zero cumulative input in the long run. Relevant population data were obtained from the Census Bureau [U.S. Census Bureau, (2004), (2007)]. The correction for the population above 15 years of age discussed above was also applied to the original per capita GDP data.

In the left panel, there are drawn two linear regression lines associated with two different sets of annual increments. First set is the original one. Second set is the original one but corrected for the input of 9-year-olds. The regression line for the original curve is characterized by a relatively high positive slope=+0.014. This slope indicates that the annual increment increases with increasing GDP per capita. For the corrected curve, the regression line drops to a practically horizontal position:

slope=+0.003. This observation supports our finding that economic trend is defined only by real GDP per capita.

The original GDP time series has the average annual increment $420 (1990$). After the correction for the number of 9-year-olds, the mean increment falls to $397. Thus, the cumulative input from the change in the number of 9-year-olds is approximately 5% of that provided by economic trend, A/G. Obviously, one can neglect the second term and assume that in the long run the growth rate of GDP is defined only by economic trend, with A=$370. Corresponding curves are presented in the right panel of Figure 3.

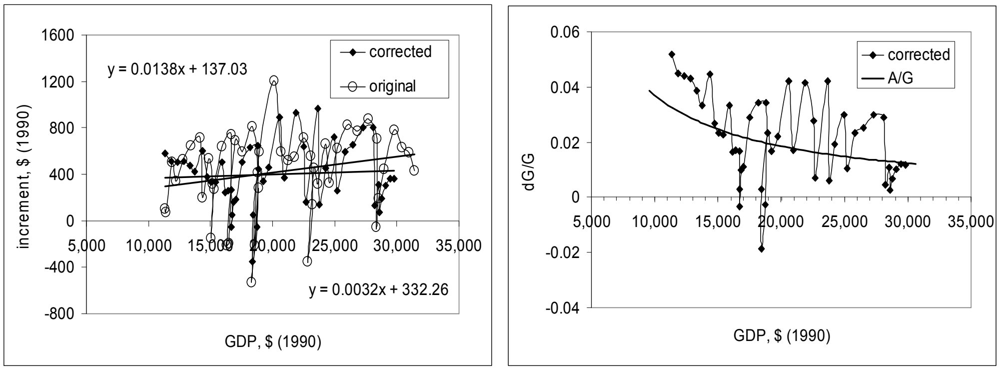


Figure 3. The evolution of real GDP per capita: left panel - annual increment; right panel – growth rate. The original data are corrected for the number of 9-year-olds and presented in both panels. Linear regression of the corrected annual increments demonstrates just a slight slope of +0.003, unlike the original readings. The growth rate of the corrected time series in the right panel is shown together with A/G, where A=$370.

Equation (1) defines the growth of GDP per capita in developed countries or, equivalently, in capitalist economies. Therefore, during the transition from socialism to capitalism, the capitalist sub-system should evolve according to (1). Continental Europe is characterized by defining age of 18 years, not 9 years as in the U.S. and UK [Kitov, (2006)]. Because the transition period is relatively short, one do not expect any dramatic change in the defining age population and, thus, can neglect the input from second term in (1) without any significant loss of accuracy. Moreover, from the start of the transition, real GDP per capita has been changing in a narrow range around its initial value in a given country. Hence, the economic trend, A/G, can be approximated by constant rate. Then, the growth of GDP in the capitalist sub-system can be approximated by an exponential function.

In the framework of micro-/macroeconomic interaction, there is a strict relationship between the efforts to increase personal income (and, thus, gross domestic income, as represented by the sum of all personal incomes) and the rate of the GDI growth [Kitov, (2005), (2006)]. It is likely that the development of the socialist economic system is in many aspects similar to that of the capitalist system. There is a fundamental difference, however. Personal incomes in the socialist system have an upper limit and people with the highest possible incomes contribute less to the GDP than they would be able to contribute under capitalism. The overall income deficiency arising from this upper income limit is estimated as 15% of GDP [Kitov, (2005)]. This deficiency has resulted in a slower economic growth and the increasing lag behind the developed countries from 1950 to 1989. So, the transition from capitalism to socialism is the transition from a lowered to normal economic growth.

Due to the uncertainty in the level of personal income suppression, the modelling of the growth in the socialist system is a sophisticated problem. From Figure 2, one could assume that the FSC had been growing at a lower rate than that in developed countries. Moreover, there was no visible sign of an exponential growth between 1950 and 1989 - a straight line would be a better interpolation for the socialist curves. The main task of this paper is a slightly simpler one - to model the free fall of the socialist system. Apparently, the disintegration of socialism in the FSC is a very intensive process compared to the inherent growth, which is likely to disappear after the start of the transition. One can easily neglect the input from the internal growth during the transition.

4. Modelling the evolution of real GDP per capita during the transition

We presume that the FSC stepped into the transition period between 1989 and 1991. At this point (corresponding start time t_0), relevant working age population, $N(t_0)$, was entirely in the socialist economic system. In other words, the portion of working age population in the socialist system, $P_s(t_0)$ or P_s^0, was equal to 1.0. After the start of the transition, this portion has been experiencing a free fall and, quantitatively, has been exponentially decaying with some index α_{sp}, which is likely country-specific and has to be determined empirically. In physical terms, the process of disintegration of socialist system is similar to radioactive decay with constant probability: $-dm/m=\lambda$, where m is the total number of radioactive atoms and dm is the number of atoms decayed per unit time. By analogy with physics, one can describe the process of "depopulation" of the socialist system using a simple relationship: $N(t)P_s(t)=N(t)P_s^0\exp(-\alpha_{sp}t)$, where $N(t)P_s(t)$ is the number of people left in the socialist system at elapsed time t.

There is a process of the decrease in GDP per capita (mean income), $A_s(t)$, in the socialist system accompanying the depopulation. We also assume that the capability to earn money for all people left in the socialist system drops to zero at t_0 and, according to [Kitov, (2005)], the mean income starts a free fall from its initial value $A_s(t_0)=A_s^0$. This process is similar to cooling of a preheated solid body and is described by an exponential function with index α_{si}: $A_s(t)=A_s^0\exp(-\alpha_{si}t)$. As a result, the input of the socialist economic system in the total GDP in a given country during the transition period is $N(t)P_s(t)A_s(t)$. Since both processes are represented by an exponential decay, one can replace two indices α_{sp} and α_{si} with one: $\alpha_{sp}+\alpha_{si}=\alpha_s$. Thus,

$$N(t)P_s(t)A_s(t) = N(t)P_s^0A_s^0\exp(-\alpha_s t). \quad (3)$$

The capitalist system starts with a zero portion in the working age population, $P_c(t_0)=P_c^0=0$. One can consider the case of a nonzero P_c^0. Then, P_s^0 is less than 1.0, and both portions should make a unit: $P_s^0+P_c^0=1.0$. We neglect this possibility because the quantitative results of our modelling do not demonstrated any necessity of additional parameters, but we retain relevant terms in the equations derived below. With the first person leaving the socialist system, there is a nonzero probability, α_c, for her or him to join the emerging capitalist system. This probability is also presumed to be constant for the population out of the capitalist system and differs from that to leave the socialist system, α_{sp}. Moreover, the sum of α_c and α_{sp} is not equal to 1. One might stay out of both available economic systems for some time. Such persons also create a reserve for joining the capitalist system. The number of people, dn, entering the capitalist system per year is proportional with coefficient α_c to the number of people out of the capitalist system so far, $n(t)=N(t)(1-P_c(t))$: $dn=\alpha_c \cdot n(t)$**;** or $dn/n=\alpha_c$. Over time, more and more people join the capitalist system and less people retain positions in the socialist system or in the reserve. The evolution of the portion of population in the capitalist system can be described (in general case, when $P_c^0\neq0$) as a satiation process:

$$P_c(t) = P_c^0 + (1 - P_c^0)(1 - \exp(-\alpha_c t)) \quad (4)$$

Opposite to the free fall of GDP per capita in the socialist system, the capitalist system undergoes an intensive growth. As discussed in Section 3, for a relatively short period of the transition, one can use a constant rate of growth, α, instead of the decelerating one, as defined by Eq. (2). This constant rate defines an exponentially growing GDP per capita, $A_c(t)=A_c^0\exp(\alpha t)$, where constant A_c^0 is the initial value of real GDP per capita in the emerging capitalist system. The model assumes that $A_c^0=A_s^0$. Simplistic intuition behind this assumption is as follows. In the very beginning of the transition, the same people work at the same physical places and their products have the same initial price as before in the socialist system. In other words, the start point of the capitalist growth is the level attained by the socialist economic system. This equality implies the normalization of real GDP per capita to A_s^0. This makes a dimensionless model of the evolution of GDP per capita in a given country, with A_s^0 as a unit of measurement.

In average, the input of each and every person in the capitalist sub-system into GDP grows at a country-specific rate. (Figure 2 shows that, in the long run, the upper limit of growth rate (economic trend) of a capitalist economy at a given level of real GDP per capita is likely defined by the rate observed in the U.S., i.e. the growth rate in the is the highest possible.) The first person starts with

GDP per capita equal to A_s^0, and the followers start at the level of real GDP per capita already attained in the capitalist sub-system. Total input of the capitalist system is defined by the following expression:

$$N(t)P_c(t)A_c(t) = N(t)A_c^0 \{P_c^0 + (1 - P_c^0)[1 - \exp(-\alpha_c t)]\}\exp(\alpha t) \qquad (5)$$

Obviously, the input to the GDP per capita of those people who are out of both systems is zero. It does not mean, however, that they have zero income. Better consider them as avoiding formal rules, not real life. There always exist some elements of shadow economy and black market out of any official statistics. The portion of these people, $1-P_c(t)-P_s(t)$, decays over time, with $P_c(t)$ asymptotically approaching unit. In some countries, this portion can be large enough for decades, as our analysis has shown.

By definition, GDP is the sum of three components: the inputs from the socialist system, the capitalist system and the shadow economy:

$$GDP(t) = N(t)\cdot A_c^0\cdot\{P_c^0 + (1 - P_c^0)\cdot[1 - \exp(-\alpha_c t)]\}\cdot\exp(\alpha t) + \\ + P_s^0\cdot A_s^0\cdot\exp(-\alpha_s t) + 0\cdot(1- P_c(t) - P_s(t))\} \qquad (6)$$

Dividing both sides in (6) by N(t) and A_s^0, one obtains real GDP per capita normalized to its initial value, $M(t)=GDP(t)/(A_s^0N(t))$, i.e. a dimensionless variable. Finally, the complete set of defining equations describing the evolution of GDP per capita during the transition from socialism to capitalism is as follows:

$$M(t) = M_s(t) + M_c(t) \qquad (7)$$
$$M_s(t) = P_s^0\exp(-\alpha_s t)$$
$$M_c(t) = \{P_c^0 + (1 - P_c^0)[1- \exp(-\alpha_c t)]\}\exp(\alpha t)$$

where $M_s(t)$ and $M_c(t)$ are dimensionless GDP per capita in the socialist and capitalist sub-system, respectively.

According to (7), the evolution of GDP per capita during the transition is completely defined by three parameters: α_s, α_c, and α. Initial values, $P_s^0=1$ and $P_c^0=0$, are the same for all the FSC, and because of the normalization: $M_s^0=1$ and $M_c^0=0$. Therefore, the modelling consists in the estimation of best-fit values of the defining parameters using actual data. Approximate values can be determined by a standard or trail-and-error process with visual fir: the parameters are varied in some reasonable range before the best visual fit between observed and predicted time histories of M(t) is achieved. We did not apply any formal statistical procedure, but only the visual fit, because the latter usually provides accuracy compared to that associated with the RMS technique. Our principal goal is not to find the exact values of the defining parameters, but to demonstrate the consistency of the functional form of the model.

Figure 4 illustrates some results of the matching procedure, as applied to Russia. The starting point of the transition is 1991, when the largest republics of the Former Soviet Union announced their independence and initiated a new economic policy aimed at the construction of capitalism. The Conference Board [6] provides relevant measurements of per capita GDP for the studied period. In the left panel, the initial portion of the socialist system $P_s(1991)=1.0$, i.e. no elements of capitalism had been permitted in Russia before 1991: $P_c(1991)=0.0$. The best-fit model is characterised by the following defining parameters: $\alpha_s=0.24$, $\alpha_c=0.066$, $\alpha=0.033$. The index α_s is relatively low compared to that in Central European countries, and the portion of population in the socialist system decays relatively slow. In 2005, the portion was approximately 2%. There was a large segment of socialist economy in the mid 1990s, however, when the sharpest economic decrease was observed.

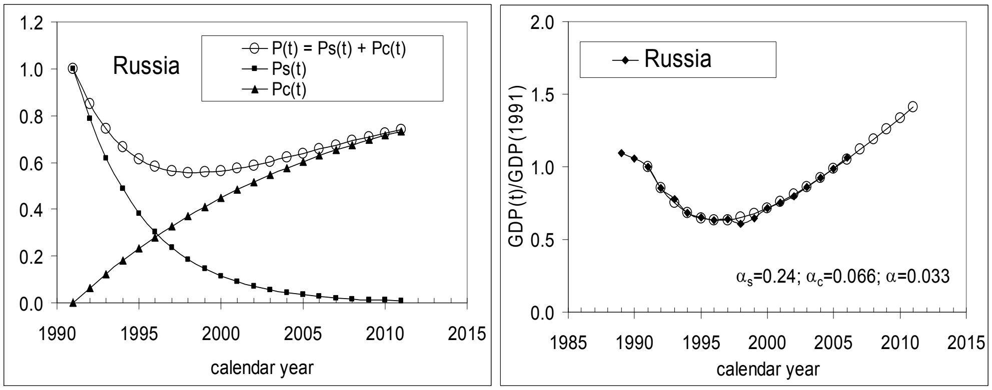


Figure 4.

Left panel: The evolution of GDP per capita, M(t), in Russia since 1991. There are two portions of the overall GDP per capita – socialist, $M_s(t)$, and capitalist, $M_c(t)$. The number of people leaving the socialist systems at is proportional to the portion of total population left in the socialist system, $P_s(t)$. The input of the capitalist system, $M_c(t)$, grows proportionally to the portion of total population in this system, $P_c(t)$. There are many people neither in the capitalist nor in the socialist system: P_s+P_c is less than 1.0. In 2005, approximately 2% of the total population was still in the socialist system, and the portion of capitalist system, $P_c(t)$, is was 65%. The input of the capitalist system, $M_c(t)$, grows proportionally to the portion of total population in this system, $P_c(t)$.

Right panel: The best-fit parameters are: α_s=0.24, α_c=0.066, and α=0.033. The capitalist system in Russia has been growing since 1991. The predicted trajectory (open circles here and below) is in a good agreement with the observed one (solid diamonds). In 2005, the influx of population in the capitalist system, dP_c/P_c, was 0.022 y^{-1} and the economic trend in the model is always 0.033 y^{-1}. Thus, the growth rate as a whole was 1.022x1.033=1.056 or 5.6%.

The build-up of the capitalist system in Russia is also characterised by a relatively slow rate. The index α_c=0.066 provides only about 65% of the total population to be in the capitalist system 15 years after the start. The residual 33% of the total population are formally included in neither of the main systems. This reservoir is potentially feeding shadow economy or represents unused workforce. The growth rate of the capitalist portion in Russia is currently low (~2% per year) and additional efforts from main political powers are urgently needed to create conditions to enable a third of the total population join the capitalist system of production and distribution. Otherwise, the performance of the Russian economy is highly undermined. The author has no idea about any possible measures, but the model shows that the portion of "non-attributed" population in Russia is one of the largest among the former socialist countries.

The right panel in Figure 4 displays the evolution of the predicted and measured per capita GDP in Russia. A good agreement is observed, given the simplicity of the model and the uncertainty in the PPP estimates of per capita GDP. In general, only relatively smooth and coordinated changes have occurred in the Russian economy since 1991. The transition process has two branches: a downward one (from 1991 to 1998) and an upward one (since 1998). Currently, the economic growth is fuelled by two processes: the internal growth (economic trend) of about 1.033 y^{-1} and the growth of the capitalist portion, P_c, at a rate of about 1.022 y^{-1}, making about 5.6% per year (=1.022x1.033) in 2005. Both factors of growth will be decaying with time. The first one is limited by the attained level of per capita GDP. The limit of the internal growth rate corresponding to the initial per capita GDP in Russia of $7373 in 1991 was 5.1% per year (=$370/$7373, see Section 2). In 2006, the limit was about 4.7%. Hence, even in this element of the overall growth, the Russian economy has been highly underperforming, if to bear in mind the bets-fit economic trend of 3.3 % for all years after 1991. The Russian Federation has some potential to accelerate the growth both by increasing the portion of the capitalist system and by using the entire potential of the capitalist system growth.

The shape of the observed curve and the best-fit parameters reveal some principal features of the transition. The shape clearly corresponds to J-curve behaviour. The curve can be split into three different segments. The transition during the initial period is mainly driven by the fall of sub-socialist system. The input of the capitalist sub-system is relatively small because only few people have joined it. This is the period of “free-fall” defined by index α_s. Hence, the estimation of this index is, chiefly, based on few initial years of the transition. Considering the uncertainty of economic measurements during these turbulent years, the prediction of M(t) for Russia between 1991 and 1995 is excellent.

The rate of decay of the overall GDP per capita would be constant if not the input of the capitalist economy growing in size and productivity. The second segment of the curve reflects the fight of two tendencies – the disintegration of socialism and the growth of capitalism. The depth of economic downturn, i.e. the lowermost level of the M(t), depends on all three defining parameters. However, α_c is more important than α because in (5) the change in the portion of population in the capitalist sub-system is larger than the growth in productivity. Having an estimate of α_s from the first segment, one can obtain a reliable value of α_c. In 1996, the Russian GDP per capita fell to 0.63 of its level in 1991. This would be the bottom of the fall if not the Russian financial crisis in 1998 with the lowermost GDP per capita value of 0.607. The deviation from the predicted curve associated with the crisis was completely recovered in the following two years. Hence, one should consider the year of 1996 as the turning point, where the growth of capitalism overcome the disintegration of socialism in Russia.

The third (open-end) segment of the curve should be dominated, in the long-run, by the internal growth of the capitalist sub-system, i.e. by economic trend. Effectively, the third stage is a pure capitalist growth. But for Russia this stage has not come yet, and the extensive component of growth associated with the increasing portion of population transferred from the reserve is still large. In Central European countries, all processes related to the migration of population from the socialist to capitalist system are finished. One can obtain unbiased estimates of α and compare them to those predicted by Eq. (2), with A=$370. As mentioned above, the economic performance of Russia is far from stellar one and it reached the level of 1991 only in 2006.

Figure 5 displays the observed and predicted time history of GDP per capita in Hungary. The start point is 1990 – one year before that in Russia. The estimates of the defining parameters are as follows: α_s=0.30, α_c=0.17, α=0.026. The evolution of GDP is smooth, as in Russia. The largest, but positive, short deviation from the predicted curve occurred in 1994 and might be associated with the effects of the changes in specific-age population in (1). Hungary reached the bottom in 1993, M(1993)=0.853, and recovered to the pre-transition level of real GDP per capita in 1998, i.e. eight years before Russia. An outstanding feature of the measured curve is the absence of any negative deviation between 1995 and 2000, which is a common observation for other FSC.

Because the indexes α_s and α_c are larger than those for Russia, the evolution of the capitalist and socialist portions is much faster. In 2007, there was nobody in the socialist sub-system in Hungary (its portion was well below 0.5%) and the population in the capitalist systems was around 96%. The population reserve for joining the capitalist sub-system was as small as 4%. Therefore, the observed growth of the Hungarian economy is totally due to the inherent growth of the capitalist economy, as shown in the right panel of Figure 5.

Since 1996, the observed and predicted curves have been in a very good agreement and one can expect the future GDP per capita heading along the predicted line at a rate of 0.026. This is the current economic trend in Hungary, but it will be decelerating in the future according to (2). In 2007, the highest possible rate could be $370/$9488=0.039, or 3.9% per year. Hence, Hungary is also far from the ultimate performance.

The case of Hungary provides a good illustration of the principal importance of each of the defining parameters. The initial and final stages of the transition are driven purely by α_s and α, respectively. In practice, one can obtain their accurate estimates independently. Since the amplitude of the fall is very sensitive to the third parameter, it is also well constraint. In some countries, all three parameters were important during the intermediate stage.

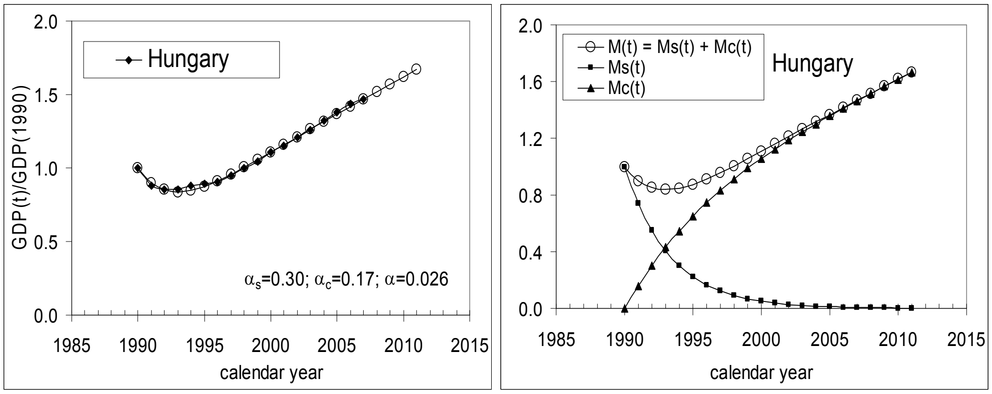


Figure 5.

Left panel: The evolution of GDP per capita, M(t), in Hungary since 1990. The best fit parameters are: α_s=0.30, α_c=0.17, and α=0.026. Currently, the per capita GDP grows at a long-run rate of 2.6% per year.
Right panel: Relative input of the socialist, $M_s(t)$, and capitalist, $M_c(t)$, sub-systems to the overall GDP per capita, M(t) . The economy grows currently due to the inherent development of the capitalist system.

