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ASSESSING THE QUALITY OF INSTITUTIONS' RANKINGS OBTAINED THROUGH MULTILEVEL LINEAR REGRESSION MODELS

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Abstract:
The aim of this paper is to assess the quality of the ranking of institutions obtained with multilevel techniques in presence of different model misspecifications and data structures. Through a Monte Carlo simulation study, we find that it is quite hard to obtain a reliable ranking of the whole effectiveness distribution, while, under various experimental conditions, it is possible to identify institutions with extreme performances. Ranking quality increases with increasing Intra Class Correlation coefficient and/or overall sample size. Furthermore, multilevel models where the between and within cluster components of first-level covariates are distinguished, perform significantly better than both multilevel models where the two effects are set to be equal and the fixed effect models.

Keywords: effectiveness, multilevel models, ranking of institutions, second-level residuals distribution.

JEL Classification: C1

1. Introduction

In the last decades, there has been an increasing use of performance indicators in the form of rankings or "league tables" in many areas of public sector, such as educational, health and socio-economic fields, with the aim of comparing the effectiveness of public institutions. Traditionally, performance indicators based on "raw" measures have been used to depict comparative performance in sport and commerce and their extent to rank services provided by public institutions has attracted resistance and criticism (Adab *et al.* 2002). Nowadays, it is widely recognized that raw rankings can be misleading (Goldstein and Spiegelhalter 1996). First of all, simple league tables ignore the quantification of uncertainty associated with the rankings. Secondly, it should be recognized that the institutions' performances depend not only on the characteristics of the institutions itself but also on those of their components. As an example, in the educational context, schools' performance is obviously affected by students' socio-economic background: schools with more problematic students tend to perform worse than schools serving advantaged students. Therefore, in order to make valuable comparisons among institutions, it is important to use some "net" measures that adjust for the so-called "compositional cluster effect".

The general approach to obtain such adjustment is through regression analysis having an indicator of effectiveness as dependent variable, while the characteristics of the institutions and those of their components are included as covariates (see e.g., Tekwe *et al.* 2004). Within this general approach, multilevel models became a widely affirmed approach because they explicitly recognize the hierarchical structure of the data (individuals clustered within institutions) and overcome the inadequate assumption of independence among units belonging to the same institution, typical of standard models (Snijders and Bosker 1999). Examples of applications of multilevel regression models can be found in many disciplines, such as medicine (Hofer *et al.* 1996, Normand *et al.* 1997) and poverty analysis (Aassve and Arpino 2007).

An important research field where multilevel modelling techniques found particularly fruitful application is the educational research, where the focus is usually on the assessment of schools' or universities' performances. In this context, the necessity to evaluate the effectiveness of the institutions was originally justified on two distinct grounds: accountability and school choice (Leckie and Goldstein 2009). The former aims at increasing the quality of the educational system and the latter at providing useful information for the choice of the future school for children. With reference to the general problem of ranking schools, the seminal work by Aitkin and Longford (1986), successively

discussed by Goldstein *et al.* (1993), describes the advantage of using multilevel regression models compared to the one-level models. Subsequently, many other applied works in the same context of analysis used similar methodologies (see e.g., Raudenbush and Willis 1995, Rampichini *et al.* 2004, Chiandotto and Varriale 2005, Jürges and Sneider 2007, Wößmann 2008).

As described by Goldstein and Spigelhalter (1996), in a two-level model, e.g. with students nested within schools, the second level residuals can be interpreted as a measure of the school effectiveness with respect to the given outcome net of the effect of the covariates and they can be used to evaluate and rank the schools. The choice of the specific outcome as well as schools' and students' characteristics that have to be adjusted for in the model depends on the final aim of the ranking, as highlighted by the recent literature on the value-added models in educational research (see, for example, Ladd and Walsh 2002; Downey *et al.* 2008; Leckie and Goldstein 2009). However, the debate on value-added models is beyond the purpose of the paper and we refer the interested readers to the cited literature.

The quality of the ranking obtained through multilevel models depends on the validity of the assumptions underlying the multilevel regression model, that are similar to those used in ordinary multiple regression analysis, such as homoscedasticity and normal distribution of the residuals. While some Monte Carlo simulation studies have been carried out in order to evaluate the robustness of multilevel models with respect to the parameter estimates and standard errors in case of violations of these assumptions (see, as an example, Maas and Hox 2004), we focus on the effect of different model misspecifications on the ranking quality. Furthermore, we assess the role of the data structure (cluster size and number of clusters) and of the intra-class correlation coefficient (ICC). Finally, we evaluate and discuss the consequences of assuming that the between and within effects of the level-1 covariates are equal, as implicitly done in many applied works. In our work, we focus in particular on the ability of multilevel models to identify extreme performing institutions, which usually are the most interesting for researchers and policy makers.

Recent works focused on the empirical comparison among different modeling approaches for value-added assessment. For example, Tekwe et al (2004) and Jürges and Schneider (2007) compared the rankings obtained with different model specifications. Ladd and Walsh (2002) discussed different fixed effects models, focusing in particular on the impact of measurement error on the ranking of schools. They found that the ranking is not always robust to the choice of the model and covariates to adjust for. In our simulation, we use a different perspective. In particular, we compare the estimated ranking with the generated (true) one in presence of different model misspecifications and we evaluate if these model misspecifications affect the ranking quality. Moreover, to the best of our knowledge, the implication of having different between and within covariate effects did not receive the attention it deserves.

Another interesting work assessing the quality (in terms of uncertainty) of rankings obtained through multilevel models has been presented by Loockwood *et al*. (2002). In their work, the authors focused on the Bayesian perspective, while we use a frequentist approach. The paper is structured as follows: in Section 2 we provide a brief overview of the multilevel linear model and the mostly used methods to obtain the estimates of higher level residuals; in Section 3 we describe the simulation study and in Section 4 we present the results; Section 5 concludes the work with a discussion and concluding remarks.

2. Ranking of clusters in multilevel linear regression models

In the paper, the problem of schools' ranking will be used as an illustrative example. Let Y_{ij} be a performance indicator, such as a test result, measured on student i attending schools j, for $i=1,\ldots,n_j$ and $j=1,\ldots,J$. Our aim is to rank the schools with respect to the performance indicator in order to identify and reward the best-performing institutions.

In order to rank the schools, we could simply use the schools' average performance indicator, $\overline{Y}_{.j}$, as usually done with "league tables". However, the consequent raw ranking does not take into account the different composition of the schools and those serving disadvantaged students (e.g., those with low SES) would be likely to fall in a "bad" position because of their students' characteristics and not because of their real performance.

As introduced above, a general approach to obtain such adjustment is through regression analysis, with both a fixed and a random approach, having Y_{ij} as dependent variable, while the characteristics of the institutions and those of their components are included as covariates. To illustrate how it is possible to derive a ranking of schools that adjust for student characteristics using multilevel techniques, we will consider a simple example of a random intercept linear regression model with two level-1 covariates[1]:

$$Y_{ij} = \alpha + \beta_1{}^{TOT} X_{1ij} + \beta_2{}^{TOT} X_{2ij} + e_{ij} + u_j \quad (1)$$

where X_{1ij} and X_{2ij} are level-1covariates, $\beta_1{}^{TOT}$ and $\beta_2{}^{TOT}$ are the regression coefficients measuring the total effect of the covariates on the outcome variable, and e_{ij} and u_j are the level-1 and level - 2 errors. Just to give a simple example, Tekwe et al (2004) used as covariates the minority and poverty status of students.

The usual assumptions of multilevel linear regression models are [Skrondal and Rabe - Hesketh, (2004)]: exogenous covariates, uncorrelated errors, normality and homoskedasticity of the level -1 and level-2 error distributions. As noticed for example by Neuhaus and Kalbfleisch (1998) and Snijders and Bosker (1999), in a multilevel context, the relationships at the cluster level, measured by the *between - cluster effects*, can be very different from the relationships at the micro level, measured by the *within - cluster effects*. The regression model (1) mixes the two relationships and its estimated *total regression* coefficients $\beta_r{}^{TOT}$ are an average of the *between - cluster* and the *within - cluster effects*.