Russia and Hungary represent two different cases of the transition from socialism to capitalism. Hungary demonstrates a shallower sink and a faster economic recovery. From the estimates of the defining indexes, one can conclude that the key parameter for a relative success in the reshaping of economy is the rate α_c, at with the capitalist system is populated. In ideal case, all people leaving the socialist sub-system at a rate α_{sp} should simultaneously join the capitalist economic sub-system, i.e. α_c should be as large as possible.

Both countries show the long-term economic performance below the potential one, as defined by (2) with A=$370. This feature is common among developed countries as well. For example, Spain, Greece and Portugal did not perform well between 1950 and 1990. At the same time, there should be some (political, economic, social, etc.) measures, which can provide additional acceleration to the economies of the FSC. A comparative analysis could reveal relevant toolkits. The size of the gap between the observed and potential rate of growth is a good measure of the performance of national authority. In 2006, Russia performed at 70% (=3.3/4.7) of its potential, and Hungary only at 65% (=2.6/4.0). As discussed below, there are severe problems with the Gary-Khamis PPP values, which make the estimates of performance in some countries unreliable.

We have modelled the transition for all European FSC and those from the Former Soviet Union. There are 27 countries including two virtual ones – the U.S.SR and Czechoslovakia, as published by the Conference Board. Each of the countries deserves a special and detailed examination. The purpose of this paper is a narrow one and we intentionally avoid any extended discussion of specific circumstances and external factors affecting the values of defining parameters. So, we are constrained to empirical and theoretical estimates and time histories of the observed and predicted GDP per capita. A complete list of the estimates is presented in Table 1. It allows a sound cross-country comparison in the framework of our concept of the transition, as depicted in Figures 6 though 8. Figure 9 illustrates the uncertainty associated with the modelling of GDP per capita.

Table 1 lists the following estimates for each of 27 countries: GDP per capita in 2006 (GK PPP); theoretical ceiling, α_t=$370/G(2006), of the long-term growth rate in 2006; empirical estimates of α_s, α_c, and α; ratio α_s/α_c, which define the duration of the disintegration and the depth of the fall; ratio α/α_t, which shows the level of economic performance relative to that in the U.S.. The FSC are ordered alphabetically.

Table 1. Empirical and theoretical indexes, as obtained for the Former Socialist Countries

Country	G(2006), $	αt =$370/G	αs	αc	α	αc/αs	α/αt
Albania	3658	0.101	0.73	0.280	0.030	0.384	0.297
Armenia	9554	0.039	0.70	0.180	0.037	0.257	0.956
Azerbaijan	7810	0.047	0.38	0.046	0.057	0.121	1.204

Belarus	10481	0.035	0.24	0.080	0.048	0.333	1.360
Bulgaria	7780	0.048	0.29	0.140	0.025	0.483	0.526
Croatia	8279	0.045	0.45	0.160	0.015	0.356	0.336
Czechoslovakia	11458	0.032	0.50	0.310	0.017	0.620	0.527
The Czech Rep.	11681	0.032	0.45	0.290	0.017	0.644	0.537
Estonia	20762	0.018	0.40	0.200	0.050	0.500	2.807
Georgia	5180	0.071	0.75	0.090	0.025	0.120	0.350
Hungary	9300	0.040	0.30	0.170	0.026	0.567	0.654
Kazakhstan	9849	0.038	0.22	0.046	0.057	0.209	1.518
Kyrgyzstan	2498	0.148	0.37	0.105	0.000	0.284	0.000
Latvia	13514	0.027	0.55	0.160	0.030	0.291	1.096
Lithuania	10361	0.036	0.45	0.135	0.025	0.300	0.700
Macedonia	3634	0.102	0.17	0.051	0.030	0.300	0.295
Moldova	3180	0.116	0.28	0.028	0.021	0.100	0.181
Poland	9028	0.041	0.39	0.230	0.030	0.590	0.732
Romania	4305	0.086	0.30	0.120	0.030	0.400	0.349
Russia	7824	0.047	0.24	0.066	0.033	0.275	0.698
Slovakia	11037	0.034	0.50	0.270	0.019	0.540	0.567
Slovenia	16364	0.023	0.30	0.165	0.020	0.550	0.885
Tajikistan	1379	0.268	0.45	0.043	0.005	0.096	0.019
Turkmenistan	2792	0.132	0.28	0.070	0.017	0.250	0.128
Ukraine	4480	0.083	0.24	0.030	0.057	0.125	0.691
Uzbekistan	4433	0.083	0.31	0.150	0.006	0.484	0.072
U.S.S.R	6025	0.061	0.24	0.060	0.0365	0.250	0.595

In 2006, the largest GDP per capita, $20762, was measured in Estonia, and the lowest, $1379, in Tajikistan. The Estonian estimate seems to be a highly biased. The estimate of GDP per capita in 2007 dollars, also provided by the Conference Board, is only $19927, i.e. less than in 1990 dollars. This is a clear mistake and a good example of low reliability of PPP estimates *per ce*, and specifically, in the countries without long history of accurate measurements. In this paper, we do not pay any additional attention to problems in the PPP estimates, but bear in mind that striking outliers are possible.

The largest α_s=0.75 and the first place for the quickest disintegration of socialism belongs to Georgia. The smallest disintegration process with α_s=0.17, has been observed in Macedonia. Kazakhstan is characterized by α_s=0.22. Belarus, Russia and Ukraine are similar with α_s=0.24. At the highest rate, population has been joining capitalist sub-system in the Czech Republic (α_c=0.29), Albania (0.28), Slovakia (0.27), and Poland (0.23). (We omit the case of Czechoslovakia with α_c=0.31 as a virtual country.) Moldova (α_c=0.028) and Ukraine (α_c=0.030) lead the list of the most capitalism-resistant countries. Kazakhstan, Belarus and Russia again demonstrate low rates of the growth of capitalism: α_c=0.046, 0.080 and 0.066, respectively. Tajikistan, Azerbaijan and Turkmenistan join the club. Figure 6 displays a scatter plot α_s vs. α_c. There is one distinct outlier- Georgia. Other countries follow a linear trend, not prominent, however.

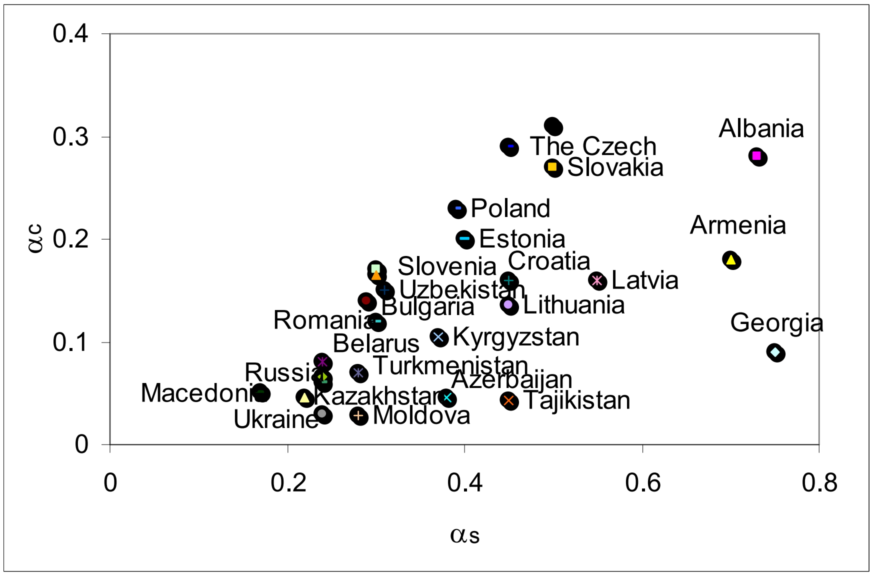


Figure 6. Scatter plot: α_c vs. α_s in the former socialist countries

As mentioned above, the depth of trough in the J-curve is correlated with the ratio α_s/α_c. The larger is the ratio the shallower is the trough. Central European countries are characterized by high ratios – between 0.644 in the Czech Republic and 0.30 in Macedonia. Estonia and Uzbekistan with α_s/α_c=0.5 and 0.48, respectively, are in the middle of the distribution for Central European countries. Many countries of the Former Soviet Union, including Latvia and Lithuania, create a cluster around 0.3. Tajikistan and Moldova demonstrate very low ratios around 0.1.

Figure 7 presents (solid diamonds) the observed dependence of the depth of trough, $d=1-\min_t(G(t)/G(t_0))$, on α_c/α_s, where $\min_t(G(t)/G(t_0))$ is the bottom level of the $G(t)/G(t_0)$-curve during the transition. There is a reliable logarithmic regression $d=-0.27\ln(\alpha_c/\alpha_s)-0.037$, with $R^2=0.95$. Theoretical dependence $d=f(\alpha_c/\alpha_s)$ (with $\alpha=0$) is shown by open circles and has a very close regression $d=-0.28\ln(\alpha_c/\alpha_s)-0.044$. The actual dependence is slightly biased by the input of the internal growth of capitalism associated with nonzero α, and apparently, neither actual nor theoretical dependence is a logarithmic one. The depth of trough approaches zero, when the satiation index, α_c, reaches the disintegration one, α_s, i.e. $d\to0$, when $\to\to1$. For the conservation of total population, ratio α_c/α_s can not be more than 1, i.e. the number of people who joining capitalism can not exceed the number of people leaving the socialist sub-system. Obviously, when $\alpha_c/\alpha_s\to0$, $d\to1$.

In any case, the behaviour of the depth as a function of α_c/α_s is mathematically trivial. But the existence of a robust relation between the depth and the ratio in real transition from socialism to capitalism is a fundamental finding. One could reach a zero-depth trough with α_c/α_s around 1. This mathematical fact has not only pure theoretical and historical significance, but also of a large importance for current and future practices. Responsible authorities must minimize the depth of trough in any transition process by retaining the ratio of the rates of disintegration of old and creation of new system near 1. It is an obvious target during large-scale economic and social reforms and the process of modernization, which are often associated with displacement of large portions of population. It might be useful for developing countries as well.

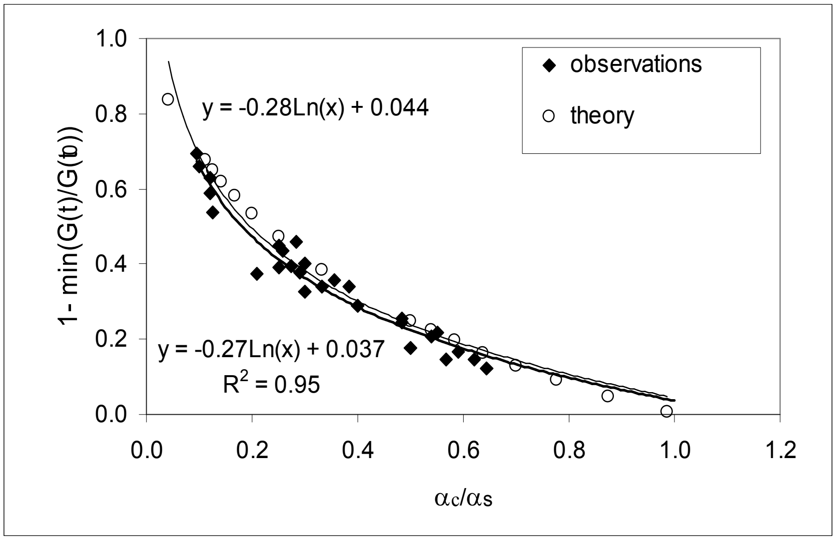


Figure 7. The depth of trough, 1-$min_t(G(t)/G(t_0))$, as a function of α_c/α_s.

Figure 8 compares economic trends: the estimated from the GDP data for the FSC and that predicted according to (2) with A=$370. The latter trend can be called theoretical one and is related to the trend observed in the U.S. at the same level of GDP per capita. In a sense, this trend is the maximum possible because no other (large) developed country has demonstrated a larger trend in the long-run. The example of Japan (see Figure 2) shows that the countries with a very high mid-term growth rate usually end-up in a long period of weak growth. (Ireland represents a small economy with strong dependence on the demand from neighboring countries, but it likely will not avoid the faith of Japan.)

The distance from the theoretical economic trend, i.e. the line $370/$G_{U.S.}(t)$ drawn through actual GDP per capita data, is a good measure of success or failure of a given economy to catch up the All countries above the line are exceptionally successful: Kazakhstan (1.52), Belarus (1.36), Azerbaijan (1.20), and Latvia (1.10). The case of Estonia with an extremely large ratio α/α_t=2.8 is not reliable. Armenia has α/α_t=0.96, which is by all means very high. There is some doubt, however, that GDP per capita in Armenia was around $9500 in 2006, i.e. more than in Hungary. This case also needs to be investigated regarding the accuracy of PPP estimation.

The worst performance of the capitalist sub-system is demonstrated by Kyrgyzstan (0.000 - no internal growth!), Tajikistan (0.02), Turkmenistan (0.07), Uzbekistan (0.13) and Moldova (0.18). Effectively, there has been no growth of capitalist sub-systems in these countries and economic growth was related to the increasing portion of population. Central European countries demonstrate α/α_t between 0.5 and 0.88 (Slovenia), except Macedonia (0.30), Croatia (0.34) and Romania (0.35).

All in all, there are two distinct clusters. Successful countries demonstrate economic growth at rates close to the maximum one. For these countries, the gap with the does not increase fast. Moreover, due to the difference in the attained level of GDP per capita, it seems that these countries are catching up. But the logic of real economic growth expressed in Eq. (1), requires higher rates for a non-increasing long-run gap, as discussed in Section 5. GDP per capita in other FSC such as Kyrgyzstan, Tajikistan and Moldova, lags behind that in the U.S. at a progressive rate. In the case of normal capitalist evolution, i.e. in the absence of worldwide catastrophes, all FSC will never catch up the U.S. and other developed countries due to severe underperformance during the socialist years.

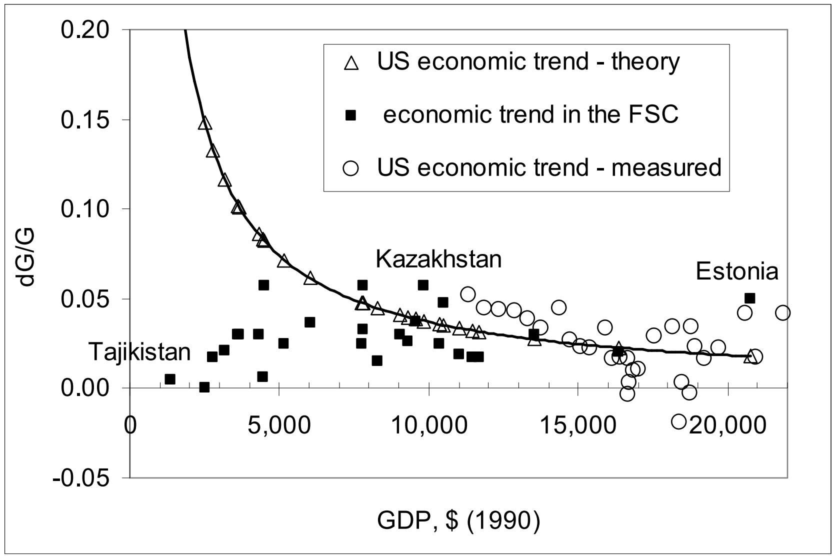


Figure 8. Comparison of the estimated (Eq. 7) and predicted (Eq. 2) economic trends in the Former Socialist Countries.

Each and every FSC has own bleeding history of struggling through socialism. Each of them deserves detailed historiography of all aspect related to the struggle, including those associated with economic development. In terms of industrial production and fast increase in quality and nomenclature of services, the transition to capitalism was an unambiguous blessing for all of them. There were different trajectories, however, and the transition process has not finished yet in many countries. Therefore, we decided to present all time histories of real GDP per capita and that predicted by our model. Figure 9 displays in alphabetic order 25 panels with relevant curves. In addition to the recognition of difficult history one can observe the discrepancy between measured and predicted trajectories and to assess the uncertainty related to the model. We do not discuss all FSC in this paper, however, and focus only on some examples, which illustrate important and exotic features of the transition.

Albania demonstrates a very high rate of disintegration with α_s=0.73. Accordingly, the first year of the transition (1991) is characterized by an enormous fall in GDP per capita - from 1.0 to 0.72. Fortunately, the mechanism of compensation expressed in an intensive growth of capitalism with α_c=0.28 limited the period of fall to two years. A positive growth rate was observed in 1993. Hence, the transition to capitalism was as quick as possible with a relatively shallow through of 0.31 (α_c/α_s=0.384): in 1999, the Albanian economy reached the level of 1990. There was a jerk in 1997, with the GDP per capita dropped from 0.942 to 0.836. Such sharp negative changes are a common feature for the FSC, as Figure 9 evidences. Albania would reach the level of 1990 two years earlier if not this sudden step down. After the downturn, the economy has been evolving at a rate of approximately 3.5% per year, almost in parallel to the predicted curve with α=0.03. Considering the level of GDP per capita, one could expect the rate of growth near 10% per year. Therefore, Albania did build up a capitalist system, but not a very effective version.

Armenia started the disintegration in 1991 and dropped down to G(1992)/G(1991)=0.59 during the first year because of α_s=0.70 and α_c=0.18, similar to those in Albania. However, the evolution of GDP per capita is characterized by large deviations from that predicted by our model. There are two major bends in the curve – in 1996 and 2000. The former is a negative deviation and the latter is a positive one. The modelled long-term economic trend in Armenia is 3.7% per year. The changes in the observed curve are too large to determine true economic trend. One needs long-term observations. As mentioned above, the level of GDP per capita in Armenia seems to be highly overestimated.

The model demonstrates an excellent predictive power for Azerbaijan: all solid diamonds are inside open circles between 1991 and 2004. The oil price boom has given an outstanding chance to all oil exporting countries and the growth rate in Azerbaijan between 2005 and 2007 was extremely high.

It has manifested in a strong deviation from the predicted curve. In 2008, the price dropped to the level of 2005, partially because of the recession in the U.S. [National Bureau of Economic Research, (2008)]. One can expect the actual curve will bend back to the predicted one, as Azerbaijan is a mono-product economy. Otherwise, the evolution of economy is standard for the FSU. The disintegration has been relatively fast with α_s=0.38, but the rate of capitalism development was extremely low α_c=0.046. So, many people are still joining the capitalist sub-system in Azerbaijan. The depth of economic fall was very large: G(1995)/G(1991)=0.41. The rate on internal growth of the economy is high, α=0.057, and even larger than the maximum possible of 0.047. Due to the influx of population from the reserve into the capitalist sub-system at a rate of 3% per year, the measured rate of economic growth in Azerbaijan is around 8% per year. Despite these two factors the level of 1991 was reached only in 2004.

All in all, the Belarusian economy follows the predicted curve with only small and short-term deviations. It presents a typical case of a slow capitalism build up. Because of a higher degree of diversification of national economy and the absence of gas and oil fields, Belarus had no peaks and troughs in real growth. It is expected that it will be growing at an average rate of 4% to 5% during the next decade.

Bulgaria and Romania have similar defining parameters and are characterized by the smallest GDP per capita among the countries joined the EU. The expected growth rate of the capitalist in 2006 was 4.8% and 8.6%, respectively. Actual trend values (see Table 1) were 2.5% for Bulgaria and 3.0% in Romania. Thus, Bulgaria and Romania really struggle to use all advantages of the capitalist growth.

As expected, the Czech Republic and Slovakia are close in defining parameters. Slovakia has slightly lower GDP per capita and a slightly higher (long-term) growth rate. The Czech Republic had a more pronounced slowdown period between 1995 and 1997, but then returned to the asymptotic growth with α=0.017. The predicted growth rate is lower than the expected value of 3.2%. In 1990, the expected growth rate was 3.4%. Slovakia also had a short period of deceleration in 1998 and 1999. Since then it has been consistently returning to the predicted curve with α=0.019. Theoretical growth rate in Slovakia has changed from 3.8% in 1990 to 3.4% in 2006.

The evolution of Polish GDP per capita is well predicted between 1989 and 2000. Only minor discrepancies were observed during this period. In 2000, a major deviation from the predicted curve started with two years of a slower growth. The observed economic growth apparently has been returning to the predicted line after 2002.