From model (1) we can obtain purely between-schools (β^B) effects of the covariates aggregating the response and exploratory variables at the school level:

$$\overline{Y}_{\cdot j} = \alpha + \beta_1^B \overline{X}_{1\cdot j} + \beta_2^B \overline{X}_{2\cdot j} + \overline{e}_{\cdot j} + u_j . \quad (2)$$

In this model, all the information on the within-schools variability is ignored. If we are interested exclusively on the within-schools effects (β^W), we can subtract model (2) from (1), obtaining:

$$Y_{ij} - \overline{Y}_{\cdot j} = \beta_1^W \left(X_{1ij} - \overline{X}_{1\cdot j}\right) + \beta_2^W \left(X_{2ij} - \overline{X}_{2\cdot j}\right) + \left(e_{ij} - \overline{e}_{\cdot j}\right). \quad (3)$$

The same within-school estimates can be obtained by replacing the random effect u_j in (1) with a fixed intercept α_j (Rabe - Hesketh and Skrondal 2005):

$$Y_{ij} = \beta_1^W X_{1ij} + \beta_2^W X_{2ij} + \alpha_j + e_{ij_j} . \quad (4)$$

In order to simultaneously estimate both the between and within-cluster effects, we can combine models (2) and (3):

$$\begin{aligned} Y_{ij} &= \alpha + \beta_1^W \left(X_{1ij} - \overline{X}_{1\cdot j}\right) + \beta_1^B \overline{X}_{1\cdot j} + \beta_2^W \left(X_{2ij} - \overline{X}_{2\cdot j}\right) + \beta_2^B \overline{X}_{2\cdot j} + e_{ij} + u_j \\ &= \alpha + \beta_1^W X_{1ij} + \left(\beta_1^B - \beta_1^W\right)\overline{X}_{1\cdot j} + \beta_2^W X_{2ij} + \left(\beta_2^B - \beta_2^W\right)\overline{X}_{2\cdot j} + e_{ij} + u_j . \end{aligned} \quad (5)$$

When the within and between effects are equal for each covariates, $\beta_r{}^B = \beta_r{}^W$ (r=1, 2), the models (5) and (1) are equivalent. Therefore, model (1) can be considered as a special case of model (5).

To derive a ranking of schools using a two-level model with students clustered into schools we can give a value-added interpretation to models we introduced above. In random effects models (1) and (5), the level-2 residuals, u_j, can be interpreted as a measure of the residual effect of the schools on the outcome variable measured at student level, after the effect of the independent variables included

[1] In the model we only use level-1 covariates for simplicity. However, our discussion can be extended to models including covariates also at the second level.

in the model has been controlled for. Through the ranking of the errors u_j we obtain our ultimate goal, which is the ranking of schools *j*. There are two methods commonly used to assign values to u_j: the *maximum likelihood estimation* and the *Empirical Bayes prediction*[2] that treat u_j, respectively, as an unknown fixed parameter and as a random variable (Snijders and Bosker 1999).

Let define the total residuals for models (1) and (5) as $\xi_{ij} = e_{ij} + u_j$ and the predicted errors, $\hat{\xi}_{ij}$, as $\hat{\xi}_{ij} = Y_{ij} - \hat{Y}_{ij}$. The ML estimates of u_j, in a two-level random intercept model, can be obtained as the sample mean of $\hat{\xi}_{ij}$ for each cluster (Skrondal and Rabe - Hesketh 2004):

$$\hat{u}_j^{ML} = \frac{1}{n_j}\sum_{i=1}^{n_j}\hat{\xi}_{ij} = \frac{1}{n_j}\sum_{i=i}^{n_j}\left(Y_{ij} - \hat{Y}_{ij}\right) = \overline{Y}_{.j} - \overline{\hat{Y}}_{ij} \tag{6}$$

The Empirical Bayes predictions $\hat{u}_j^{EB}$ are obtained as the mean value of the posterior distribution of u_j, where the prior is usually a normal distribution with zero mean and the estimated variance of u_j plugged in (Rabe - Hesketh and Skrondal 2005).

In two-level random intercept linear models there is a simple relationship between the estimates obtained with these two approaches: $\hat{u}_j^{EB} = \hat{s}_j * \hat{u}_j^{ML}$, where $\hat{s}_j = \tau^2 / (\tau^2 + \sigma^2 / n_j)$ is the so - called *shrinkage factor* that ranges from 0 to 1 and causes the empirical Bayes prediction to be shrunken toward 0. When the data structure is balanced (constant number of first - level units in each cluster) the values assigned by the two methods to u_j are equal up to a constant and, as a consequence, the rankings of $\hat{u}_j$ (and of *j*) are the same. However, even when the data structure is unbalanced, Tekwe *et al*. (2004) found little impact of shrinkage by itself on value-added assessment of school performance. Since we will use a Monte Carlo simulation study based on balanced data structures, we will only focus on ML estimates of u_j and we will refer to these simply as $\hat{u}_j$, instead of $\hat{u}_j^{ML}$.

From (6), we can interpret the $\hat{u}_j$ as an "adjustment" of the average outcome $\overline{Y}_{.j}$ observed in cluster *j* with the quantity $\overline{\hat{Y}}$ that depends on the model specifications. Models in equations (1) and (5), having different covariates specifications, "adjust" $\overline{Y}_{.j}$ in a different way and this has consequences on the ranking of $\hat{u}_j$.

From model in equation (1), we have:

$$\hat{u}_j = \overline{Y}_{.j} - \left(\alpha + \beta_1^{TOT}\overline{X}_{1.j} + \beta_2^{TOT}\overline{X}_{2.j}\right) \tag{7}$$

and from model in equation (5), we have:

$$\hat{u}_j = \overline{Y}_{.j} - \left(\alpha + \beta_1^{B}\overline{X}_{1.j} + \beta_2^{B}\overline{X}_{2.j}\right) \tag{8}$$

The $\hat{u}_j$ obtained from the two models are equal when $\beta_r{}^W = \beta_r{}^B$ (r =1.2); otherwise, the model in equation (5) correctly uses the between-cluster effects $\beta_r{}^B$ as weights for the between component of the covariates, $\overline{X}_{r.j}$, while the weights used by model (1) are the total effects.

From model (4), we can interpret the fixed effects α_j in a similar way:

$$\hat{\alpha}_j = \overline{Y}_{.j} - \left(\beta_1^{W}\overline{X}_{1.j} + \beta_2^{W}\overline{X}_{2.j}\right) \tag{9}$$

If $\beta_r{}^W = \beta_r{}^B$, this model gives exactly the same ranking as the models in equations (1) and (5). Otherwise, $\beta_r{}^{TOT}$ can be expressed as an average of $\beta_r{}^W$ and $\beta_r{}^B$, weighted in inverse proportion to their

[2] We refer to the values assigned to the random effects produced by both methods as *estimates* even though the term *prediction* would be more appropriate for the empirical Bayes method (Rabe-Hesketh and Skrondal 2005).

respective variances (Maddala 1971) and, interestingly, the more similar (different) the clusters are in terms of cluster-level averages of level-1 covariates the more similar β_r^{TOT} will be to the β_r^W (β_r^B). This implies that the more similar the clusters are in terms of cluster means the more similar ranking obtained trough adjustments (7) and (9) are. On the contrary, in presence of very different clusters, adjustments (7) and (8) will be more similar with respect to those based on (9).

Summarising, we expect substantial differences in the ranking obtained using models (1), (4) an (5) only in presence of a discrepancy in the *between* and *within*-cluster effects of the covariates. Moreover, these differences should be small when the difference among the two effects is small.

3. Simulation procedure

In this section we illustrate the Monte Carlo simulation study we used in order to evaluate the goodness of schools' rankings obtained with multilevel models. In particular, we aim at evaluating the consequences of different model misspecifications concerning the cluster-level errors and data features (data structure, ICC value, discrepancy among the between and within effects of the level-1 covariates) and at comparing the performance of a fixed effect model in comparison with the multilevel models. In this work we concentrate on the assumptions of normality and homosckedasticity of cluster-level errors and we assess the effects produced by their violation on the quality of cluster ranking. We focus on model misspecifications relative to level-2 residuals since the sample size at the second level is always lower than the sample size at the level-1, implying that the assumptions on errors at the highest level are more problematic.