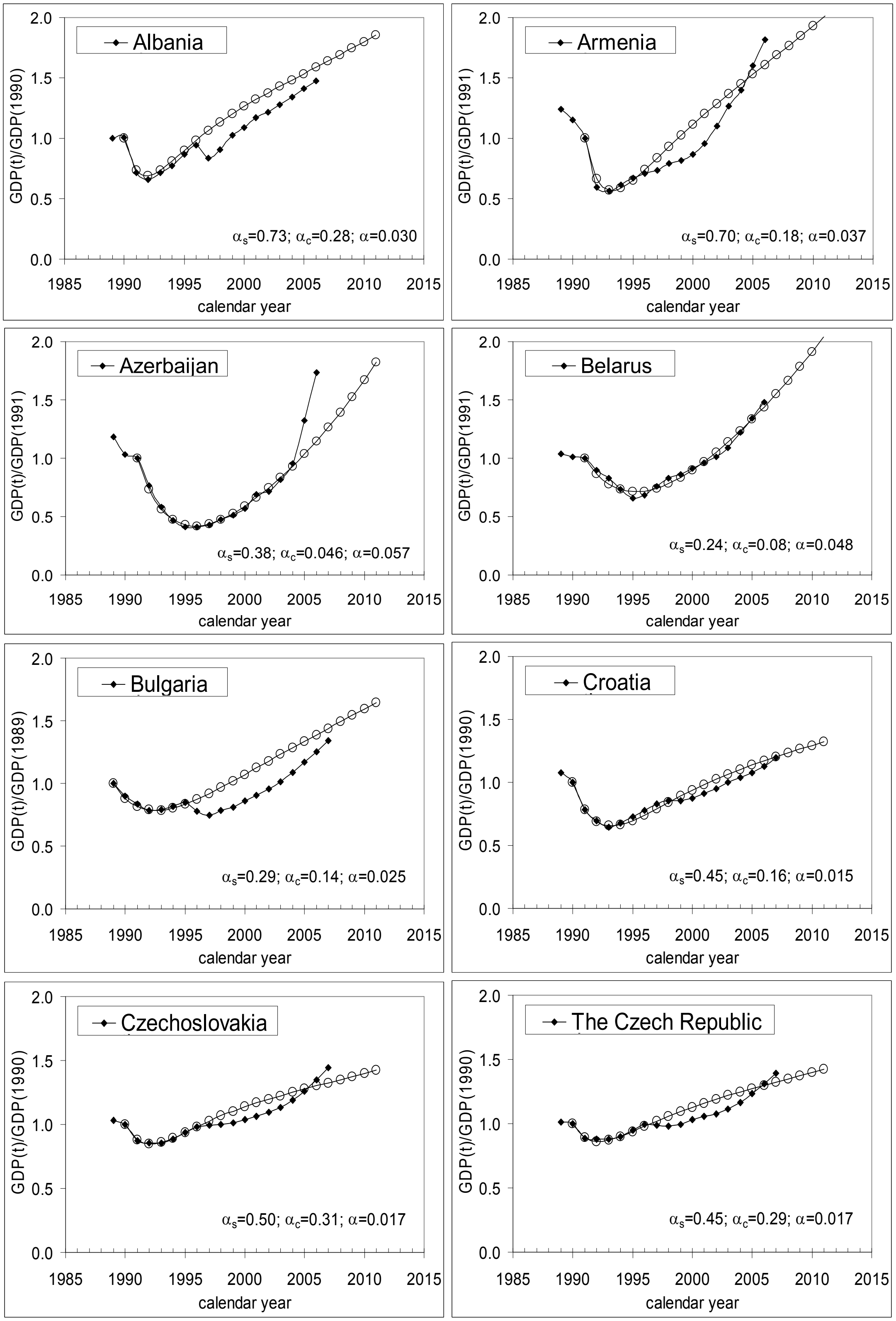
Slovenia is the most prosperous country among the FSC, with GDP per capita in 2006 of $16364. It has avoided any deep downturn (the bottom at 0.78 in 1992) and recovered to the pre-transition level in 1999. Its economy is entirely capitalistic and evolved between 1992 and 2004 at a rate of 2.0% per year, as a Swiss watch. In 2005, a positive deviation from the predicted curve was registered.

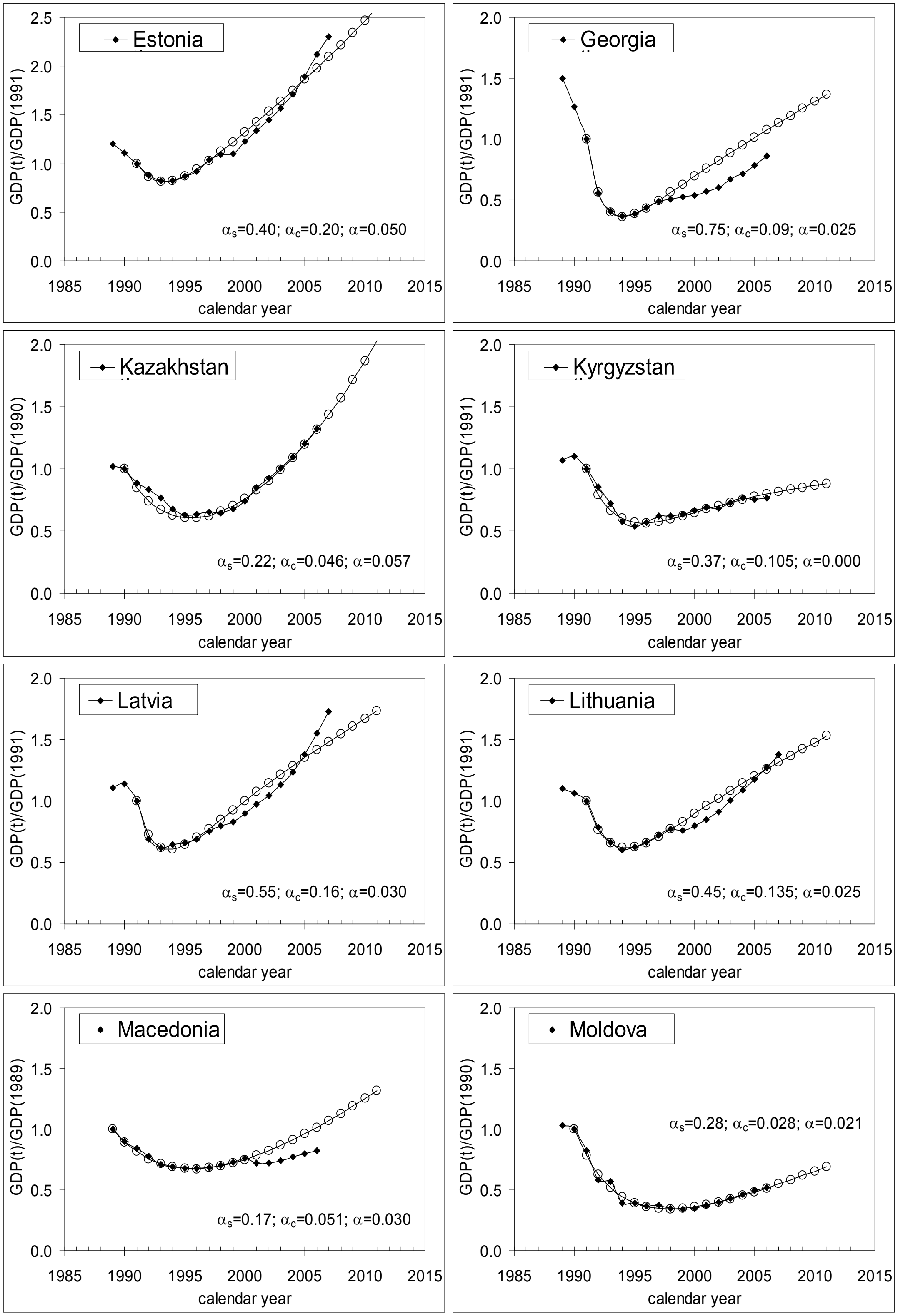
The deviation between predicted and observed curves in the countries joined the EU is likely associated with the changes in defining-age population in (1). This component of economic growth becomes more and more important in the course of the replacement of socialist economy with capitalist one. When the latter occupies whole working age population, the internal growth of the capitalist sub-system prevails over all other processes and Eq. (1) is fully applicable. In other words, when the transition period is over, the resulting capitalist economy evolves on its own.

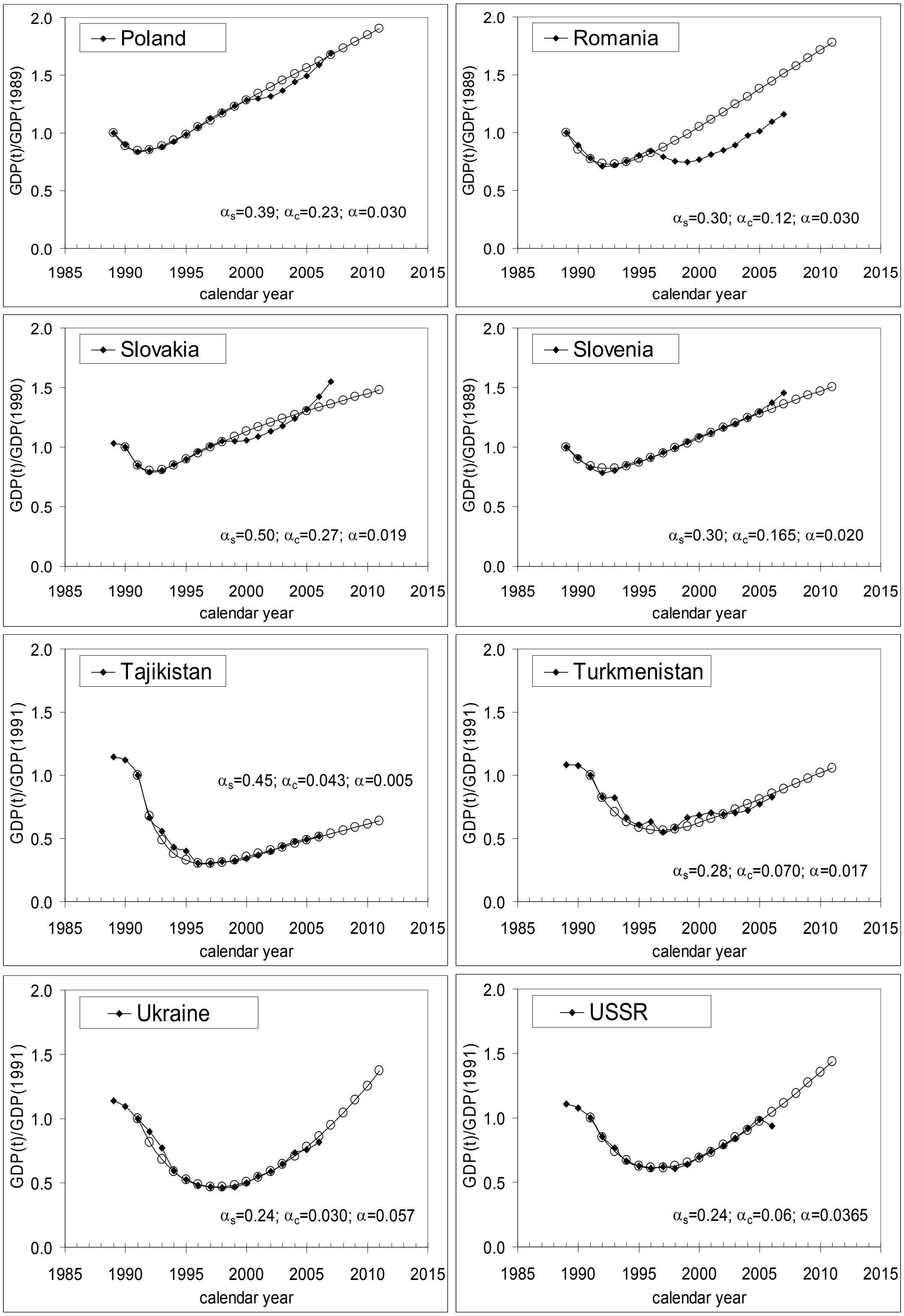
Among the FSU countries, the most striking result of poor performance is demonstrated by Kyrgyzstan. It is characterized by the long-term rate of economic growth, α, equal to zero! The socialist sub-system has completely disintegrated, α_s=0.3, and the formation of capitalist sub-system is close to completion, α_c=0.105. As a result, there is no source of economic growth and the future of Kyrgyzstan seems not to be bright. In the current situation, one can not predict when Kyrgyzstan will recover to its economic level in 1991. Very close to Kyrgyzstan are Tajikistan, Turkmenistan, Uzbekistan and Moldova. Surprisingly, Macedonia joins the club of poorly performing countries despite it certainly belongs to Central European countries.

Kazakhstan and Ukraine are very dynamic economies with the growth rate, α, above 5% per year. Both countries suffer a very painful process of the attraction of people to capitalism with α_c of 0.046 and 0.030, respectively. In respect that only a half of working age population has joined the capitalist sub-system in Ukraine, the performance during the transition might be much more effective.

By avoiding deep economic troughs, Ukraine and Kazakhstan could reach the level of 1991 long time ago and even to double it by 2010.




Estonia
GDP(t)/GDP(1991)
α_s=0.40; α_c=0.20; α=0.050
calendar year
Georgia
GDP(t)/GDP(1991)
α_s=0.75; α_c=0.09; α=0.025
calendar year
Kazakhstan
GDP(t)/GDP(1990)
α_s=0.22; α_c=0.046; α=0.057
calendar year
Kyrgyzstan
GDP(t)/GDP(1991)
α_s=0.37; α_c=0.105; α=0.000
calendar year
Latvia
GDP(t)/GDP(1991)
α_s=0.55; α_c=0.16; α=0.030
calendar year
Lithuania
GDP(t)/GDP(1991)
α_s=0.45; α_c=0.135; α=0.025
calendar year
Macedonia
GDP(t)/GDP(1989)
α_s=0.17; α_c=0.051; α=0.030
calendar year
Moldova
GDP(t)/GDP(1990)
α_s=0.28; α_c=0.028; α=0.021
calendar year


Poland
GDP(t)/GDP(1989)
αs=0.39; αc=0.23; α=0.030
calendar year
Romania
GDP(t)/GDP(1989)
αs=0.30; αc=0.12; α=0.030
calendar year
Slovakia
GDP(t)/GDP(1990)
αs=0.50; αc=0.27; α=0.019
calendar year
Slovenia
GDP(t)/GDP(1989)
αs=0.30; αc=0.165; α=0.020
calendar year
Tajikistan
GDP(t)/GDP(1991)
αs=0.45; αc=0.043; α=0.005
calendar year
Turkmenistan
GDP(t)/GDP(1991)
αs=0.28; αc=0.070; α=0.017
calendar year
Ukraine
GDP(t)/GDP(1991)
αs=0.24; αc=0.030; α=0.057
calendar year
USSR
GDP(t)/GDP(1991)
αs=0.24; αc=0.06; α=0.0365
calendar year

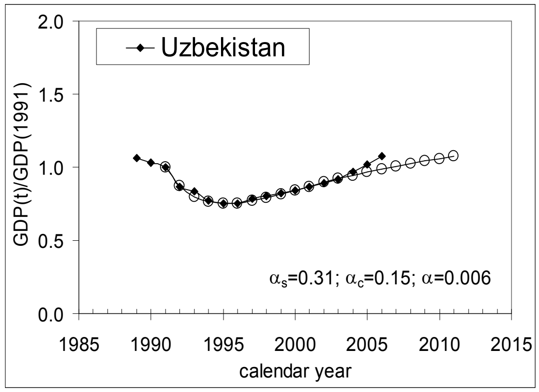


Figure 9. Comparison of the observed and predicted transition process in the FSC. Defining parameters are presented. The start point varies between 1989 and 1991.

We have modelled the evolution of GDP per capita in 27 former socialist countries, including two virtual countries: the U.S.SR and Czechoslovakia. These countries have quite different social, cultural, ethnical, racial, demographical, religious, and technological histories. As a result, our model demonstrates a varying degree of success in the overall prediction between the start point and the year of 2006(7). In all cases, the most accurate prediction is associated with the initial segment of the transition, when socialism was dynamically replaced by capitalism. The initial stage is characterized by the largest changes in GDP per capita, and thus, provides a wide dynamic range as a crucual condition for accurate modelling. At later stages, some exogenous forces, such as the change in defining-age population or in oil price, might disturb the agreement between measured and predicted GDP and introduce some bias in the estimation of the defining parameters. This later stage, however, is of lower relevance to the transition itself and rather demonstrates the behaviour of a regular capitalist economy. Therefore, further observations are of a marginal usefulness for the transition modelling. But the evolution of capitalism in the FSC is of certain importance for theoretical consideration and practical application.

5. The future of the FSC

In Section 4, we concluded that the transition process has effectively finished in Central and Eastern European countries. Thus, the long-tern growth rate of GDP per capita in these countries is limited by the attained level of the GDP per capita, as in developed countries. Any deviations from the long-term rate can be explained only by variations in defining age or by inefficient economic performance. The former can only be of a short-term nature. The latter is expressed in the fact that many developed countries are characterized by lower values of economic trend than that in the U.S. at the same level of GDP per capita.

Here we assume that the future economic growth in the FSC will follow the either potential or current value, as listed in Table 1. When no inefficiency is allowed, the best case scenario of economic growth is realized. In the case of the actual rate of growth, $\alpha<\alpha_t$, the performance is not perfect. In both cases, Eq. (2) completely defines the future evolution of the FSC. The level of GDP per capita in 2006 is used as initial value.

Figure 10 shows the past and future evolution in Hungary and Poland compared to that the U.S. All other FSC have time histories similar to those in Hungary and Poland, but with different initial values and actual slopes. Theoretical slopes are equal: A=\$370, i.e. annual increment in GDP per capita is \$370 (1990 \$). Actual increments are obtained as \$370 times (α/α_t). After 2006, the GDP per capita curves are predicted, and thus, are represented by straight lines with different slopes in coordinates: calendar year - GDP per capita.

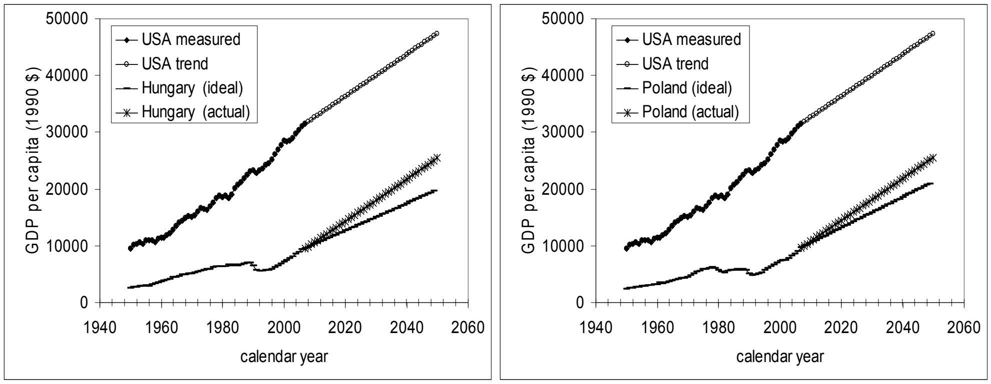


Figure 10.

Left panel: The evolution of per capita GDP in Hungary compared to that in the U.S. The gap between the countries has been increasing since 1950. In the ideal case, when Hungary performs at the theoretical level (A=$370), it will be able to retain the gap. The absolute gap between the U.S. and Hungary can theoretically be constant at the level $22,000 in the future.

Right panel: Same as in the left panel for Poland. The absolute gap between the U.S. and Poland is currently $22,300.

The U.S. curve is much higher and has no prominent horizontal or downward segments, as observed in Hungary and Poland. In Poland, the stagnation process started in the late 1970s. Hungary is characterized by a shorter period of weak performance. Apparently, the years between 1950 and 1989 are characterized by a reduced rate of economic growth with an increasing gap between the FSC and the U.S. The best case scenario would allow maintaining a constant lag behind the U.S., X. In relative terms, the lag will decrease as a function $G_{FSC}/(X+G_{FSC})$, where G_{FSC} is the GDP per capita in a given FSC. If the growth rate from Table 1 persists, the lag will be growing.

6. Conclusion

The principal result of this study is the model for the transition from a socialist to capitalist system. The model is intentionally simplified and is defined by only three parameters, which have clear analogies in natural sciences. The depopulation of the socialist system is an analogue of the radioactive decay with the same meaning of the decay rate, α_s, i.e. the share of population leaving the parent system per unit time. The socialist economy also suffers a natural decline similar to cooling a preheated body. The socialist GDP per capita does not drop to zero momentarily after the start of the transition, but attenuates exponentially over time. The growth of the capitalist system is modelled as the process of saturation during phase transition.

Hence, the interpretation of the model could also be simple in terms of physics. But economic, sociological, political, and so on, interpretation of the defining parameters for a given country is a big challenge and a subject for thorough investigations in the future. Currently, one can not estimate the defining parameters beforehand. Every country has a specific set of conditions and internal cultural relations between people and interactions with and between state and political powers. Technological issues can not be disregarded [Biegelbauer, (1996)]. The author can witness the tremendous influence of mass-media in Russia during the initial stage of the transition. All these and many others processes and phenomena determine country-specific values of the indices. It is also difficult to judge whether it is possible to change the indices for the countries still in the transition.

However, the defining parameters reported for the FSC in this paper create an indispensable framework and firm basis for qualitative and quantitative speculations on relative importance of various factors for the observed differences between the countries. Moreover, the model does not imply the existence of any inherent features defining capitalism or socialism *per ce*. It does not include any measured macro-variable, which can be associated with only one of the two systems. Technically, it is completely constrained to *measured* GDP per capita irrelevant to the name of the country of economic system. Hence, the (economic) terms *socialism* and *capitalism* can be easily replaced, if the transition between any two systems is governed by the same equations.

When transition processes in a society are examined and modelled, any sound power must be aimed at the minimization of negative consequences, such as deep economic troughs, and the enhancement of positive processes, such as the creation of new system. One should not permit people to be out of both systems during the transition process. The best recipe is to retain the ratio of the rates of disintegration of old and creation of new system near 1. It is an obvious target during large-scale economic and social reforms and the process of modernization, which are often associated with displacement of large portions of population. It might be useful for developing countries as well. The author has no recipe helping to achieve the target ratio.

At first glance, the above consideration results are similar to those obtained by other researchers, who use sophisticated interpolation and extrapolation procedures in order to describe observed economic time series. There are several aspects, however, which are inherently different between this study and other interpolations. It was found that exponential functions not only well describe economic processes, but also are the solutions of the model equations. Therefore, one can consider these solutions as basic functions or eigenfunctions of the transition, and actually we have carried out an interpolation of observed time series using a full set of eigenfunctions.

Per capita GDP is a fundamental parameter defining the economic state in any given country. Total GDP depends on the size of population and is often misused to express the level of economic development. This misuse is unveiled by the fact that GDP per capita is the only parameter defining the long-term rate of economic growth or economic trend. As a result, a high growth rate is not a large achievement for countries with low GDP per capita, because it is expected. And a slow growth in some developed countries is not a characteristic of underperformance. Economies have to be evaluated by their performance relative to the potential one. As we have seen above, not many FSC follow their potential path of growth. The majority find themselves below the potential and only a few have a short term growth rate above the potential.