The setup of the simulation study builds on the setup used by Maas and Hox (2004), where the authors focus on the issue of bias and efficiency of fixed and random effects estimators. Our study consists in 5 main steps:

1. we generate the data representing the schools' performance through a multilevel regression linear model with different types of distribution of the level-2 error term, u_j;

2. we obtain the true ranking of u_j (and j) for each true distribution of u_j;

3. we estimate the model parameters through three different estimation methods;

4. for each estimation method we obtain, as explained in section 2, the maximum likelihood estimates of u_j ($\hat{u}_j$), and we rank them (and, consequently, we rank the clusters j);

5. for each estimation method, we compare the true and estimated rankings of u_j.

Steps 1 and 2.

As the first step of our simulation study, we generate two-level balanced data structures, where the overall sample size N is determined by the product of the number of clusters, nc, and the fixed cluster size, cs. In the data generating model we use two level-1 covariates, X_1 and X_2, which are allowed to vary both within and between clusters. In particular, they are treated as random variables and are generated through a variance component model as the sum of two independent normal variables representing their within (X^W) and between components (X^B):

$$X_{kij} = X_{kij}^W + X_{kj}^B, \text{ for k = 1.2} \tag{10}$$

where it is assumed that:

$$X.1)\ X_{kj}^B \text{ are } iid \text{ with mean } \mu_{X_k} \text{ and variance } \tau_{X_k}^2, \quad \text{for } k = 1,2$$
$$X.2)\ X_{kij}^W \text{ are } iid \text{ with zero mean and variance } \sigma_{X_k}^2, \quad \text{for } k = 1,2$$
$$X.3)\ X_{kj}^B \perp X_{kij}^W, \quad \forall i, j \text{ and for } k = 1,2.$$

The data generating model is then:

$$Y_{ij} = \alpha + \beta_1^W X_{1ij}^W + \beta_1^B X_{1j}^B + \beta_2^W X_{2ij}^W + \beta_2^B X_{2j}^B + e_{ij} + u_j, \tag{11}$$

where α and β are the model parameters and e_{ij} and u_j are the error terms defined, respectively, at level 1 and level 2.

Obviously, the true between (X_{kj}^{B}) and within components (X_{kij}^{W}) of the covariates in equation (10) are not observable in practice and can be distinguished in an estimation model by using their sample counterparts (see, i.e., equation (5)), the cluster mean $\overline{X}_{kj} = \frac{1}{n_j}\sum_{i=1}^{n_j} X_{kij}$ for X_{kj}^{B}, and the deviation from the cluster mean (centred covariate) $\widetilde{X}_{kij} = X_{kij} - \overline{X}_{kij}$ for X_{kij}^{W}.

We use five different processes to generate the "true" distribution of the error terms u_j:

a. homoschedastic, Normal (N.Hom);
b. heteroschedastic, Normal (N.Het);
c. homoschedastic, asymmetric (Chi-Square with one degree of freedom, CHI);
d. homoschedastic, symmetric and bimodal (50:50 mixture of two normal distributions, BIM);
e. homoschedastic, symmetric and heavy-tailed (t-Student with two degree of freedom, STU).

The first specification (a.) conforms to the usual assumptions; the other four imply different forms of model misspecification when the normality and homoskedasticity assumptions are used in the estimation procedure. In all cases, the values sampled from the assumed distribution of u_j are used to obtain the true ranking of j, indicated with R_{Tj}.

Besides the error term distribution, three other conditions have been varied: (i) number of clusters (nc = 30, 50, 100), (ii) cluster size (cs = 5, 30, 50) and (ii) the intraclass correlation coefficient value, $\rho = \frac{\tau^2}{\tau^2 + \sigma^2}$, ($\rho$ = 0.1, 0.2, 0.3); as mentioned by Maas and Hox (2004), these values are commonly found in the applied educational literature. The residual variance at level 2 is determined as a consequence of the imposed values of ρ and of the residual variance at level 1, which is set to 0.5. The intercept term α in equation (6) is set to 0; the other regression coefficients are set to 1, except β_1^B that is set to 1.5: in this way, the *between* and the *within* effects of the first covariate are different. Finally, since we also want to evaluate the consequences of assuming the equality of the covariates' *between* and *within* effects, we run a set of simulations where the difference between the two effects for both covariates is varied and take values -1; 0 and +1.

Steps 3 and 4.

In order to estimate the model parameters and subsequently obtain the ranking of u_j, we use and compare three different estimation models:

$$M1. \quad Y_{ij} = \alpha + \beta_1^W \widetilde{X}_{1\cdot j} + \beta_1^B \overline{X}_{1\cdot j} + \beta_2^W \widetilde{X}_{2\cdot j} + \beta_2^B \overline{X}_{2\cdot j} + e_{ij} + u_j$$

$$M2. \quad Y_{ij} = \alpha + \beta_1^{TOT} X_{1ij} + \beta_2^{TOT} X_{2ij} + e_{ij} + u_j$$

$$M3. \quad Y_{ij} = \beta_1^W X_{1ij} + \beta_2^W X_{2ij} + \sum_{j=1}^{J} \alpha_j D_j + e_{ij}$$

The characteristics of the three models have been discussed in Section 2. M1 and M2 are two-level models corresponding to equations (5) and (1). M3 is a fixed effect model corresponding to equation (4).

Each model is used to obtain the estimates of the cluster effects u_j and, consequently, the estimated ranking of j (R_{Ej}); M1 and M2 by means of the maximum likelihood estimates of u_j and M3 by means of the estimated α_j coefficients. In the estimation of Models M1 and M2 we make the usual assumptions on the error terms (Section 2) and, therefore, these models are misspecified if the true u_j distribution is not normal and/or not homoschedastic (cases from b.-e.). In this case, we aim at assessing the implications on the ranking quality of these misspecifications by comparing M1 and M2

with respect to model M3. Moreover, as we explained in Section 2, the ranking obtained through the three models is expected to be different if β_r^W and β_r^B (r=1,2) coefficients are different.

Step 5.

As the last step of our Monte Carlo experiment, we evaluate the quality of the estimated rankings obtained with different model conditions comparing the closeness of R_{Ej} (estimated ranking) to R_{Tj} (true ranking).

For each experimental condition we generate 1000 simulated data sets and we evaluate two measures of the ranking quality. As a first measure, we calculate the average Spearman correlation coefficient between the true and the estimated distribution of the level-2 residuals over the 1000 simulated data sets. For each replication, the coefficient is calculated as:

$$\rho R_T, R_E = 1 - \frac{6\sum_{j=1}^{J}\left(R_{T_j} - R_{E_j}\right)}{J\left(J^2 - 1\right)}$$

where J is the total number of clusters; $\rho_{RT,RE}$ ranges from -1 to +1 and the closer it is to 1, the more similar the rankings are. The average Spearman correlation coefficient, ρ, also ranges from -1 to +1 and shows how well a model performs in the classification of the level-2 units.

The Spearman correlation coefficient is an *overall* measure and is affected by the difference between the estimated ranking positions of each unit with respect to the true positions. A property of the index is that the impact of a misclassification increases quadratically with the distance between the true and estimated position and only the absolute value of this distance matters. For example, consider the ranking of the school j out of 100 schools. Let consider the two situations whit R_{Tj} =100; R_{Ej} =90 and R_{Tj} = 50; R_{Ej} = 40: in both cases, the mistake in the classification of the school j has the same weight in the index, even if the two mistakes can be considered different from a substantive point of view. In the first case a school with an extreme performance is ranked 10 positions below and this could make a difference in the assignment of a price or a sanction; in the second case, it probably makes little difference for the school j to be ranked in the 50th or 40th position.

In order to evaluate the quality of the estimated ranking separately for groups of institutions we introduce the classification matrixes. The idea is to divide the true and the estimated distributions of u_j into intervals defined by the deciles of the respective distributions and to evaluate, for each interval, the percentage of correctly classified schools over the 1000 simulated data sets.

Following the example introduced above (Section 2), it turns out natural to divide the schools in two groups: "Top" and "Non Top". In particular, we define the "Top" institutions (best-performing) as those belonging to the last[3] decile of the true distribution of u_j and we define the remaining institutions as "Non Top"[4]. In this setting, two kinds of errors can be generated in the ranking: one error involves classifying as Top a true Non Top institution (γ), and the other error involves classifying as Non Top a true Top institution (δ):

$$\gamma = \Pr(T_E/NT_T),$$

$$\delta = \Pr(NT_E/T_T).$$

Which is the worst error strictly depends on the aim of the research or on the policy goals. In our example, where a public organisation wants to reward the best-performing schools, the overriding concern is misclassifying schools as Top when, in fact, they are not. This is mainly because a Non Top school will become an example for the others and will receive a non deserved reward. In this case the

[3] Whether the Top institutions belong to the first or last decile of the true distribution of u_j depends on the nature of the observed outcome Y_{ij}. When Y_{ij} represents some "positive" phenomenon, such as a test result or the salary at the first job, the Top institutions belong to the last decile. On the contrary, if Y_{ij} represents some "negative" phenomenon such us the school dropout rate, the Top institutions belong to the first decile.