Acknowledgments

The author is grateful to Dr. Wayne Richardson for his constant interest in this study, help and assistance, and fruitful discussions. The manuscript was greatly improved by his critical review.

References

[1] Barkley Rosser, J., Jr., Vcherashnaya Rosser, M., (2004). *Complex Dynamics of Macroeconomic Collapse and Its Aftermath in Transition Economies*, in: *Eastern Economic Journal, Eastern Economic Association*, Volume 30(2), pp. 207-221, Springer.

[2] Bezemer, D., Dulleck, U., Frijters, P., (2003). *Socialism, Capitalism, and Transition-Coordination of Economic Relations and Output Performance*, Vienna Economics Papers 0305, University of Vienna, Department of Economics.

[3] Biegelbauer, P., (1996). *Realizing Hungary's Potential - The Country's Industrial R&D System in Transition*, in: *East European Series 32*, Institute for Advanced Studies.

[4] Brada, J., King, A., (1992). *Is There a J-Curve for the Economic Transition from Socialism to Capitalism?*, in: *Economic Change and Restructuring*, Springer, Volume 25(1), pp. 37-53.

[5] Bureau of Economic Analysis, (2008). *National Income and Product Accounts*. *Table 1.1.6. Real Gross Domestic Product, Chained Dollars*, retrieved in November 2008 from http://bea.gov/be/dn/nipaweb/.

[6] The Conference Board, (2008). *Total Economy Database*, retrieved in November 2008 from http://www.conference-board.org/economics/downloads/TED08I.xls.

[7] Hoelscher, J., (2006). *Income Distribution and Convergence in the Transition Process; A Cross-Country Comparison*, Comparative Economic Studies, Palgrave Macmillan Journals, Volume 48(2), pages 302-325, June.

[8] King, L., (1999). *The Developmental Consequences of Foreign Direct Investment in the Transition from Socialism to Capitalism: The Performance of Foreign Owned Firms in Hungary*, William

Davidson Institute Working Papers Series 277, William Davidson Institute at the University of Michigan Stephen M. Ross Business School.

[9] Kitov, I., (2005). *A model for microeconomic and macroeconomic development*, Working Paper 05, ECINEQ, Society for the Study of Economic Inequality.

[10] Kitov, I., (2005). *The personal income distribution in the U.S. High incomes.* (2005) Working Papers 02, ECINEQ, Society for the Study of Economic Inequality.

[11] Kitov, I., (2006). *GDP growth rate and population*, Working Papers 42, ECINEQ, Society for the Study of Economic Inequality.

[12] Kitov, I., (2009). *The Evolution of Real GDP Per Capita in Developed Countries,* in: *Journal of Applied Economic Sciences*, Spiru Haret University, Faculty of Financial Management and Accounting Craiova, Volume IV, Issue1(8), Summer 2009, pp. 221-234.

[13] Kitov, I., Kitov, O., Dolinskaya, S., (2009). *Modelling real GDP per capita in the USA: cointegration tests*, in: *Journal of Applied Economic Sciences*, Spiru Haret University, Faculty of Financial Management and Accounting Craiova, Volume IV, Issue 1(7), Spring 2009, pp. 80-96.

[14] National Bureau of Economic Research, (2008). *Business Cycle Expansions and Contractions*, retrieved March 5, 2007 from http://www.nber.org/cycles/cyclesmain.html#announcements.

[15] U.S. Census Bureau, (2004). *National intercensal estimates (1990-2000)*, retrieved February 26, 2007 from http://www.census.gov/popest/archives/methodology/ intercensal_nat_meth.html.

[16] U.S. Census Bureau, (2007). *Population Estimates*, retrieved February 26, 2007 from http://www.census.gov/popest/estimates.php.

THE INVOLVEMENT OF INFORMATION TECHNOLOGY IN THE OPTIMAL FUNCTIONING OF ELECTRIC DRIVE SYSTEMS

Simona **ROTARU**, Petru **BARDAŞ**, Mirela **GHIŢĂ**, Mihaela **COCOŞILĂ**
Spiru Haret University, **Romania**
Faculty of Financial Management Accounting Craiova
simona_rotaru_ro@yahoo.com, bardastehnorob@yahoo.com, mire_ghita@yahoo.com

Abstract:

The implementation of sustainable development in Romania and the abrupt increase of prices for fussil fuels have imposed more serious activies for the examination of the energy consumption in different industrial sectors. Here, the asynchronous electric motors represent the main loads; therefore the energy consumption in electrical drives has to be careffuly watched. The achievement of various procedures to improve energy efficiency, compulsory imposes an energy balance who aims to illustrate the existent profile of energy consumption .

The study presents an industry case study about estimation of operating systems functioning that use variable speed motors, highlighting the necessity and appropriateness of using informatic instruments that provide calculations needed to elaborate energy balance and by that, to determine the measures to increase energetic efficiency.

Keywords: energy efficiency, electric drive, energy balance, power factor, informatic instruments.

Jel Classification: M15

1. Energy and Sustainable Development

Along with complex phenomena such as the explosive rate at which the world`s population continues to increase, the associated and inevitable increase in energy consumption and the reality of the environment`s decline, humanity is faced with three very perilous problems:– Economic Growth, Energy and Resource consumption, and Protecting the environment– in other words, the world is faced with an unprecedented dilemma.

For the world consumption of primary energy forecast, several important studies have been done in the last years by prestigious world organizations in developed countries.

An example of such a study is that conducted by the World Energy Council (WEC) and named Energy for Tomorrow`s World. Within this study, at which specialists and organizations of tens of countries took place, were analyzed four scenarios of world primary energy consumption evolution until 2020, compared to the situation of 1960 and 1990, both on a global level, and geographical areas.

The main results of this study are summarized in Table 1.

Table 1. The World primary energy consumption structure (Gtep)

	1960	1990	Scenarios in 2020			
			A	B1	B	C
Coal	1,4	2,3	4,9	3,8	3,0	2,1
Oil	1,0	2,8	4,6	4,5	3,8	2,9
Natural Gas	0,4	1,7	3,6	3,6	3,0	1,5
Nuclear	–	0,4	1,0	1,0	0,8	0,7
Hidro	0,15	0,5	1,0	1,0	8,9	0,7
Traditional Sources	0,5	0,9	1,3	1,3	1,3	1,1
New and regenerable Sources	–	0,2	0,8	0,8	0,6	1,3
Total*	3,3	8,8	17,2	16,0	13,4	11,3

*Differences owned to approximation

Scenarios:A – High economic development; B – reference; B1 – reference to lower energy intensity; C – .organic

You can notice the following: while the world primary energy consumption increased 2.7 times between 1960 and 1990 a substantially smaller increase for the 1990–2020 period (28 - 95 %).

According to these scenarios, in the year 2020 the hydrocarbon consumption will increase to 5.4 – 8.2 Gtep compared to 4.5 Gtep in 1990 and 1.4 Gtep in 1960; we can conclude that from the total increased consumption mentioned for 2020, the hidrocarbon ratio will reach 47 – 51% compared to 51% in 1990 and 42% in 1960, denying the pessimistic forecast made a decade ago.

In any of the scenarios, the nuclear energy does not exceed 1 Gtep in 2020, compared to a total consumption of 11.3 – 17.2 Gtep.

Energy structure underwent important changes by increasing the share of electricity in total energy consumption. This is due, first, the broad implementation of electric technologies, cleaner and ensure the achievement of high quality products.

In 2007, the major final energy consumption is recorded in industry, residential and transport sector (Figure 1).

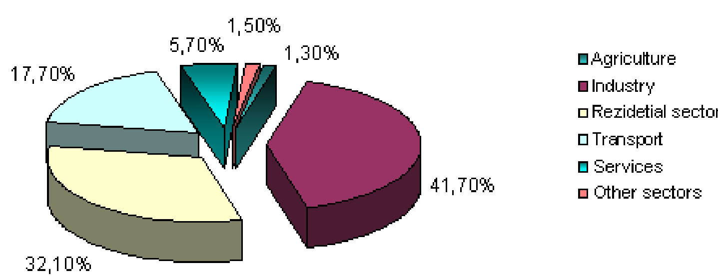


Figure 1. Sectoral structure of final energz consumption in 2007

Through a strong energy policy that promotes energy efficiency, it is forecast that in late 2025 to obtain a change of final energy consumption structure (Figure 2).

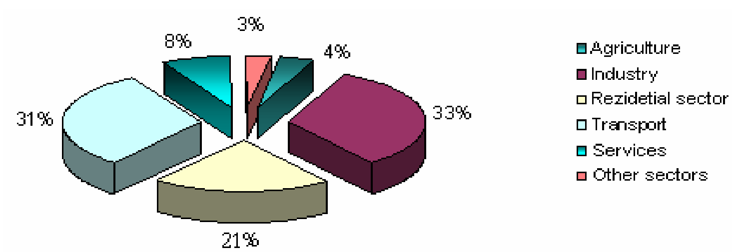


Figure 2. Forecast structure of final energy consumption in 2005

Energetic efficiency reflects the relationship between the production of a system and imputed energy. Improving of energetic efficiency means achieving the same effect with a small amount of energy and involves the allocation of material and human resources, whose efficient use must be analyzed. Major sources of energetic inefficiency and loss of energy that occur in materials, devices, equipment, technologies, due to their low quality (thermal insulation, building materials, heat exchangers, pumps, compressors, fans, burners, heating boilers, electrical equipment, appliances, lighting, metering, energointensive technologies, facilities, stolen energy).

Favorable factors for promoting energetic efficiency in Romania are represented by the law, institutions and existing regulations, the relatively high price of energy and fuels [Rotaru, Ghiță, Dincă, (2007)]. Unfavorable factors (which paradoxically outperforms favorable factors) are owned to the fact that energetic efficiency is downplayed, the responsible institutions are not very active, the energetic efficiency programs are only declarative, without any practical outcome, energy audits are formal, unstimulating penalties, bad management, difficult financing.

The study presents an industry case study about estimation of operating systems functioning that use variable speed motors, highlighting the necessity and appropriateness of using informatic instruments that provide calculations needed to elaborate energy balance and by that, to determine the measures to increase energetic efficiency.

The balance of electric power to act asynchronous short circuit electric motor

An electric drive system (SAE) is represented by all elements that converting electrical energy into mechanical energy, in order to carry out a technological process. As a rule, a SAE is composed of three main components, shown in Figure 3 [Carabogdan, (1986)].

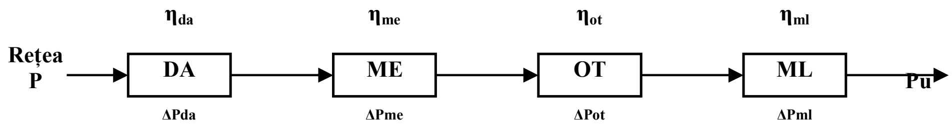


Figure 3. The structure of an electric drive system

– electric engine (ME) – sub–assembly which performs mechanical conversion;

– the transmission (OT) – sub–assembly which ensures transmission of motion from the electric motor to involved car;

– machine work (ML) – sub–assembly making technological process;

– other items included in supplying device (DA) equipment such as power devices, switching, control, regulation and protection, and in which, usually, loss of significantly electricity does not appear.

General equation of energetic power balance of a SAE is expressed as [ARCE.ICEMENERG, (2003)]:

$$W_i = W_u + \Delta W_p + W_r \quad [kWh], \tag{1}$$

Wi – the input energy in the contour balance, representing the amount between outside induced energy and that generated within the contour, [kWh];

Wu – useful energy consumed for the technological process [kWh];

ΔWp – losses of energy inside the contour, [kWh];

WR – energy released outside contour, [kWh].

Where the energy losses have the expression:

$$\Delta W_p = \Delta W_{da} + \Delta W_{me} + \Delta W_{ot} \quad [kWh], \tag{2}$$

ΔWda – loss of energy in power supply device, made by supply equipment, switching, control, regulation and protection, [kWh];

ΔWme – energy losses in electric motor, the sub–assembly which ensures mechanical conversion [kWh];

ΔWot – energy losses in the transmission, the sub–assembly which ensures motion transmission from the electric motor to involved car

In previous relationship, the engine power losses consist of the following elements:

$$\Delta Wme = \Delta WCu + \Delta WFe + \Delta Wmot \ [kWh], \tag{3}$$

ΔWCu – losses in wrapping [kWh];

ΔWFe – losses in the magnetic circuit, [kWh];

ΔWmot – losses in engine power, [kWh]; Since in practice, losses in the machine and in the transmission are difficult to be determined separately, they are regarded as global mechanical losses:

$$\Delta W_{mec} = \Delta W_{ml} + \Delta W_{ot} \quad [kWh], \tag{4}$$

In some situations it is difficult to separate mechanical losses in the SAE from the losses in ferromagnetic circuit of electrical machine; in these cases total energy and mechanic losses in iron and electrical power system are highlighted:

$$\Delta W_{Fe,m} = \Delta W_{mec} + \Delta W_{Fe} + \Delta W_{mot} \text{ [kWh]}, \quad (5)$$

Energetic losses in wrapping are calculated by the relationship

$$\Delta W_{Cu} = 3 * K^2_f * I^2_m * R_e * \tau_f * 10^{-3} * k_i * k_u * k_s \text{ [kWh]}, \quad (6)$$

KF – form factor of the current;
Im – average intensity of electric current within the time frame to which the balance refers;
Re – equivalent resistance of electric current wrapping , [Ω]

Where the equivalent resistance is:

$$R_e = R_1 + R_2 \quad [\Omega] \quad (7)$$

R1 – the resistance on phase of stator wrapping, [Ω];
R2 – the resistance on phase of rotor wrapping reported to stator.

The equivalent mechanical energy losses in asynchronous motor with rotor in short circuit are determined as the sum of the losses in the magnetic circuit (ΔWFe) and of mechanical losses in the engine(ΔW_{mot});.

$$\Delta W_{Fe+mot} = \Delta W_{Fe} + \Delta W_{mot} = \{P_0 - 3 * R_0 * I^2_0 * 10^{-3}\} * \tau_f * k_i * k_u * k_s \text{ [kWh]}, \quad (8)$$

while the energetic equivalent of mechanical losses in transmission and the working car has the expression:

$$\Delta W_{mec} = \{P_{0m} - 3 * R_e * I^2_{0m} * 10^{-3}\} * \tau_f * k_i * k_u * k_s - \Delta W_{Fe+mot} \text{ [kWh]}, \quad (9)$$

Losses of electricity in the power cord are determined by the expression:

$$\Delta W_{linie} = 3 * K^2_f * I^2_m * R_{linie} * \tau_f * 10^{-3} * k_i * k_u * k_s \text{ [kWh]}, \quad (10)$$

Useful energy is calculated from the expression (1), where incoming energy is determined by measurements made at the supply panel jacks of electric actuators and losses are calculated using the expressions outlined above. Thus:

$$W_u = W_i - \Delta W_p \text{ [kWh]}, \quad (11)$$

and

$$\Delta W_p = \Delta W_{linie} + \Delta W_{Fe+mot} + \Delta W_{Cu} + \Delta W_{mec} \text{ [kWh]}, \quad (12)$$

2. Analysis of implementing energy efficiency measures

To highlight the possible measures that can be implemented in order to improve energetic efficiency of an asynchronous electric motor a case is presented of foundries. For the considered contour an actual active energy balance is established so that input energy is the energy absorbed from electric network, energy that can be measured, and the useful energy is represented by mechanical energy developed at the end of the kinematic chain, determined by the expression (11).

On base the results obtained of energetic power balance, proposed to improve power factor. Power factor is defined as the ratio of active power P and apparent power S of the system (Figure 4).

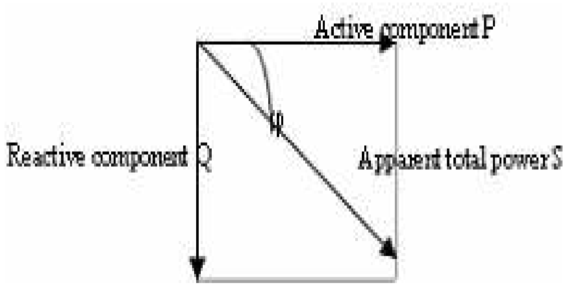


Figure 4. Diagram of Powers

In the sine curve system, we can define the cosine angle between voltage and current (figure 5). Line current of AC machine contains two components: magnetism current (produces the magnetic flux which occur in the machine, but creates a reactive power Q) and the power producing current (which is a current interacting with the magnetic flux to produce the torque of the machine).

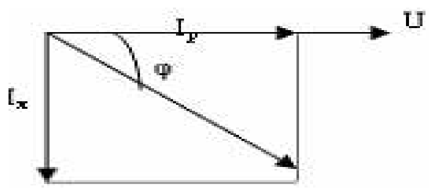


Figure 5. Diagram of currents

The torque of the machine:

$C=K_{C*}\Phi*I_P$

where:

Kc is the constant torque
Φ is the flow of magnetism between the iron
Ip is the current which produces the torque, the power

For an electrical installation of an established apparent electrical power, the maximum of active power, i.e. efficiency maximum, is obtained at a power factor as high as it can (closer to unity) , a de–phased between voltage and current as low as possible, so to a reactive power consumption of distribution network as low as possible[Zobaa, (2004)] (Fig.6).

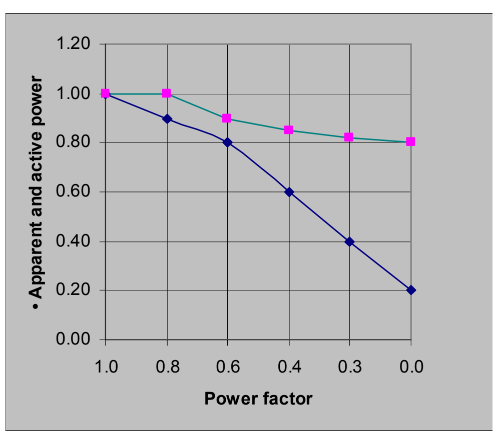


Figure 6. Diagrame power- power factor

From the relationship *cos* $\varphi=P/S$ appears that the problem of improving the power factor is actually the problem of reducing reactive power absorbed by the consumer of a network.

A low power factor has a number of negative consequences for the functioning of electrical installation, including: – increasing active power loses; – extra investments; – increasing voltage loses in the network; – reducing energy capacity installations.

Power factor improvement is achieved through:

– technical and organizational methods (natural methods/ways) that consist in the application of measures for streaming the operation, with reduced costs and without being equipped with additional facilities;

– methods of compensation of reactive power by using specialized sources of reactive power.

The most popular method to improve the power factor to a system of distribution with low voltage is to use the power condensers.

The condensers for improving the power factor are available in a wide range of rated reactive powers. The reactive power Q_c which has to be installed to raise the power factor from a value $cos\ \varphi_1$ to a value $cos\ \varphi_2$ is based on the active power absorbed by the consumer [Ferrandis, Amantegui, Pazos, (2003)].

$$Q_c=P(tg\ \varphi_1 - tg\ \varphi_2$$

3. Case studies

The studied consumer that absorbs an active power P=1000kW at a natural power factor $cos\varphi_1=0,6$. Apparent power is $S_1=P/cos\ \varphi_1=1000/0,6=1667$ kVA and current $I_1=P/\ \sqrt{3}\ \cdot U\ \cdot cos\ \varphi_1=1000\cdot 10_3/\sqrt{3}\cdot 380\cdot 0,6=2532$ A. The reactive power Q_c needed to improve the power factor to a neutral value $cos\ \varphi_2=0,92$ is $Q_C=1000(1,333–0,426)=907$ kVAr. Increasing the power factor to a value $cos\ \varphi_2=0,92$ leads to an apparent power $S_2=P/cos\ \varphi_2=1000/0,92=1087$kVA and a current $I2=P/\ \sqrt{3}\ \cdot U\ \cdot cos\ \varphi_2=1000\cdot 103/\sqrt{3}\cdot 380\cdot 0,92=1651$ A, both values well below the previous ones. A battery of condensers is chosen Qbc = 920 kVAr. The improved power factor becomes $cos\ \varphi=1000/\sqrt{10002+(1000\cdot 1,333–920)2}=0,924$

Following the improvement of power factor from $cos\ \varphi_1=0,6$ to $cos\ \varphi_2=0,92$

– reduce the apparent power with (1667–1087)/1667=0,348 → 34,8%

– reduce loss of power with 1–(1651/2532)2=0,575 → 57,5%

Is an analysis technical–economic analysis of reactive power compensation. The economic efficiency of reactive power compensation is pointed out by the method of updated total expenditures. Choosing the best method and development in time of the facilities to compensate the reactive power in the consumer ‘s installations is made by comparing the total updated expenditures for each variant (natural ways/solutions, specialized sources, solutions for placements), analyzing the situation without compensation (corresponding to the natural power factor), and compensation solutions at different levels of the power factor.

Example of calculating the costs

Three things are taken into account in the payment bill:

1. The cost of consumed energy Cec = 0,38 lei/ KWh
2. The cost of the total required power Cpc = 41,8 lei / KW
3. The additional costs due to the power factor below 85%

The paid penalties depend on the minimum power factor η_m , the actual power factor η, and the total required power Ptc [Cziker, Chindris, (2004)].

$$C_{sfp} = (\eta_m - \eta)\ Ptc*\ Cpc/\ \eta$$

The factory used in a month 240000KWh x 0,38 = 91200 lei

The demand of total power was 1700kW x 41,8 = 71060 lei

The paid penalties for a low power factor (70%) 15 x 1700 x 41,8/70 = 15227 lei

For processing experimental data and implementing mathematical relations presented above, we have developed a computer application which purpose is to calculate the necessary elements of the energetic balance according to the electric drive; based on the results, the application displays the corresponding graphs.

The application was made in the Access program. Input data, consisting of the catalog characteristics of engine and experimental determinations are stored in tables.