[4] This classification can be mirrored: an evaluator can be interested in individuating the extremely bad-performing schools ("Bad") that can be defined as those belonging to the first decile.

public evaluator can be more concerned to reduce the error γ. In other situations a public evaluator could be more interested to reduce errors of type δ or both.

Similarly to what is noticed by Lockwood *et al.* (2002), we think that if policy makers intend to use the rankings for accountability, it is advisable that the choice between focusing on γ or δ is guided by consideration of the losses incurred by these different kinds of errors. For example, if schools identified as extreme are likely to face punitive sanctions or receive large monetary rewards, then policy makers might find misclassifying non extreme schools as relatively more costly and prefer using decision rules based on γ; if schools classified as low-performing will receive additional resources, then policy makers might see missed investments as costly and prefer using decision rules based on minimising δ.

In the following, we will focus only on the error γ to illustrate the results of our simulation study.

4. Conclusions

In the first set of simulations, we consider different u_j distributions, estimation methods and combinations of cluster size (*cs*) and number of clusters (*nc*), while we set the Intraclass Correlation Coefficient (ICC) at a medium level (0.2).

Table 1 shows the Spearman correlation coefficient averaged over 1000 replications. Taking the u_j distribution into account, the best scenario, regardless of the estimation model, is a., when the level-2 error term distribution is correctly specified (normal and homoschedastic). On the contrary, the worst scenario is always c., when the u_j are generated from a Chi-Square distribution.

Focusing on the different estimation methods, M1, by allowing β_r^W to be different from β_r^B (r=1.2), performs better than M2 and M3. For all estimation methods, the Spearman correlation coefficient is higher as *cs* and *nc* increase; in particular, the best results are for the combination of *cs*=50 and *nc*=100. In particular, even for the worst scenario (case c.), the ranking quality seems to be acceptable when using model M1 for the estimation process and the sample size is not small. For example, with a medium sample size (N = 1500; *cs* = 30 and *nc* = 50) the Spearman coefficient is equal to 0.764 while with a big sample size, *cs* = 50 and *nc* = 100, the index is 0.817.

Table 1. Spearman correlation coefficient (averaged over 1000 replications) for different estimation models, data structure and u_j distributions

Models	Data structure		True level-2 error term (u_j) distribution				
	cs	*nc*	a. (N.Hom)	b. (N.Het)	c. (CHI)	d. (BIM)	e. (STU)
M1	5	30	0.692	0.595	0.554	0.671	0.584
	30	50	0.906	0.821	0.764	0.840	0.802
	50	100	0.945	0.876	0.817	0.872	0.844
M2	5	30	0.594	0.505	0.477	0.583	0.502
	30	50	0.659	0.553	0.524	0.657	0.538
	50	100	0.672	0.555	0.518	0.667	0.513
M3	5	30	0.554	0.467	0.449	0.544	0.472
	30	50	0.647	0.539	0.515	0.645	0.528
	50	100	0.664	0.547	0.512	0.660	0.507

Table 2 shows the analysis of the data structure effect on the ranking quality. From this table we see that the ranking quality increases as the value of *cs* or *nc* increase. However, the values of the Spearman correlation coefficient are very similar if we consider two data structures with the same sample size (N = 1500) but different number of clusters and cluster size (*cs* = 30; *nc* = 50 and *cs* = 50; *nc* = 30).

From these results we conclude that increasing the total sample size substantively improves the quality of the ranking, while the composition of the sample (combination of *cs* and *nc*) does not have a strong effect *per se*.