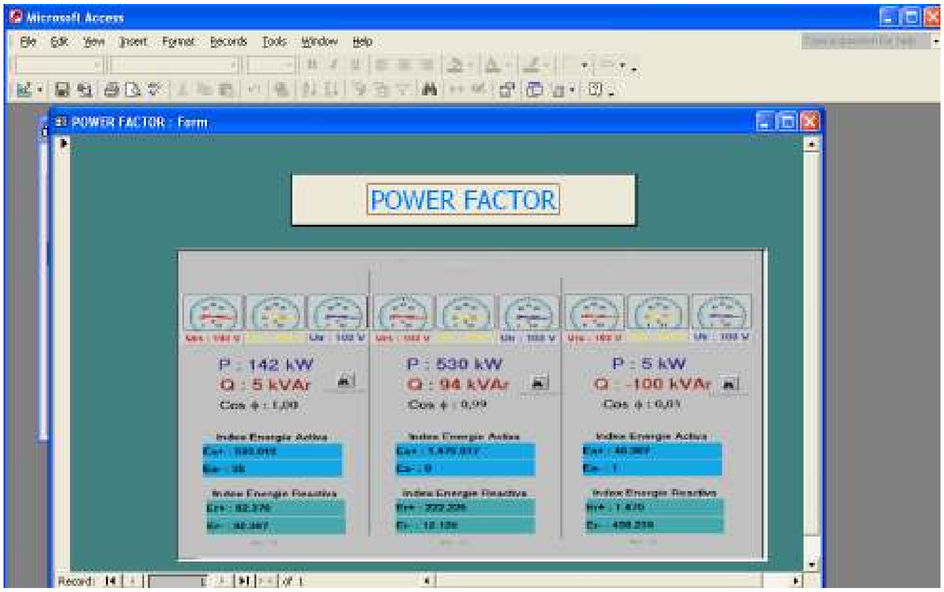


Figure .7 The metering system

The main sizes are measured by the metering system (figure 7):

- Active energy;
- Reactive energy;
- Apparent energy;
- Phases voltages;
- Active and reactive power;
- Phase currents;
- Power factor.

The results are presented in table reports and diagrams [Rotaru, Ghiță, (2005)] (figure 8).

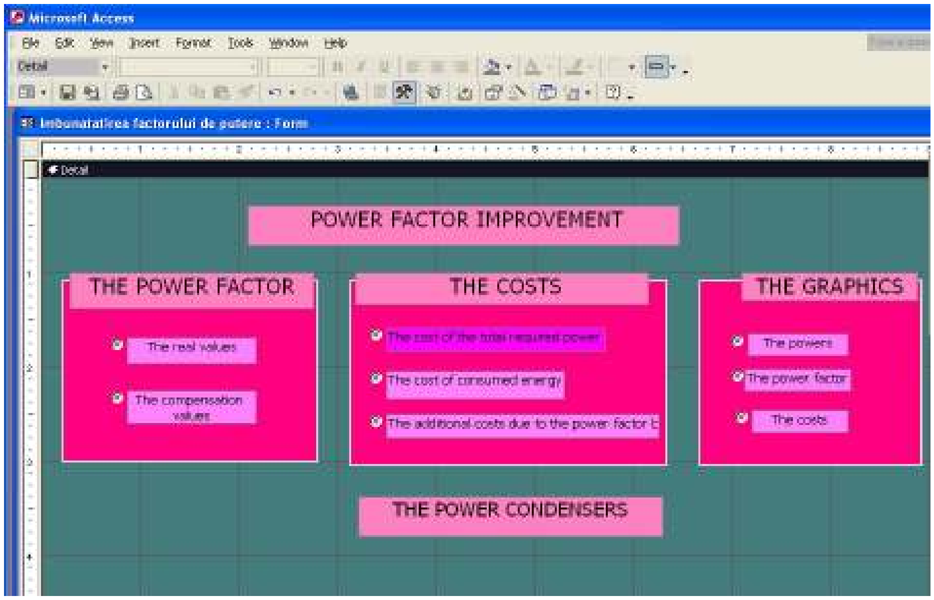


Figure 8. Update interface

4. Conclusions

The concept of sustainable development of energy sector has become lately a main concern of our country specialists. As a result, actions have been initiated in order to align to European legislation in the field and also practical activities to implement the energy management principles both in industry and tertiary [Cziker, Chindris, (2006)].

In industry, the most widely spread electric receptors are the asynchronous motors, so that energy consumption in electrical systems they are integrated in should be carefully monitorized. The implementation of energetic efficiency improving measures mandatory requires an energy audit, which to highlight the real status of consumption way.

In this circumstance, the electricity balance is being developed chiefly to obtain necessary information to determine quantitatively the various components that characterize in terms of energy the operation regimes of electrical installations. Based on these experimental data and on their processing, solutions are established and measures that can be taken for a more efficient use of electricity.

The study presents a computer application that allows to determine components of balance of energy for electric drive systems with asynchronous motors with rotor in short circuit.

The results provided both in table and in diagrams, allow to analyze the actual consumption way and to determine measures to improve energy efficiency in order to reduce consumption.

5. References:

[1] Carabogdan, I. Gh. all., (1986), *Bilanțuri energetice. Probleme şi aplicații pentru ingineri*. Editura Tehnică, Bucureşti, *in Romanian.*

[2] Cziker A., Chindris M., (2004), *Managementul energiei electrice*, Casa Cărții de ştiință, Cluj–Napoca, *in Romanian.*

[3] Cziker A., Chindris M. (2006), *Analiza pierderilor reale de putere in rețelele electrice de joasă tensiune*. Energetica, nr.4, aprilie 2006, pp. 143–148, *in Romanian.*

[4] Ferrandis F., Amantegui J., Pazos F. J., (2003), *Power factor correction within industrial sites: experiences regarding*, CIRED Barcelona 2003, R2_35.

[5] Rotaru S., Ghiță M., (2005), *Programarea în Access*, Editura Universitaria, Craiova, *in Romanian*

[6] Rotaru S., Ghiță M., Dincă S., (2007), *Use of an informational system for modeling and simulation concerning the prognosis of electric power*, Journal of Applied Economic Sciences, Volume I, Issue 1(1)_Fall2007, pp.55.

[7] Zobaa A. F., (2004), Comparing Power Factor and Displacement Power Factor Corrections Based on IEEE Std. 18–2002, ICHQP 2004.

[8] *** ARCE.ICEMENERG. (2003), *Ghid de elaborare şi analiză a bilanțurilor energetice*, Bucureşti, *in Romanian.*

MODELING RISK OF INTERNATIONAL COUNTRY RELATIONS

Sergey **SVESHNIKOV,** Victor **BOCHARNIKOV**
Consulting group INEX-FT, Kiev, **Ukraine**
sveshnikosv@yandex.ru, bocharnikovvp@yandex.ru

Abstract:

In this article we consider the modeling principles and model for estimation of tension of international relations of a country with other countries. We use the tension of international relations as partial indicator of international political-economical country-risk. The model bases on estimation of coincidences and contradictions of views of countries concerning decision of political, economic, military, domestic and international problems and projects. The model aggregates detailed estimations of separate problems into composite estimation of relations tension with using of fuzzy measures and integrals. The model allows receiving quantitative estimations of tension of international relations which are necessary for making investment decisions. We use this model for estimation of international political-economical risk of Ukraine.

Keywords: Model, International relations, Fuzzy measure, Political-economical risks.

JEL Classification: C63, D81, F21, F59, H56

1. Introduction

The dependence of investments risk into country from its international relations appreciably rises in conditions of globalization. The stability of international relations is especially important factor for investment into export-oriented industries of developed and post-soviet countries. The tense relations with neighboring states or states - world leaders in policy sphere or in safety sphere very often negatively influence export-import streams. Therefore the detailed studying and analysis of structure of international relations is today especially topical.

The analysts evaluate the risk of investments into country by means of country-risk. The well-known researches consider various aspects of country-risk. In [Bourke and Shanmugam, (1990)], for example, the authors consider the country-risk as the risk that the country will be unable to service its external debt due to an inability to generate sufficient foreign exchange. The country risk model [www:\\riskmodel.eiu.com] calculates the country-risk as additive convolution along hierarchical system of financial, economic and political risk-categories: debt structure, fiscal policy, liquidity, political stability and others. This model includes the indicator <international relations> into category <political stability> only as one parameter. In many publications [Andrade and Kuhl, (2004); Simpson, (1997); Arin, Molchanov and Reich, (2007); Hammer, Kogan and Lejeune, (2004, 2007); Erdogdu, (2006)] authors reveal the dependences between various risk-indicators (including political). Moser, Nestmann and Wedow (2006) reveal the dependence of necessary governmental guarantees of exporter-country and of political risks of importer-country. Lensink, Hermes and Murinde (2000) investigate the dependence between capital outflow and political risks in developing countries. Brewer and Rivoli (1997) consider the dependence of domestic political relations and country-risk. At the same time many papers point out on role increase of international relations at evaluation of country-risk.

The well-known researches consider mainly the risks of domestic economic policy of country: government stability, social and economic conditions, corruption and so on [International Country Risk Guide]. These researches do not give due attention to the risks which arise because of negative international relations. For example, Misztal (2007) considers the international competitiveness of Polish economy only in context of macroeconomic indexes: GDP, unemployment, inflation and so on.

However the investments efficiency into export-oriented industries greatly depends on relations conditions of exporter-country and importers-countries. For example, not looking at favorable domestic economic conditions for foreign investors, there is a big investments risk into metallurgy of country which has the tense relations with country - large metallurgical importer because there is decline possibility of export markets. For other example, it is gas warfare between Russia and Ukraine which arouses on background of exacerbation of interstate contradictions. Such situations often arise in post-soviet countries which haven't of stable political traditions and also haven't of interests balance in international relations. Moreover the generalized risk-rating of country not always adequately estimates investments risk because of details lack. For investor it is important to know about detailed structure of problems in international country relations to have a tentative estimation of possibility of critical situations on foreign markets.

The International Country Risk Guide estimates the political risk along several weighed components (government stability, internal and external conflicts, ethnic tension and others). The risk components can have subcomponents. The Guide measures the components values and subcomponents in points. The experts assign the values according to prescribed scales. Such technique has two shortcomings.

1. This technique propose to the expert to answer questions, for example: evaluate the level of political relations between Ukraine and Russia. But the person cannot evaluate simultaneously more than 5-7 factors. The limited opportunities of the person are a source of the most widespread errors in problems of expert evaluations. Saaty (1980) draws this conclusion in researches. Moreover the high level of questions generalization often doesn't allow the expert to give exact answer. For example, it is complex to give an unequivocal estimation for international ethnic relations if these relations with one state develop positively, but with another they develop negatively.

2. This technique uses linear convolution with weight coefficients for calculation of composite evaluation of country risk on the basis of partial evaluations. This linear convolution is an additive measure and has properties of probability measure. As is well known, the main shortcoming of additive measure is smoothing and the independence requirement of partial evaluations. Smoothing leads to loss of method sensitivity. Researchers do not recommend using such measures at generalization more than 5-7 factors. If these factors are dependent among themselves, linear convolution cannot be used at all. In case of factors dependence inevitably arise a systematic errors. It is necessary to use special methods for exception of correlations influence. We emphasize that the international relations greatly depend from each other. Compromises in relations are mutual concessions along different problems. Besides, additive measures do not allow modelling the threshold phenomena in the international relations, when quantitative changes after accumulation provoke the qualitative changes of relations.

Therefore we propose the new model for estimation of international relations which has no these shortcomings.

2. The basic concepts

*The political-*economical *forces.* The basic elements of system of international relations are political-economical forces: the states, states coalitions, international corporations. The political-economical forces have own interests. We consider the forces interests as the most deep and latent stimulators of relations development.

The power of political-economical forces. For interests achievement the political-economical force uses various material and non-material resources which we consider as political and economic instruments. The generalized estimation of resources quantity characterizes the power of political-economical force.

The aggressiveness of political-economical forces. Each political-economical force has volition (propensity, aspiration) to resources use for interests' achievement. This volition depends on political traditions, personality of political leaders, own estimation of situations and other conditions. The volition to resources using characterizes force aggressiveness. Taking into account aggressiveness the forces use the resources for economic expansion, economic sanctions and restrictions, for support of domestic political forces, financing of mass media, military intervention, etc.

The structure of relations. The relations between forces arise in decision context of domestic and international problems. For example, the first force prefers one decision variant of problem, but other force prefers other decision variant. The contradiction between preferences (views) of these forces concerning problem decision provokes the contradiction between forces. And vice versa, the coincidence between views of forces concerning the problems decision stimulates development of friendly relations. The contradiction and coincidence levels which we compose along all problems with taking into account power and aggressiveness of forces describes the tension of international relations.

3. The structure of model

The figure 1 shows structure of model with explanations of partial estimations.

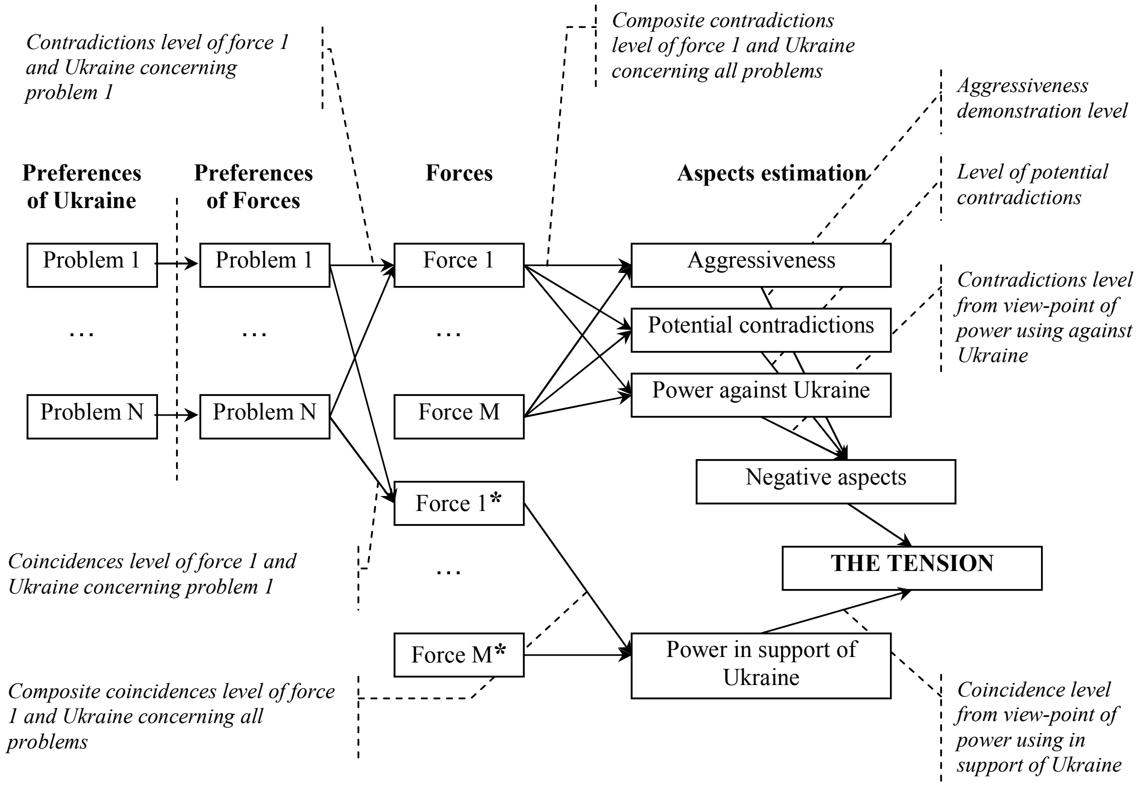


Figure 1. The structure of model

This model is the set of interrelated elementary concepts which describe preferences of political-economical forces concerning various problems and also describe the various aspects of estimation of these preferences. The quadrangles (graph tops) show the concepts of model. The arrows between the tops show the connections between the concepts. The arrows also show the direction of calculations and estimations movement. The top in arrow-ending is consideration context (view-point) for the top in arrow-beginning. For example, the model considers the concept <Problem 1> from view-point of concepts <Force 1>, <Force 2> and so on.

The algorithm moves the estimations from the top in arrow-beginning to the top in arrow-ending. The model formalizes the set of entrance estimations as the membership of fuzzy set. In the each top the user previously determines the set of fuzzy measures which describe the contexts of corresponding concept. The number of fuzzy measures corresponds to number of contexts of this top. The algorithm integrates entrance membership along each fuzzy measure and calculates the resulting estimations.

For example, in the top <Force 1> the user determines the fuzzy measure which describes the importance of problems from view-point of aggressiveness of this political-economical force. To entrance of top the algorithm moves estimations of contradictions levels between Ukraine and this force concerning each problem. In the top the algorithm calculates composite contradictions level between Ukraine and this force concerning all problems. The algorithm fulfills analogous calculations for all contexts of top <Force 1>.

The algorithm uses the fuzzy integral Sugeno (1972) for integration of membership $h(x): X \to [0,1]$ along contextual fuzzy measure $g(\bullet): 2^X \to [0,1]$:

$$L = \int_X h(x) \circ g(x) \tag{1}$$

where X is universal set.

From view-point of systems analysis, the measures with softer axiomatics are more adequate tools for modelling. Sugeno (1972) and Pospelov (1986) in detail describe the advantages of a fuzzy measure. Fuzzy measure Sugeno is generalization of probability measure of Kolmogorov. This measure has higher sensitivity and does not demand the factors independence at generalization. The measure has nonlinear properties and can well model the threshold phenomena.

The algorithm fulfills the calculations step by step.

Step 1. The calculation of contradictions levels and coincidences levels of Ukraine preferences and preferences of political-economical forces for each problem of international relations.

Calculation of contradictions levels. The algorithm fulfills the calculations of contradictions levels in the tops <Problem 1> - <Problem N> out of group <Preferences of forces>. In each top the user determines the gradations set as the possible variants of problem decision. On this set the user also determines the fuzzy measure which describes the preferences of forces concerning problem decision variants.

The user determines the set of fuzzy measures for contexts which we denote by the tops <Force 1> - <Force M> (tops group <Forces>). These measures describe unacceptability (undesirability) of decision variants from view-point of various political-economical forces. Figure 2 demonstrates the gradations set and one fuzzy measure in top <Integration of Ukraine into EU> from view-point of EU, that is measure describes the EU preferences concerning this problem. It's evidently that EU prefers the associate membership of Ukraine.

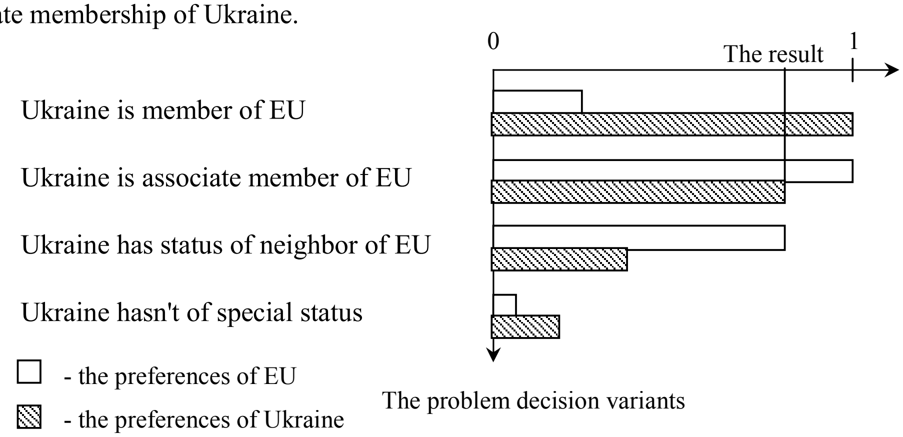


Figure 2. The formalization of concept <Integration of Ukraine into EU>

The user determines the Ukraine preferences also on corresponding gradations sets in the tops <Problem 1> - <Problem N> out of group <Preferences of Ukraine> (see figure 2). The integration results are contradictions levels of Ukraine preferences and preferences of each political-economical force concerning each problem. If preferences of force we describe by the possibility measure the fuzzy integral calculates the result by analogy with maximin rule (see figure 2). But this comparison isn't the full analogy from view-point of mathematic of fuzzy integral.

Calculation of coincidences levels

The algorithm fulfills the calculations of coincidences levels also in the tops <Problem 1> - <Problem N> out of group <Preferences of forces> by analogy with the calculation of contradictions levels. However the algorithm fulfills the calculations for other contexts which we denote by the tops <Force 1*> - <Force M*> (tops group <Forces>). For these contexts the user determines the fuzzy measures with reverse sense - as the measures of variants desirability. The integration results are the coincidences levels of Ukraine preferences and preferences of each political-economical force concerning each problem.

Step 2. The generalization along all problems and the calculation of composite contradictions levels and composite coincidences levels of preferences between Ukraine and each political-economical force.

The algorithm fulfils the calculations in each top out of group <Forces>. In the tops <Force 1> - <Force M> the algorithm calculates composite contradictions levels of preferences. In the tops <Force 1*> - <Force M*> the algorithm calculates composite coincidences levels of preferences.

Calculation of composite contradictions levels of preferences

In the tops <Force 1> - <Force M> the user influences the fuzzy measures of problems importance for each political-economical force from view-point of three contexts:

- the aggressiveness demonstration of political-economical force;
- the level of potential contradictions;
- the power using against Ukraine.

We consider the contradictions in the three different contexts because political-economical forces differently perceive contradictions for determination of intentions and actions. For example, Georgia can accept the declaration for Ukraine support concerning problem <The using of sea-shelf of Serpent-island>. However Georgia hasn't objective prerequisites for use of power and resources because for Georgia this problem is not important.

To entrance of the tops <Force 1> - <Force M> the algorithm moves the estimations of contradictions levels of preferences along each problem and calculates three composite contradictions levels between Ukraine and political-economical forces.

Calculation of composite coincidences levels of preferences

In the tops <Force 1*> - <Force M*> the user determines the fuzzy measure of problems importance for each political-economical force from view-point of power using in support of Ukraine. To entrance of these tops the algorithm moves the estimations of coincidences levels of preferences along each problem and calculates the composite coincidence level of preferences. This level describes the possibility of Ukraine support by these forces.

Step 3. The calculation of aspects estimations of international relations.

The algorithm fulfills the calculation in tops out of group <Aspects estimation>.
In these tops the user determines the following fuzzy measures:

- in the top <Aggressiveness> - the aggressiveness measure of political-economical forces (we form the measure with help of expert's or with help of special model);
- in the top <Potential contradictions> - the measure of influence (the measure of the importance) of political-economical forces;
- in the top <Power against Ukraine> - the power measure of political-economical forces (we form the measure with help of expert's or with help of special model);
- in the top <Power in support of Ukraine> - the weakness measure of political-economical forces (it is inverse measure of forces power).

The algorithm moves the composite contradictions levels of preferences of each political-economical force, integrates these levels along listed measures and calculates three estimations:

- the aggressiveness demonstration level of political-economical forces in attitude to Ukraine - A_Σ;
- the level of potential contradictions between Ukraine and other forces (objective prerequisites for contradictions) - dI_Σ;
- the possibility of power using against Ukraine - M_Σ.

The algorithm also integrates the composite coincidences level of preferences of political-economical forces along weakness measure of these forces and calculates the possibility estimation of power using in support of Ukraine - M_U.

Step 4. The calculation of tension of international relations.

The algorithm fulfills the calculations in the tops <Negative aspects> and <The tension> according to logic formula:

$$N = \left(A_{\Sigma} \vee M_{\Sigma} \vee dI_{\Sigma}\right) \wedge \overline{M_U} \tag{2}$$

where

$\vee, \wedge$ - the symbols of logic operations <OR> and <AND> which the algorithm fulfills by means the integration along the subadditive and superadditive fuzzy measures;

N - the tension of international relations of Ukraine.

The formula (2) shows that the high level of aggressiveness; the high potential contradictions; the high using possibility of power against Ukraine; the low using possibility of power in support of Ukraine provoke the high tension of international relations.

4. The tension estimation of international relations of Ukraine in 2007

Figure 3 shows the screenshot of program realization of model. In model we analyze the full set of international relations of Ukraine with other political-economical forces of region: with the neighbouring states and the states - world leaders. We use the special models for calculation of aggressiveness and power of political-economical forces. We not consider these models for abridgement of article.

We have collected the information messages (publications, reports, reviews, articles) which have been published in mass media during 2007. We have used these messages for preferences identification of political-economical forces concerning domestic and international problems. After that we have introduced the formalized preferences of forces into model.

Figure 4 shows the topicality of problems of international relations as the number distribution of information messages along all problems with taking into account the mention frequency of forces in these messages.

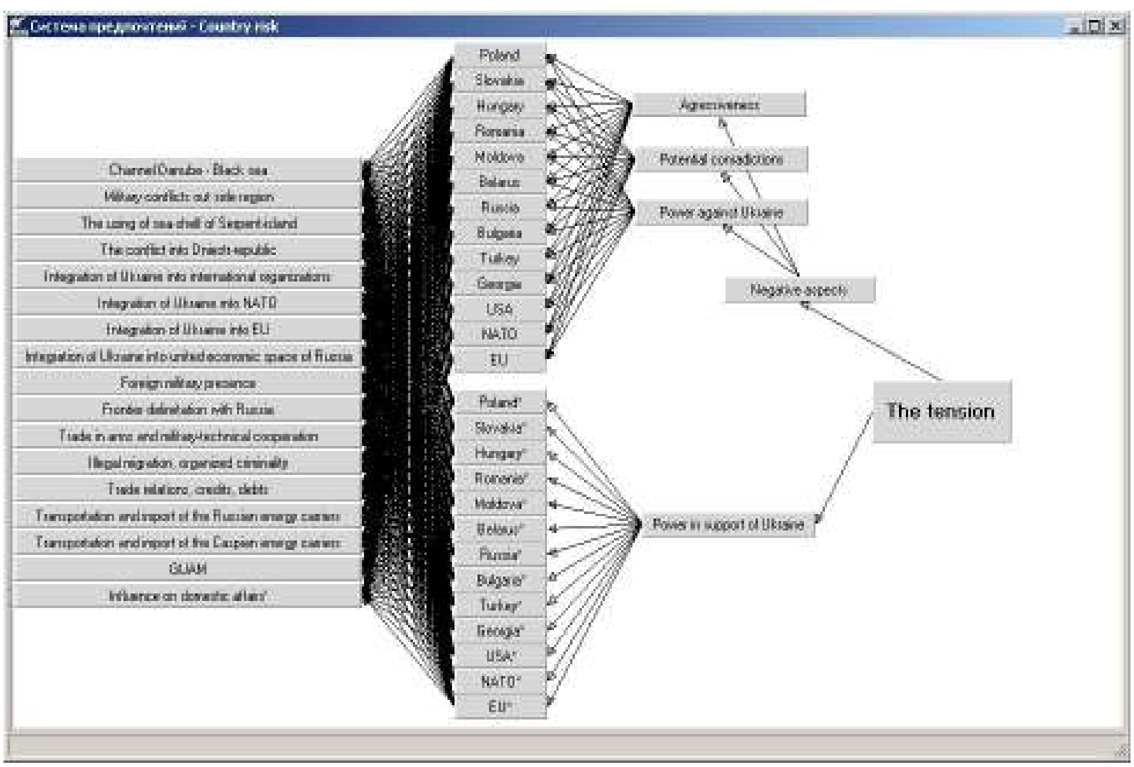


Figure3. The screenshot of program realization of model

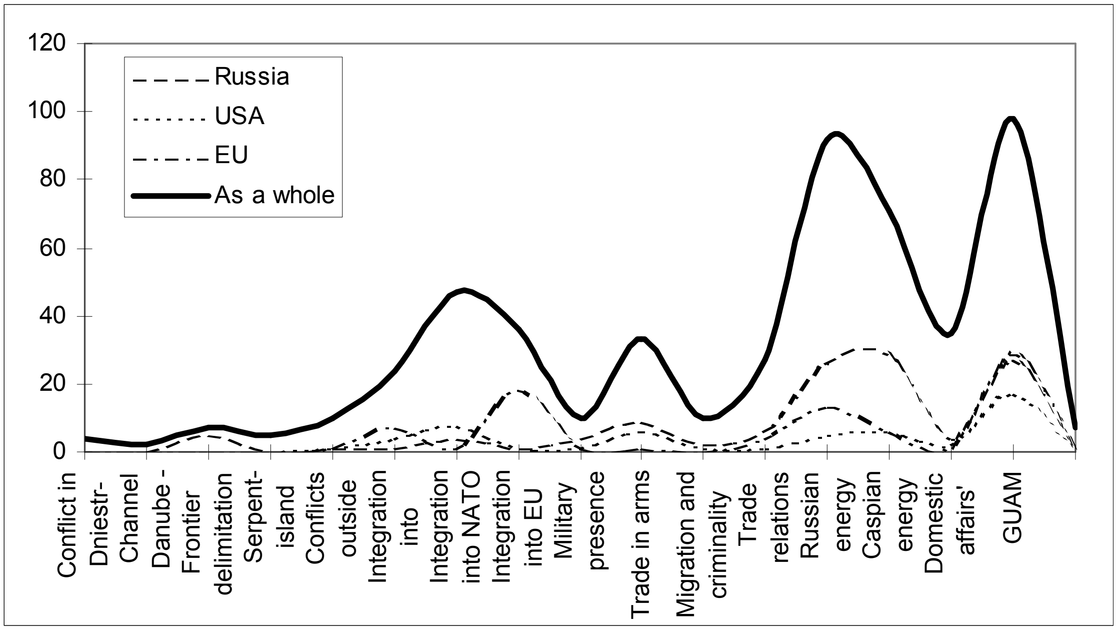


Figure 4. The number distribution of information messages along all problems

The greatest intensity of information field has been concentrated along the problems: <Influence on domestic affairs'>, <Trade relations> (trading wars, export-import restrictions), <Integration of Ukraine into NATO and EU>. The problem <Transportation and import of the Russian energy carriers> (so-called <Gas warfare>) has lost the topicality in comparison to 2006.

Contradictions between preferences of political-economical forces

The table 1 demonstrates the estimations of contradictions between Ukraine and other political-economical forces which we differentiate concerning positive and negative aspects of international relations.

Table 1. Contradictions estimations on the end of 2007

Political-economical forces	Aspects of international relations			
	Negative			Positive
	Level of potential contradictions	Contradictions for power using against Ukraine	Aggressiveness demonstration	Preferences coincidences for power using in support of Ukraine
Belarus	0,25	0,26	0,27	0,75
Bulgaria	0,18	0,09	0,18	0,88
Georgia	0,16	0,16	0,18	0,84
EU	0,54	0,27	0,54	0,73
Moldova	0,27	0,18	0,29	0,86
NATO	0,28	0,27	0,28	0,73
Poland	0,36	0,18	0,36	0,82
Rumania	0,39	0,36	0,43	0,64
Russia	0,55	0,45	0,64	0,45
Slovakia	0,18	0,18	0,18	0,82
USA	0,36	0,21	0,43	0,8
Turkey	0,27	0,26	0,27	0,82
Hungary	0,18	0,15	0,18	0,85

In comparison to 2006 the structure of political-economical forces which have the least contradictions with Ukraine has changed. The relations of Ukraine and Bulgaria, Georgia, Moldova, Slovakia, Hungary, Turkey and NATO were traditionally quiet. Per 2007 Belarus also has been included into this list.

Poland has left the list of states which have the least contradictions with Ukraine. The import prohibition of poor-quality meat from Poland and unclear the Poland preferences concerning building of oil-pipeline <Odessa - Brody> provoke the tension increase of relations.

The estimations structure along aspects of international relations in 2007 almost has not changed. The tensest aspects of relations (in compliance with number of political-economical forces which have the maximal contradictions) were aspects: the level of potential contradictions and the aggressiveness demonstration. In these aspects Ukraine had the tensest relations with Russia, EU, Romania, Poland and USA. Russia, USA and EU are countries - world leaders. Therefore the tense relations with them confirm key importance of Ukraine for the further development of regional relations. These tense relations also are the evidence of views division of influential political-economical forces concerning Ukraine.

The estimations of international relations from the view-point of power using against Ukraine in comparison to other aspects have low values and not exceed level 0,5. As well as in 2006, Russia and Romania had the greatest reasons for power using against Ukraine. The Russia had the minimal coincidence of preferences (0,45) from the view-point of power using in support of Ukraine. This level is very near to 0,5 and shows transition to new qualitative conditions of relations between Ukraine and Russia.

Contradictions with Russia, USA and EU along problems of international relations

These political-economical forces basically form the international relations in region. The figure 5 illustrates the contradictions levels along problems on the end of 2007.

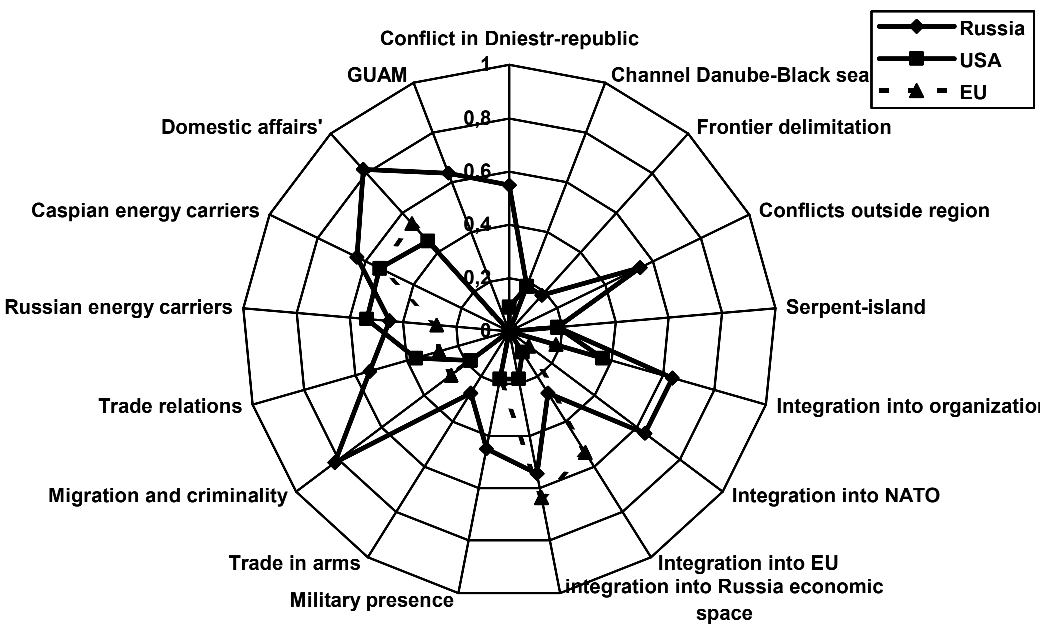


Figure 5. The contradictions levels along problems with Russia, USA and EU

In comparison to 2006 (see fig. 6) the composite contradictions level of Ukraine and Russia has increased. The problems structure also has changed. The most contradictory problems of relations between Ukraine and Russia are:

Influence on domestic affairs':

- the non-recognition by Russia of Ukrainian views concerning famine, the translation of interstate rhetoric into international organizations (in particular, into United Nations);
- the creation in Ukraine of museum of Soviet occupation;

- the publication in mass media (including foreign mass-media) of articles and declarations where one party negatively characterizes other party;
- the harsh estimations of parliamentary crisis in Ukraine;
- the Russia's refusal from negotiations concerning the property of former USSR;
- the Ukrainian accusations of concealment of functionaries who have poisoned Ukraine President;
- the vandalism actions of Russian public organization concerning Ukrainian state symbols, the monuments dismantling of Great domestic war in Ukraine;
- the declarations of Russian politicians about unselfish support of Ukrainian economy by the low gas-prices, the accusations of ingratitude of Ukraine;

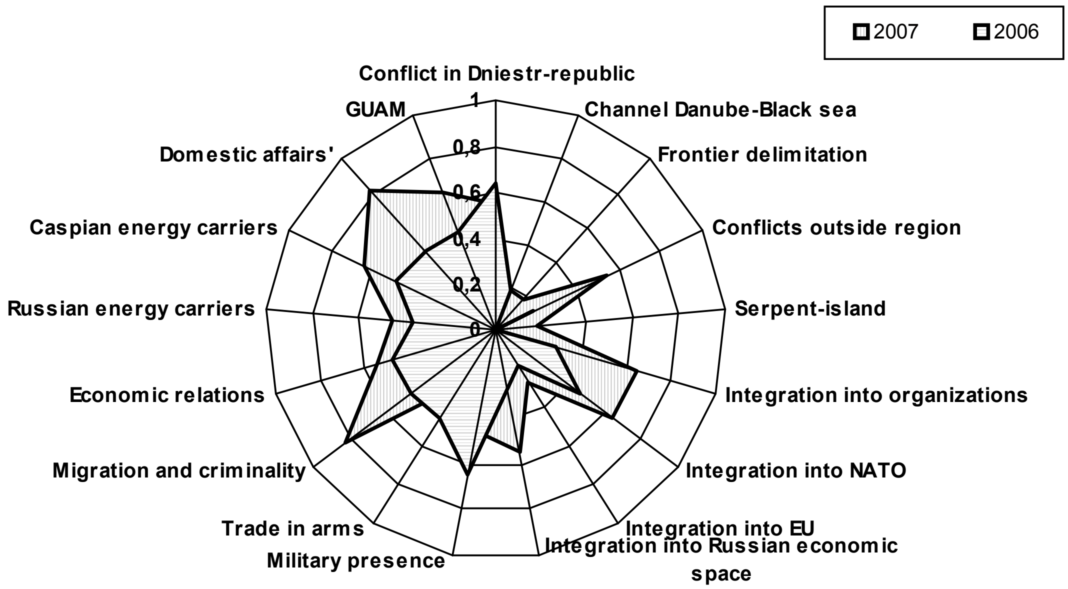


Figure 6. The contradictions levels with Russia on the end 2006 and 2007

Migration problems:

- the accusations of unobstructed transit through Ukraine of foreign hirelings into conflicts zones' on Northern Caucasus;
- drawing up lists of politicians - persons non grata;
- the cancelling by Russia the agreements about registration of Ukraine citizens in territory of Russia;

Integration problems into international organizations:

- the accusations of political pressure of Russia at the time of negotiations between Kirghizia and Ukraine for the integration of Ukraine into WTO;
- the negative expectations of Russia of negotiations with Ukraine for integration of Russia into WTO;

Integration Ukraine into NATO:

- the negative expectations of Russia of disposition of NATO military bases near frontiers, the access possibility of NATO forces to Azov sea, the vulnerability increase of strategic objects;
- the declarations of Russian politicians about cooperation restriction with Ukraine in military-technical and economic area;

Transportation and import of Caspian energy carriers:
- the negative attitude of Russia to transit of energy carriers from Kazakhstan, Turkmenistan, Azerbaijan around of Russia;
- the building by Russia of gas pipeline from Central Asian countries around of Ukraine (Near-Caspian gas pipeline, second line of gas pipeline <The Blue stream> through Black sea up to Bulgaria);

Transportation and import of Russian energy carriers:
- the building by Russia of gas pipeline for transportation of Russian gas around of Ukraine (<Nord Stream> through Baltic sea up to Germany, the second line of gas pipeline <Jamal - Europe> through Belarus and Poland);
- the volumes decreasing of oil transportation through Ukrainian oil pipeline <Friendship> owing to increasing of transit volumes through Russian port Primorsk;
- the refusal of Russia from building of gas pipeline <Bogorodchany - Uzhgorod> through Ukraine;
- the refusal of Russia from fixed price of gas-deliveries into Ukraine;
- the intention of Ukraine to agree the prices of transit and gas.

Moreover the contradictions of Ukraine and Russia along problems of foreign military presence and economic relations have decreased. Ukraine and Russia have found the reciprocal compromise between the problems of basing the Russian Fleet in Crimea and the export of meat and milk into Russia.

The list of problems with contradictory preferences between Ukraine and USA in 2007 has changed in comparison to 2006. In 2006 Ukraine had the contradictions with USA along problems of transportation of Russian energy carriers and influences on domestic affairs' (different views on parliamentary elections). In 2007 the rhetoric activity concerning elections problem has decreased. But the contradictions along problem <Transportation of Caspian energy carriers> have increased. The persistence and tone of declarations demonstrate that the formation principles of the price of Central-Asian gas (which Russia buys and delivers to Ukraine) not satisfy USA. The USA considers the intermediary (company RosUkrEnergo) as the corrupt branch. Also the USA does not agree with transportation route of Caspian energy carriers through Ukraine. The declaration of former ambassador of USA in Ukraine concerning completion hopelessness of oil pipeline <Odessa - Brody> up to Gdansk (Poland) confirms these views of USA. The USA prefers the transportation of Caspian energy carriers through Turkey - through old ally of USA.

Moreover the Ukraine propagandizes the route of gas pipeline <Nabucco> through the own territory and wants to take part in consortium for building of this gas pipeline. However the Ukraine intention does not meet support USA which is the main political engine and initiator of this project. Also USA continues influence attempts on domestic affairs' of Ukraine. The top-level consultations with Ukrainian opposition and the criticism of export policy of Ukrainian government confirm this statement.

In comparison to 2006 the contradictions structure of Ukraine and EU has little changed. The problems with contradictory views of Ukraine and EU are:

Influence on domestic affairs':
- the declarations concerning disclosing murder of journalist G.Gongadze;
- the accusations of corruption of Ukrainian officials;
- the promulgates of parliament dissolution of Ukraine;
- the criticism of constitutional reform of Ukraine;
- the visits cancelling of Ukraine President into some European countries;
- the accusations against Ukraine in participation in confidential program of CIA concerning transportation of people, which CIA considers as terrorists;

Transportation of Caspian energy carriers:
- EU not interests the participation of Ukraine in project of gas pipeline <Nabucco>;
- EU not interests the passage of gas pipeline <Nabucco> through territory of Ukraine;

- EU not supports the project for continuation of oil pipeline <Odessa - Brody> up to Europe;

Transportation of Russian energy carriers:
- EU not interests the transit concentration of all Russian gas through territory of Ukraine;

Integration Ukraine into EU:
- the refusal of membership prospect of Ukraine in EU;
- the signing retardation of agreement with Ukraine about simplification of a visa mode.

In 2006 there were no problems with high contradictions simultaneously for all three forces (Russia, the USA and EU). However in 2007 we have observed the high contradictions between Ukraine and all these forces in problem <Influences on domestic affairs'>. This fact is evidence of influence intensification on domestic and international policy of Ukraine and evidence of intensification of geopolitical struggle between world leaders.

Tension of international relations

The table 2 and figure 7 show the calculation results of aspects estimations of international relations and composite tension.

Apparently, among negative aspects the level of potential contradictions has the least value. The estimation of this aspect (0,39) continues the decrease tendency. The research of model has shown that the estimation level basically depends on contradictions between Ukraine and USA: the low level of contradictions with USA compensates the high level of contradictions with Russia. The maximal value among negative aspects has aggressiveness demonstration level (0,64) which basically depends on contradictions with Russia.

In comparison to 2006 the estimations structure of international relations has changed. In 2006 among negative aspects the contradictions level for use of power against Ukraine had minimal value and the aggressiveness demonstration level had the maximal value. In 2007 objective prerequisites for intentions and actions against Ukraine and for tension growth of international relations is absent: the level of potential contradictions is low. The situation in 2007 becomes similar to situation in 2005 after presidential elections of Ukraine. In 2005 the tension of international relations has increased on background of problems which we not connect with real economy. Pay attention, what the demonstration level of aggressiveness in 2007 has exceeded 0,5. This exceeding is the transition evidence of international relations into new qualitative conditions.

Table 2. Aspects estimations of international relations and composite tension as of the end of 2007

Aspects of international relations	Estimation
Level of potential contradictions	0,39
Contradictions for power using against Ukraine	0,45
Preferences coincidence for power using in support of Ukraine	0,46
Aggressiveness demonstration level	0,64
Tension of international relations	**0,55**

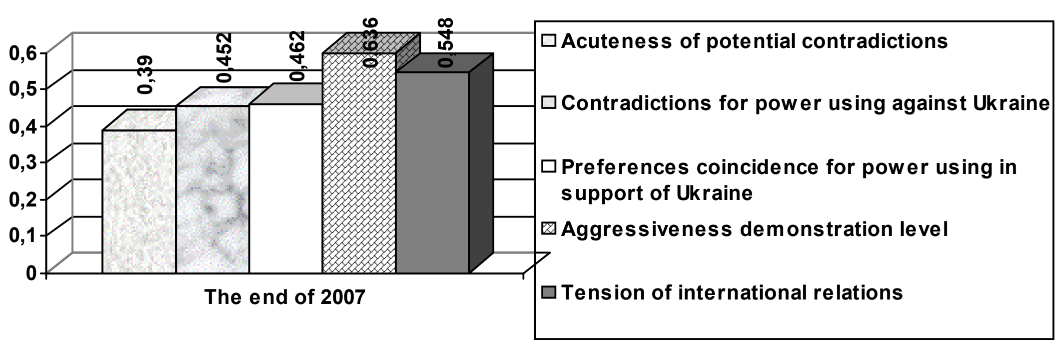


Figure 7. Aspects estimations of international relations and composite tension as of the end of 2007

The model estimates the tension of international relations on the end of 2007 at level 0,55. In conformity with scale on figure 8, we characterize the international relations as <unstably quiet relations with aggravations attributes>.

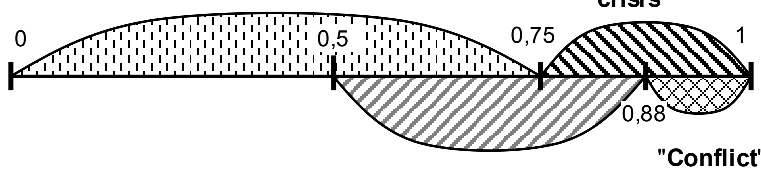


Figure 8. Scale for quality tension estimation of international relations

5. Conclusions

We propose the model of international relations for measurement and detailed analysis of international political-economical risk of country. The model bases on analysis of contradictions and coincidences of states preferences concerning domestic and international problems. In algorithm of model we use the fuzzy integral Sugeno for calculation of partial and composite estimations. We have realized the model by means of special software and have used her for tension estimation and the analysis of international Ukraine relations in 2007.

The proposed model does not replace the person. The model concentrates the analysts' attention on small details (components) and on rules of their aggregation into generalized (composite) conclusions. It is very important as the data amount for real problem can be more than 1000 information units.

The model also can solve subsidiary problems:

- the determination of most important problems in international relations and most dangerous states from view-point of risk for country;
- the search of possible compromises areas and possible integration areas of states;
- the development forecast of international relations.

6. References:

[1] Andrade, Joaquim P., Teles, Vladimir Kuhl, (2004), *An Empirical Model of the Brazilian Country Risk - An Extension of the Beta Country Risk Model*. Social science research network, http://ssrn.com/abstract=558263.

[2] Arin, Kerim Peren, Molchanov, Alexander, Reich, Otto F., (2007), *Politics, Stock Markets, and Model Uncertainty*. Social science research network, http://ssrn.com/abstract=1010251.

[3] Bourke, P., Shanmugam, B., (1990), *An Introduction to Bank Lending*. Addison-Wesley Business Series.

[4] Brewer, T.L., Rivoli, P., (1997), *Political Instability and Country Risk*. in: *Global Finance Journal*, 8 (2): 309-321.

[5] *Country Risk Model*, Economist Intelligence Unit, http://www.riskmodel.eiu.com.

[6] Erdogdu, Oya S., (2006), *Political Decisions, Defense and Growth*. Social science research network, http://ssrn.com/abstract=932514.

[7] *Fuzzy measure and fuzzy integral*. Trans. SICE, 1972, v.8, №2, 95-102.

[8] *Fuzzy Sets in Models of Control and Artificial Intelligence*, Ed. by D.A. Pospelov, Nauka, Moscow, 1986, *in Russian.*

[9] Hammer, P.L., Kogan, A., Lejeune, M.A., (2004), *Country risk ratings: statistical and combinatorial nonrecursive models*. RUTCOR Research Report RRR 8-2004, Rutgers University New Brunswick, New Jersey.

[10] Hammer, P.L., Kogan, A., Lejeune, M.A., (2007), *Reverse-Engineering Country Risk Ratings: Combination Non-Recursive Models*. Social science research network, http://ssrn.com/abstract=975564.

[11] ICRG. *International Country Risk Guide*, The PRS Group Inc., 2000 - 2006.

[12] Lensink, Robert, Hermes, Niels, Murinde, Victor, (2000), *Capital flight and political risk*. in: *Journal of International Money and Finance*, Volume 19, Issue 1: 73-92.

[13] Misztal P., (2007), *International Competitiveness of Polish Economy in Years 1995-2005*, in: *Journal of Applied Economic Sciences*, Volume 2, Issue 1(2).

[14] Moser, Christoph, Nestmann, Thorsten, Wedow, Michael, (2006), *Political Risk and Export Promotion: Evidence from Germany*. Social science research network, http://ssrn.com/abstract=944779.

[15] Saaty T.L., (1980), *The Analytic Hierarchy Process*, McGraw Hill, New York, NY.

[16] Simpson, John L., (1997), *A Regression Model of Country Risk and Risk Scoring*. Curtin School of Economics and Finance. Working Paper No. 97.11., http://ssrn.com/abstract=280748.

SIMILARITIES AND DIFFERENCES BETWEEN FEMALE AND MALE ENTREPRENEURS IN A TRANSITION CONTEXT: EVIDENCE FROM BULGARIA

Desislava **YORDANOVA**, Tsvetan **DAVIDKOV**
Sofia University "*St. Kliment Ohridski*", **Bulgaria**
Faculty of Economics and Business Administration
d_yordanova@abv.bg, tzvetandavidkov@feb.uni-sofia.bg

Abstract

The aim of this paper is to examine similarities and differences between Bulgarian female and male entrepreneurs with regard to a number of personal characteristics, characteristics of their ventures, and characteristics of the environmental context, in which they operate. A sample of 501 companies (282 male-owned and 219 female-owned) with a single owner is used in the present study. Data have been analyzed using a binary logistic regression. The differences in entrepreneurship identified in this paper are strikingly similar to those reported in the literature in Western countries. This could be explained with the presence of similar gender inequalities and deeply structured processes of female subordination in capitalist, command and transition economies.

Key words: gender, entrepreneurship, women, Bulgaria.

JEL Classification: M1

1. Introduction

During the last decades, the research on female entrepreneurs and their ventures has increased significantly [Carter et al., (2001)]. This literature provided valuable descriptions of female entrepreneurs when the mainstream research had focused predominantly on male entrepreneurs (Carter, 2000) and thus made female entrepreneurs more "visible" [Berg, (1997:259)]. However, despite the growing number and sophistication of the studies on female entrepreneurship [Ahl, (2002)], most of this research has been conducted mainly in Anglo-Saxon countries [Ahl, (2002)] and there is a need for more theory-based, heterogeneous, and cumulative studies [Carter et al., (2001), Bruin et al., (2006)]. Female entrepreneurship in transition economies in CEE is a new phenomenon and therefore has not attracted much research interest [Isakova et al., (2006)]. The purpose of this study is to examine whether Bulgarian female and male entrepreneurs are the same or different with regard to a number of personal characteristics (age, education level, start-up motivation, management training/skills, growth intentions, personality traits, management style), characteristics of their ventures (firm age, size, initial resources, legal form), and characteristics of environmental context, in which their ventures operate (sector and support from family and friends).

2. The context for female entrepreneurship in transition economies

During the period of command economy the participation of women in all types of education and professions as well as in politics and social life was demanded and encouraged [Metcalfe and Afanassieva, (2005)]. Women endured "double-burden" responsibilities for taking the primary care for their children and families and for participate equally with men in the labour market and in social and political life [Grapard, (1997); Pollert, (2003)]. In the labour market in CEE, there were gender-based vertical as well as horizontal employment segregation and gender-based discrimination [Pollert, (2003); UNECE (2002); Metcalfe and Afanassieva, (2005)]. The numerous arrangements and privileges for women, which were designed to allow them to combine work and family responsibilities, "simultaneously sacrificed the goal of equality for women" [Bliss and Garratt, (2001)] and actually reinforced gender differences [Grapard, (1997)]. In summary, although women under communism enjoyed significant gender equality advantages in comparison with other industrialized countries, they were victims of female subordination in all social spheres [Pollert, (2003)].

The prevailing political and economic views about reforms and transition in CEE relied on liberal democratic political systems and free markets to guarantee individual prosperity and equality [Metcalfe and Afanassieva, (2005)]. However, the transition period not only failed to build on gender equality advantage of communist legacy, but also damaged it and produced new gender inequalities in both the public and the private spheres [Pollert, (2003)]. The social cost of transition was disproportionately beard by women and children [Grapard, (1997)]. There were trends towards "the resurrection and strengthening of patriarchal views of the role of women in society" [Degtiar, (2000:9)]. Women were constrained to participate in or displaced from political, economic, and social spheres [Grapard, (1997); Degtiar, (2000)]. Two years after the EU accession of the 10 new member states, the status of gender equality in these countries still faces serious concerns[7]. Recently, the role of women political, economic, and social activity for lower corruption levels in transition economies was demonstrated by Michailova and Melnykovska (2009).

Despite the negative influence of market reforms on women's status, paid employment opportunities for women have expanded and alternative opportunities for women such as self-employment and creation of small enterprises have appeared [Degtiar, (2000)]. With regard to entrepreneurship it has been acknowledged that women were again in a disadvantaged position compared to men especially in the early years of transition [Welter et al., (2006)]. Moreover, in many transition countries women were confronted with negative gender stereotypes such as entrepreneurship being a male occupation [Welter et al., (2006)] and very traditional beliefs about women's role in society [Tilley, (2002)]. Despite this, entrepreneurship became an attractive employment option that might enable women to overcome shortcomings in the labour market and to combine work and family lives and could play an important role for improving the status of women in the economy and society as a whole [Degtiar, (2000); Stoyanovska, (2001)].

3. Institutional theory

Institutional theory draws attention to the role of institutions in shaping individual behaviour. Institutions are defined as "the rules of the game in a society or, more formally, are the humanly devised constrains that shape human interaction" [North, (1990)]. North (1990) makes a distinction between formal institutions - which comprise political and judicial rules, economic rules, and contracts - and informal institutions - such as codes of conduct, norms of behaviour, and conventions. While formal institutions can be changed relatively easy with political or judicial decisions, informal institutions are path-dependent and deeply rooted in society and therefore very resistant to change [North, (1990)]. Both formal and informal institutions influence individual behaviour, assist in reducing transaction costs, facilitate economic exchange, and determine economic development [North, (1990)]. Gender issues received little attention by institutional theorists. However, in contemporary society gender norms are recognized as influential institutions [Van Staveren and Odebode, (2007)].

Recently, the role of formal and informal institutions has been highlighted particularly for understanding female entrepreneurship in transition economies [Welter et al., (2003)]. Informal institutions such as beliefs that entrepreneurship was a male occupation [Welter et al., (2006)], family values [Aidis et al., (2007)] and traditional beliefs about women's role in society [Tilley, (2002)] in transition economies may influence the assistance women may receive from family and friends for starting and running a business, their access to start-up resources [Welter et al., (2003)], growth intentions, and start-up motivation. Formal institutions relevant for understanding gender differences in entrepreneurship in transition economies are laws for gender equality, regulations against gender-based discrimination, social security arrangements for maternity, tax regulations, etc. [Welter et al., (2003)].

4. Empirical evidence about female and male entrepreneurs

4.1. Gender differences and similarities in entrepreneurship in Western countries

Significantly fewer women are involved in entrepreneurship than men in Western countries [Allen et al., (2008)]. Although male and female entrepreneurs exhibit similar levels of education,

---

[7] Concluding statement of the consultative meeting organized by the United Nations Development Fund for Women (UNIFEM), Regional Office for Central and Eastern Europe (CEE) on April 21-22, 2006 in Bratislava. Available at: http://www.unifem.org/attachments/stories/currents_200606_EUBratislavaMeeting_ConcludingStatement.pdf, retrieved on 12 October 2007.

female entrepreneurs may lack appropriate type of education and prior experience [Brush, (1992); Boden and Nucci, (2000); Kalleberg and Leicht, (1991); Verheul, (2005)] for starting and running a successful business compared to their male counterparts. Female entrepreneurs are more similar than different from male entrepreneurs in terms of personality traits except in terms of risk-taking propensity [Brush; (1992)]. Women choose self-employment and entrepreneurship for family-related and other non-economic reasons more often than men [Cromie, (1987); Boden, (1999); DeMartino and Barbato, (2003)], while men tend to place more importance on economic motives [Cromie, (1987); DeMartino and Barbato, (2003); Wilson et al., (2004)]. Women tend to use relational practices and exhibit participative management style, while men tend to be autocratic managers [Chaganti, (1986); Neider, (1987); Rosener, (1990)]. Some studies find that female entrepreneurs are also less likely to exhibit growth intentions [Rosa et al., (1996); Orser et al., (1998)].

The majority of female-owned businesses are concentrated in service and trade industries [Neider, (1987); OECD, (1998); Loscocco et al., (1991), Orser et al., (2006)] and are registered as sole proprietorships [Brush, (1992), Baker et al., (1997), Greene et al. (2003), Carter et al., (2001)], which may be associated with their lower risk preferences and lower growth aspirations in comparison with male entrepreneurs [Turk and Shelton, (2004)]. Female-owned firms are smaller than those owned by men [Orser et al. (2006)] even after controlling for firm age, industry [Rosa et al., (1996)], education, experience, and motivation [Fisher et al., (1993)]. Female entrepreneurs start their businesses with relatively less resources such as human, social, and financial capital, than male entrepreneurs [Carter et al., (2001); Boden and Nucci, (2000); Cooper et al., (1994); Verheul, (2005), Alsos et al., (2006)].

4.2. Female entrepreneurship in a transition context

As in many Western countries, women in CEE become entrepreneurs significantly less often than men despite their good levels of education and high labour force participation (UNECE, 2002). The available literature on gender and entrepreneurship in the countries in transition from centrally planned to market economy apart from being scarce is limited in two aspects. First, most studies use qualitative methodology or limited samples and therefore the available finings cannot be easily generalized [Hisrich and Fulop, (1994, 1997); Lituchy and Reavley, (2004)]. And second, the majority of the studies is mainly descriptive and deals with the profile of female entrepreneurs or the environment for female entrepreneurship in certain countries [Hisrich and Fulop, (1994, 1997); Wells et al., (2003); Zapalska, (1997)]. Only few studies examine gender differences in entrepreneurship and business ownership using a larger sample in a transition context [Welter et al., (2005); Manolova et al., (2007); Davidkov, (2006); Isakova et al., (2006)].

The demographic profile of female entrepreneurs in transition countries is very similar to the profile identified by empirical research on female entrepreneurs in developed countries with the exception that female entrepreneurs operating in transition countries exhibit a higher level of education [Welter et al., (2005)]. Female entrepreneurs in transition economies differ from their colleagues in Western countries in their approaches to running a business. They exhibit a somewhat autocratic management style [Lituchy and Reavley, (2004)] and report growth as one of their main objectives [Welter et al., (2005); Wells et al., (2003); Lituchy and Reavley, (2004)].

In transition economies we find similar gender differences in entrepreneurship as in Western countries. Female entrepreneurs in transition economies are less growth-oriented than male entrepreneurs [Isakova et al., (2006)] and tend to consult with subordinates more often than their male colleagues [Davidkov, (2006)] than male entrepreneurs. As in Western countries, female-owned companies in transition economies are very small and concentrated in traditional industries such as services and trade [Wells et al., (2003); Welter et al., (2005); Izyumov and Rasumnova, (2000); Aidis et al., (2007)], which reflects mainly the education and previous work experience of their owners [Izyumov and Rasumnova, (2000); Hisrich and Fulop, (1994)]. Female entrepreneurs in transition economies also tend to operate smaller companies than their male colleagues [Drnovsek and Glas, (2006); Aidis, (2006)].

5. Research methodology

This study uses data obtained from a database on Bulgarian private enterprises and their owners containing a representative sample of more than 1000 companies [Davidkov, (2006)] created in 2004 through a survey using standardized interviews with the owner-manager or one of the owner-managers of the companies. The survey is representative for the population of Bulgarian private enterprises with regard to legal form and location and was accurate to 0.05 (5%). Approximately 40% of the interviewed owner-managers were female, while 60% were male. Since the database does not contain information about other partners' gender in the case of multiple ownership, we have extracted a sub-sample of 501 companies (282 male-owned and 219 female-owned) with a single owner to be used in the present study.

The dependent variable in this study (GENDER) is measured by a dummy taking value 1 if the owner is female and value 0 if the owner is male. The study employs three groups of independent variables. The first group comprises individual characteristics of the owner: *age*, *level of education, management style, presence of management training and/or skills, growth intentions, risk-taking propensity, locus of control, and motivation for start-up*. In order to identify the *management style* of respondents, they were provided with four short descriptions of different styles of making and implementing management decisions in organizations adopted from Hofstede (1996) and asked to choose the description which more closely resembles the owner-manager in their company. As in other studies [Powell and Ansic, (1997)], in order to measure risk taking propensity respondents were confronted with three investment opportunities and were asked to choose whether they would invest a certain amount of money. The owners who refused to make an investment in all three cases were regarded as risk averse. The locus of control of respondents was explored asking the following question: "To what extent does the resolution of the problems of your business depend on you?". LOCCONT takes value 1, if respondents believe that they can solve most of the problems of their business (internal locus of control), and value 0, if they believe that the resolution of only some or few problems depends on them (external locus of control). The second group of variables consists of the following characteristics of the business: *size, firm age, legal form, initial resources*, while the third group of variables comprises the following characteristics of the environment: *the presence of support from family and friends* and *sector*. The definition of all variables used in the study is presented in Table 1.

Table 1. Variables used in the study

Variable	Definition
GENDER	1 = female, 0 = male
EDU	1 = the respondent has completed University studies, 0 = the respondent has a lower level of education
MANAGEMENT	1 = if the respondent has management training or have acquired management skills, 0 = otherwise
RISK_AVERSE	1 = the respondent is risk averse, 0 = otherwise
LOCCONT	1 = internal locus of control, 0 = external locus of control
FIN_MOTIVES	1 = the respondent reports financial motives as very important for start-up, 0 = otherwise
M_STYLE	1 = autocratic management style, 0 = consultative/participative management style
GROWTH	1 = the respondent plans to expand her/his current activity or to start new activity, 0 = otherwise
LN_AGE	natural logarithm of entrepreneur's age (in number of years)
SIZE	1 = no employees, 2 = less than 6 employees, 3 = between 6 and 10 employees, 4 = between 11 and 25 employees, 5 = between 26 and 50 employees, 6 = more than 50 employees
FIRM_AGE	natural logarithm of firm age (in number of years)
LEGAL_FORM	1 = sole proprietorship, 0 = other legal form
PERSONNEL	1 = not enough personnel at start-up, 0 = otherwise
CAPITAL	1 = not enough start-up capital, 0 = otherwise

MANUFACTURING	1 = the main business activity of the company is in the manufacturing sector, 0 = otherwise
TRADE	1 = the main business activity of the company is in the trade sector, 0 = otherwise
SUPPORT	1 = the respondent receives support from family and friends, 0 = otherwise

Data are analyzed using both descriptive statistics and multivariate analysis. Correlations between independent variables are measured using Pearson correlation and Spearman's rho coefficients (Table 2). These correlations are relatively modest (Table 2). They do not exceed 0.33 except for the correlation between TRADE and MANUFACTURING ($r=-0.424$, $p < 0.01$). Therefore, we do not expect serious multicollinearity problems. As the dependent variable is dichotomous, a logistic regression model has been employed to deal explicitly with that type of dependent variable [Greene, (1997)]. Data analyses are performed with the statistical package EViews version 6.0 (see Table 2).

6. Empirical Results

In this section we first describe the profile of Bulgarian female entrepreneurs and their companies. Then, we estimate several regression models to examine similarities and differences between female and male entrepreneur in our sample of 501 Bulgarian private companies.

The average age of female entrepreneurs is 43 years. They are most likely to be between 36 and 55 years old and have often been influenced by financial motives to enter entrepreneurship. Bulgarian female entrepreneurs are willing to take risks and exhibit internal locus of control. The great majority of them have experienced lack of personnel and capital at start-up. Almost half of them exhibit autocratic management style, while the others have participative or consultative management style. Female-owned companies are usually very small (have less than 6 employees) and registered as sole proprietorships. These companies predominantly operate in service and trade sectors and are in business usually more than 5 years. With regard to these characteristics, Bulgarian female entrepreneurs are very similar to female entrepreneurs in other transition economies in CEE. There are some differences between our results and empirical evidence about female entrepreneurs and their ventures in other transition economies. Surprisingly, more than 75% of female entrepreneurs in our sample have acquired management training and/or skills. However, the majority of them have not completed University studies (56.6%). And finally, they relatively rarely exhibit growth intentions (49.8%) in comparison with female entrepreneurs in other countries in transition.

Four logistic regression models have been estimated to identify which independent variables are associated with entrepreneur's gender (Table 3).

Table 2: Correlations between variables in the study.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	SIZE																
2	GROWTH	.23***															
3	GENDER	-.19***	-.12***														
4	FIRM_AGE	.21***	-0.05	-.18***													
5	MANU-FACTURING	.32***	.14***	-.14***	.12**												
6	TRADE	-0.07	-0.07	.16***	-0.03	-.42***											
7	LEGAL_FORM	-.30***	-.17***	.16***	0.03	-.27***	.14***										
8	PERSONNEL	-.29***	-0.09*	0.06	0.06	-0.02	-0.01	.14***									
9	CAPITAL	-0.02	-0.07	0.01	-0.05	0.05	0.04	0.05	.21***								
10	EDU	.10**	.10**	0.03	-0.01	0.03	-.10**	-.18***	-0.04	-0.06							
11	M_STYLE	0.05	-0.01	-.13***	0.001	-0.06	0.01	-0.04	-0.01	-0.04	-0.03						
12	MANA-GEMENT	.16***	0.08*	-.09**	.13***	0.08*	-0.03	-.11**	-.17***	-0.09*	.11**	0.08*					
13	RISK_AVERSE	-.15***	-.26***	0.07	-0.004	-.10**	.11**	0.04	0.04	0.03	-.14***	-0.02	-0.03				
14	FIN_MOTIVES	.15***	.16***	-0.03	.10**	0.04	-0.07	-0.05	0.01	-0.01	.10**	0.03	0.07	-.13***			
15	SUPPORT	.12***	0.06	-0.02	0.05	0.05	-0.004	-0.03	-.09**	0.03	-0.06	0.05	0.08*	-0.02	0.01		
16	LN_AGE	0.03	-.16***	-.09**	.31***	0.04	-0.06	-0.01	0.03	-0.05	0.06	-0.02	0.08*	.14***	-0.05	-0.06	
17	LOCCONT	-0.06	-0.07	0.01	0.01	0.05	0.02	-0.01	-0.02	-0.08*	-.11**	-0.01	0.06	0.03	-0.04	0.05	-0.05

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

The first two models consider the influence of entrepreneur's personal characteristics on the owner's gender. The third model takes into account only the influence of business characteristics on the dependent variable. And the fourth model presents the influence of the characteristics of environment on GENDER. Table 3 contains estimated coefficients, standard errors, and goodness of fit measures of the models. All models are significant at least at 99% confidence level according to their LR statistics, therefore rejecting the null hypothesis that all coefficients (except the constant) are zero. All models are able to correctly predict GENDER at a rate higher than random chance (50%).

Table 3. Results of binary logistic regressions including GENDER as a dependent variable.

	Model 1		Model 2		Model 3		Model 4	
Variable	**B**	**S.E.**	**B**	**S.E.**	**B**	**S.E.**	**B**	**S.E.**
EDU	0.17	0.19	0.24	0.19				
FIN_MOTIVES			-0.051	0.19				
GROWTH			-0.52***	0.20				
LN_AGE	-0.74**	0.38	-1.06***	0.40				
LOCCONT			0.03	0.25				
M_STYLE			-0.54***	0.19				
MANAGEMENT	-0.46**	0.23	-0.35	0.23				
RISK_AVERSE			0.24	0.21				
CAPITAL					-0.06	0.22		
FIRM_AGE					-0.50***	0.14		
LEGAL_FORM					0.83***	0.29		
PERSONNEL					0.17	0.21		
SIZE					-0.17*	0.10		
MANUFACTURING							-0.59*	0.31
SUPPORT							-0.10	0.47
TRADE							0.49**	0.20
McFadden R-squared	0.013079		0.040084		0.050225		0.024303	
Log likelihood	-338.8052		-329.5344		-326.0532		-334.9522	
LR statistic	8.979826**		27.52144***		34.48399***		16.68586***	
Overall % correct predictions	59.68%		61.88%		63.07%		57.68%	
Number of cases	501		501		501		501	

* p < 0.1, ** p < 0.05, *** p < 0.01

In order to examine gender differences in individual characteristics of entrepreneurs we estimate 2 different models (Table 3). According to Model 1 female entrepreneurs are less likely to possess management training and skills even when holding LN_AGE and EDU constant. Model 2 includes all individual characteristics used in this study. The coefficients of the variables GROWTH, LN_AGE, and M_STYLE are statistically significant and negative, while the coefficient of the variables EDU, FIN_MOTIVES, LOCCONT, and RISK_AVERSE are not significant. Model 3 indicates that the coefficients of the variables FIRM_AGE, LEGAL_FORM, and SIZE are statistically significant, while the coefficients of the variables PERSONNEL and CAPITAL are not significant. Model 4 shows that two environmental characteristics are linked to GENDER (TRADE and MANUFACTURING). However, male and female entrepreneurs are equally likely to receive support from family and friends.

7. Discussion and Conclusions

This study explores the question whether Bulgarian female and male entrepreneurs are the same or different with regard to a number of individual, business, and environmental characteristics. As in the research undertaken in Western countries [Greene et al., (2003); Ahl, (2002); Carter et al., (2001); Brush, (1992)] and in other transition economies [Isakova et al., (2006)], the main conclusion of our empirical analysis is that Bulgarian male and female entrepreneurs and their businesses are different in some characteristics and similar in others. In particular, the following similarities have been identified in our analysis:

- Female and male entrepreneurs in Bulgaria are very similar in personality traits such as locus of control and willingness to take risks, which are considered as some of the distinctive psychological traits of entrepreneurs. Although female and male business owners in private firms seem to differ in terms of risk taking [Davidkov, (2006)], these differences disappear when comparing female and male entrepreneurs.
- Women and men in our sample report having obtained similar levels of education. Formal institutions - such as quota system for recruiting students of both sexes in Bulgarian secondary schools and universities - and informal institutions - such as positive attitudes in society toward educating children of both sexes - can explain this finding.
- Both female and male entrepreneurs are equally likely to cite financial motives as very important for start-up. This finding is not surprising in transition countries characterized with unfavourable economic conditions, where the need to generate income is very significant for both men and women.
- Entrepreneurs regardless of their gender have experienced lack of initial start-up resources such as capital and personnel. It seems equally difficult to obtain the necessary start-up capital and personnel for both women and men in a country with a poor economic situation.
- The probability of receiving support from family and friend is similar for both female and male entrepreneurs.

Gender differences can be observed in a number of individual, business, and environmental characteristics of Bulgarian entrepreneurs and their ventures:

- Female entrepreneurs are younger than male entrepreneurs.
- Male entrepreneurs are more likely to exhibit autocratic management style, while female entrepreneurs tend to show participative or consultative management style.
- In comparison with men, women are less likely to report growth intention.
- Female entrepreneurs are less likely to possess management training and skills than their male counterparts even when controlling for age and education.
- Women are more likely to choose sole proprietorship as a legal form and to run smaller businesses than men. Formal institutions - such as higher capital requirements and more unfavourable tax and social security regulations associated with other legal forms - may be obstacles for Bulgarian female entrepreneurs.
- Female-owned businesses are more likely to operate in trade sector, while male-owned businesses in manufacturing sector.

Institutional Theory seems applicable to explain gender differences in a transition context. Various formal and informal institutions may account for the reported similarities and differences between male and female entrepreneurs, their ventures, and the environment in which they operate. Moreover, the differences identified in this study are strikingly similar to differences between female and male entrepreneurs reported in the literature in Western countries despite the huge differences in institutional environments. This could be explained with the presence of similar gender inequalities and deeply structured processes of female subordination in capitalist, command and transition economies [Pollert, (2003); Grapard, (1997)], which eventually lead to gender differences [Kimmel, (2004)]. The fundamental transformations in CEE, based on liberal democratic tradition, have produced and reinforced similar informal institutions such as social arrangements and practices as in Western countries. In the economic sphere, the reforms aimed at establishing market economy in CEE have mimicked to a great extent the institutions of business ownership in Western developed countries, "which *are already gendered*, in the sense of having been built and dominated by men" [Baker et al., (1997)]. For example, Welter (2006) stresses that in Germany "the rapid re-unification process, which transferred West German institutions, rules, laws, and organizations to East Germany, also favoured a 'renaissance of conservatism', thus resulting in hidden conflicts between the predominant orientation of East German women and societal values".

We should consider the limitations of this study before considering the implications of our results. First, data were collected through a self-reported survey and thus may be subject to cognitive and motivational biases and errors due to problems with memory. The fact that the survey was anonymous may lessen some areas of potential biases. Second, our sample comprises only businesses with a single owner; therefore, our findings can not be generalized to the case of businesses started and managed by entrepreneurial teams. And finally, our findings may be influenced by the Bulgarian cultural environment and therefore may not be applicable to other transition economies.

The findings presented here can help to outline several policy priorities and measures for supporting female entrepreneurship in a transition context. First, as suggested by Welter et al. (2006), the improvement of institutional environment and administrative capacity to deal with new and small firms will facilitate both female and male entrepreneurship. Second, special programs and policy initiatives to make start-up resources more accessible for entrepreneurs are needed. In the context of EU membership, Bulgarian authorities should provide equal access to EU-funded programs for new and small (female) firms. Third, it is necessary to improve social services which will allow female entrepreneurs to combine family and business responsibilities because family and children are of great concern for Bulgarian female entrepreneurs [NSI, (2004)]. In addition, more attention should be paid to developing education and training initiatives for female entrepreneurs, which will help them to improve their management skills. And finally, since Bulgarian female entrepreneurs prefer to operate their ventures in trade and service sectors, policy makers should be aware that policies and measures oriented toward these sectors could affect stronger female entrepreneurs as a group than male entrepreneurs and their businesses [Welter et al., (2005)].

In order to understand better gender differences in entrepreneurship, future research should examine the influence of various social arrangements and practices on male and female entrepreneurship in transition economies. This may shed more light on whether female entrepreneurs choose purposely to avoid growth and to operate smaller companies and, if yes, for what reasons and/or whether they encounter specific barriers and obstacles, which prevent their companies from business expansion.

8. References:

[1] Aculai, E., Rodionova, N., Vinogradova, N. (2006), *Women Business Owners in Moldova: Proprietors or Entrepreneurs?*, in Welter, F., Smallbone, D., and N. Isakova (eds.), *Enterprising Women in Transition Economies*, Ashgate, Aldershot, pp. 67-91.

[2] Ahl, H. (2002), *The making of the female entrepreneur, a discourse analysis of research texts on women's entrepreneurship*, JIBS Dissertation Series 015, Jonkoping University.

[3] Aidis R., Welter F., Smallbone D., Isakova I. (2007), *Female entrepreneurship in transition economies: the case of Lithuania and Ukraine*, in: *Feminist Economics*, Volume 13, No. 2, pp. 157 – 183.

[4] Aidis, R. (2006), *From Business Ownership to Informal Market Traders: The Characteristics of Female Entrepreneurship in Lithuania*, in Welter, F., Smallbone, D., and N. Isakova (eds.), *Enterprising Women in Transition Economies*, Ashgate, Aldershot, pp. 119-142.

[5] Allen, E., Elam, A., Langowitz, N., Dean, M. (2008), *GEM 2007 Report on Women and Entrepreneurship*.

[6] Alsos, G., Isaksen, E., Ljunggren, E. (2006), *New venture financing and subsequent business growth in men- and women-led businesses*, in: *Entrepreneurship Theory and Practice*, Volume 30 No. 5, pp. 667-686.

[7] Baker, T., Aldrich, H., Liou, N. (1997), *Invisible entrepreneurs: The neglect of women business owners by mass media and scholarly journals in the United States*, in: *Entrepreneurship and Regional Development*, Volume 9, No. 3, pp. 221-238.

[8] Berg, N. (1997), *Gender, place and entrepreneurship*, in: *Entrepreneurship and Regional Development*, Volume 9 No. 3, pp. 259-268.

[9] Bliss R. and Garratt N. (2001), *Supporting women entrepreneurs in transitioning economies*, in: *Journal of Small Business Management*, Volume 39 No. 4, pp. 336-344.

[10] Boden, R. J. (1999), *Flexible Working Hours, Family Responsibilities, and Female Self-Employment: Gender Differences in Self-Employment Selection*, in: *American Journal of Economics and Sociology*, Volume 58, No. 1, pp. 71-83.

[11] Boden, R. J., Nucci, A. R., (2000), *On the survival prospects of men's and women's new business ventures*, in: *Journal of Business Venturing*, Volume 15, No.4, pp. 347-372.

[12] Bruin A., Brush, C. and Welter, F. (2006), *Introduction to the special issue: towards building cumulative knowledge on women's entrepreneurship*, in: *Entrepreneurship Theory and Practice*, Volume 30 No. 5, pp. 585–593.

[13] Brush, C., (1992), *Research on women business owners: Past trends, a new perspective and future directions*, in: *Entrepreneurship Theory and Practice*, Volume 16, No. 4, pp. 5-30.

[14] Carter, S. (2000), *Improving the numbers and performance of women-owned businesses: some implications for training and advisory services*, in: *Education and Training*, Volume 42, No. 4/5, pp. 326-333.

[15] Carter, S., Anderson, S., Shaw, E. (2001), *Women Business Ownership: a review of the academic, popular and internet literature*, Report to the Small Business Service, Department of marketing, University of Starthclyde.

[16] Chaganti, R., (1986), *Management in women owned enterprises*, in: *Journal of Small Business Management*, Volume 24 No. 4, pp. 18-29.

[17] Cooper, A. C, Gimeno-Gascon, J. F., Woo, C., (1994), *Initial human and financial capital as predictors of new venture performance,* in: *Journal of Business Venturing*, Volume 9, No. 5, pp. 371-395.

[18] Cromie, S., (1987), *Similarities and differences between women and men who choose business proprietorship*, in: *International Small Business Journal*, Volume 5 No. 3, pp. 43-60.

[19] Davidkov, Tz., (2006), *Bulgaria & The Entrepreneurs*, St. Kliment Ohridski University Press, Sofia.

[20] Degtiar, L. (2000), *The transformation process and the status of women*, in: *Problems of Economic Transition*, Volume 43, No.7, pp. 7–19.

[21] DeMartino, R., Barbato, R. (2003), *Differences between women and men MBA entrepreneurs exploring family flexibility and wealth creation as career motivators*, in: *Journal of Business Venturing*, Volume 18, No. 6, pp. 815-832.

[22] Drnovsek, M., Glas, M., (2006), *Women Entrepreneurs in Slovenia: by fits and starts*, in Welter, F., Smallbone, D., N. Isakova (eds.), *Enterprising Women in Transition Economies*, Ashgate, Aldershot, pp. 143-170.

[23] Grapard, U. (1997), *Theoretical issues of gender in the transition from socialist regimes*, in: *Journal of Economic Issues*, Volume 31, No. 3, pp. 665-686.

[24] Greene, P., Hart. M., Gatewood. E., Brush, C, Carter, N. (2003), Women Entrepreneurs: *Moving Front and Center: An Overview of Research and Theory*, United States Association Small Business and Entrepreneurship White Paper, Available at: http://www.cofc.edu/entrepreneurconsortium/resources/researchpdf/greene2003.pdf.

[25] Greene, W., (1997), *Econometric Analysis, Prentice Hall*, New Jersey.

[26] Hirsch, R., Fulop, G., (1994), *The role of women entrepreneurs in Hungary's transition economy*, in: *International Studies of Management and Organizations*, Volume 24, No. 4, pp. 100-117.

[27] Hirsch, R., Fulop, G., (1997), *Women entrepreneurs in family business: The Hungarian case*, in: *Family Business Review*, Volume 10, No.3, pp. 281-302.

[28] Hofstede, G., (1996), *Cultures and Organizations, Software of the Mind: Intercultural Cooperation and its Importance for Survival*, McGraw-Hill, New York.

[29] Isakova, N., Krasovska, O., Kavunenko, L., Lugovy, A., (2006), *Entrepreneurship in the Ukraine: A Male Female Comparison*, in Welter, F., Smallbone, D., and N. Isakova (eds.), *Enterprising Women in Transition Economies*, Ashgate, Aldershot, pp. 17-43.

[30] Izyumov, A., Razumnova, I., (2000), *Women entrepreneurs in Russia: learning to survive the market*, in: *Journal of Developmental Entrepreneurship*, Volume 5, No. 1, pp. 1-19.

[31] Kalleberg, A., Leicht, K., (1991), *Gender and organizational performance: Determinants of small business survival and success*, in: *Academy of Management Journal*, Volume 34, No.1, pp. 136-161.

[32] Kimmel, M., (2000). *The Gendered Society*, Oxford University Press, New York, Oxford.

[33] Lituchy, T., Reavley, M., (2004), *Women entrepreneurs: A comparison of international small business owners in Poland and the Czech Republic*, in: *Journal of International Entrepreneurship*, Volume 2, No.1-2, pp. 61-87.

[34] Loscocco, K., Robinson, J., Hall, R., Allen, J., (1991), *Gender and small business success: An inquiry into women's relative disadvantage*, in: *Social Forces*, Volume 70, No. 1, pp. 65-85.

[35] Manolova, T., Carter, N., Manev, I., Gyoshev, B., (2007), *The differential effect of men and women entrepreneurs' human capital and networking on growth expectancies in Bulgaria*, in: *Entrepreneurship Theory and Practice*, Volume 31, No. 3, pp. 407-426.

[36] Metcalfe, B., Afanassieva, M., (2005), *Gender, work, and equal opportunities in central and eastern Europe*, in: *Women in Management Review*, Volume 20, No. 6, pp. 397-411.

[37] Michailova, J., Melnykovska, I. (2009), *Gender, corruption and sustainable growth in transition countries*, in: *Journal of Applied Economic Sciences,* Volume IV Issue 3(9), pp. 387-407.

[38] Neider, L., (1987), *A preliminary investigation of female entrepreneurs in Florida*", in: *Journal of Small Business Management*, Volume 25, No. 3, pp. 22-29.

[39] North, D., (1990), *Institutions, institutional change and economic performance*, Cambridge University Press, Cambridge.

[40] NSI, (2004), *Small and medium-sized enterprises in the Republic of Bulgaria*. Report published on January 29, available at http://www.nsi.bg.

[41] OECD, (1998) *Women entrepreneurs in small and medium enterprises*, Proceedings of the OECD Conference on Women Entrepreneurs in Small and Medium Enterprises: A Major Force in Innovation and Job Creation, 16-18 April 1997.

[42] Orser, B., Hogarth-Scott, S., Wright, P., (1998). *On the growth of small enterprises: the role of intentions, gender and experience*, in *Frontier of entrepreneurship research*, Babson College, Wellesley, MA, pp. 366–380.

[43] Orser, B., Riding, A., Manley, K. (2006), *Women entrepreneurs and financial capital*, in *Entrepreneurship Theory and Practice*, Volume 30, No. 5, pp. 643-665.

[44] Pollert, A., (2003), *Women, work and equal opportunities in post-Communist transition*, in *Work, Employment and Society*, Volume 17, No. 2, pp. 331-357.

[45] Powell, M., Ansic D., (1997), *Gender differences in risk behaviour in financial decision-making: An experimental analysis*, in: *Journal of Economic Psychology*, Volume 18, No. 6, pp. 605-628.

[46] Rosa, P., Carter, S., Hamilton, D., (1996), *Gender as a determinant of small business performance: insights from a British study*, in: *Small Business Economics*, Volume 8, No. 4, pp. 463-478.

[47] Rosener, J., (1990). *Ways Women Lead,* in: *Harvard Business Review*, Volume 68, No. 6, pp. 119–125.

[48] Stoyanovska, A., (2001), *Jobs, gender and small enterprises in Bulgaria*, Series on women's entrepreneurship development and gender in enterprises – WEDGE, Seed working paper No. 20, International labour organization, Geneva.

[49] Tilley, J., (2002), *Is youth a better predictor of sociopolitical values than is nationality?*, in: *The ANNALS of the American Academy of Political and Social Science*, Volume 580, pp. 226-256.

[50] Turk, T., Shelton, L. (2004), *Growth aspirations, risk, gender and legal form: a look at the services industries*, in: *Proceedings of the Academy of Entrepreneurship*, Volume 10, No. 2, 29-34.

[51] UNECE, (2002), *Women's entrepreneurship in Eastern Europe and CIS countries*, Series: Entrepreneurship and SMEs, Geneva (Switzerland).

[52] Van Staveren, I., Odebode, O. (2007), "Gender norms as asymmetric institutions: a case study of Yoruba women in Nigeria", in: *Journal of Economic Issues*, Volume 41 No. 4, pp. 903-925.

[53] Verheul, I., (2005), *Is there a (fe)male approach? Understanding gender differences in entrepreneurship*, ERIM Ph.d series, Erasmus University Rotterdam.

[54] Wells, B., Pfantz, T., Bryne, J., (2003), *Russian women business owners: evidence of entrepreneurship in a transition economy*, in: *Journal of Developmental Entrepreneurship*, Volume 8, No. 1, pp. 59-71.

[55] Welter, F., (2006), *West and East German women entrepreneurs: (Why) are they still different?*, in Welter, F., Smallbone, D., N. Isakova (eds.), *Enterprising Women in Transition Economies*, Ashgate, Aldershot, pp. 171-200.

[56] Welter, F., Smallbone D., Aculai E., Isakova, N., Schakirova, N., (2003), *Female Entrepreneurship in Post Soviet Countries*, in Butler, J. (ed.) New *Perspectives on Women Entrepreneurs*, Information Age, Greenwich, pp. 243 – 269.

[57] Welter, F., Smallbone, D., Isakova, N., (Eds.) (2006), *Enterprising Women in Transition Economies*. Ashgate, Aldershot:

[58] Welter, F., Smallbone, D., Isakova, N., Aculai, E., (2005). *The role of gender for entrepreneurship in a transition context*, Paper presented at RENT XIX Conference, Naples.

[59] Wilson, F., Marlino, D., Kickul, J., (2004), *Our entrepreneurial future: examining the diverse attitudes and motivations of teens across gender and ethnic identity*, in: *Journal of Developmental Entrepreneurship*, Volume 9, No. 3, pp. 177-197.

[60] Zapalska, A., (1997), *A profile of women entrepreneurs and enterprises in Poland*, in: *Journal of Small Business Management*, Volume 35, No. 4, pp. 76-82.