Table 2. Spearman correlation coefficient (averaged over the 1000 replications) for different data structures and u_j distributions with estimation model M1

Cluster size	True u_j distribution	Number of clusters		
		30	50	100
5	a. (N.Hom)	0.692	0.708	0.719
	b. (N.Het)	0.595	0.611	0.613
	c. (CHI)	0.554	0.561	0.561
	d. (BIM)	0.671	0.693	0.709
	e. (STU)	0.584	0.566	0.558
30	a. (N.Hom)	0.884	0.906	0.921
	b. (N.Het)	0.788	0.821	0.839
	c. (CHI)	0.750	0.764	0.776
	d. (BIM)	0.821	0.840	0.853
	e. (STU)	0.790	0.802	0.801
50	a. (N.Hom)	0.910	0.931	0.945
	b. (N.Het)	0.818	0.857	0.876
	c. (CHI)	0.782	0.807	0.817
	d. (BIM)	0.837	0.855	0.872
	e. (STU)	0.827	0.831	0.844

Table 3a and 3b show two classification matrixes obtained for a total sample size equal to 3000 (cs = 30 and nc = 100) with the correct model specification M1. In the first table, the true u_j distribution is normal and homoschedastic (case a., best scenario, as summarized in Table 1), while in the second table the true u_j distribution is Chi-Square (case c., worst scenario).

Table 3a. Classification matrix for estimation model M1 and a normal and homoschedastic u_j distribution (case a.) with cs = 30 and nc = 100

True decile	Estimated decile										Tot.
	1	2	3	4	5	6	7	8	9	10	
1	*0.73*	0.22	0.05	0.01	0.00	0.00	0.00	0.00	0.00	0.00	1.00
2	0.21	*0.41*	0.24	0.09	0.03	0.01	0.00	0.00	0.00	0.00	1.00
3	0.05	0.24	*0.33*	0.23	0.10	0.04	0.01	0.00	0.00	0.00	1.00
4	0.01	0.09	0.23	*0.28*	0.22	0.12	0.04	0.01	0.00	0.00	1.00
5	0.00	0.03	0.10	0.23	*0.27*	0.21	0.11	0.04	0.01	0.00	1.00
6	0.00	0.01	0.04	0.11	0.22	*0.27*	0.22	0.11	0.03	0.00	1.00
7	0.00	0.00	0.01	0.04	0.11	0.22	*0.28*	0.23	0.09	0.01	1.00
8	0.00	0.00	0.00	0.01	0.04	0.11	0.23	*0.32*	0.24	0.04	1.00
9	0.00	0.00	0.00	0.00	0.01	0.03	0.10	0.24	*0.42*	0.21	1.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.04	0.21	*0.74*	1.00

Table 3b. Classification matrix for estimation model M1 and a Chi-Square u_j distribution (case c.) with cs = 30 and nc = 100

True decile	Estimated decile	Tot.									
	1	2	3	4	5	6	7	8	9	10	
1	0.26	0.21	0.17	0.14	0.10	0.07	0.04	0.01	0.00	0.00	1.00
2	0.23	0.20	0.17	0.14	0.11	0.08	0.04	0.01	0.00	0.00	1.00
3	0.20	0.19	0.16	0.15	0.13	0.09	0.06	0.02	0.00	0.00	1.00
4	0.15	0.15	0.17	0.16	0.15	0.12	0.07	0.03	0.00	0.00	1.00
5	0.09	0.13	0.14	0.16	0.16	0.14	0.11	0.05	0.01	0.00	1.00
6	0.05	0.08	0.11	0.13	0.17	0.19	0.16	0.10	0.02	0.00	1.00
7	0.02	0.03	0.06	0.08	0.13	0.18	0.24	0.20	0.06	0.00	1.00
8	0.00	0.01	0.02	0.03	0.05	0.11	0.21	0.35	0.21	0.01	1.00
9	0.00	0.00	0.00	0.00	0.01	0.02	0.06	0.22	0.56	0.13	1.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.13	0.86	1.00

To ease the interpretation of the classification matrixes, let make some examples. In the first row of Table 3a we have the relative conditional frequencies of the institutions that belong to the first decile of the true distribution and are classified in the different estimated ten groups. Therefore, we can interpret the first cell as the percentage of correctly classified first group institutions: the probability that one institution is estimated as belonging to the first group given that it belongs to the first group of the true u_j distribution. The second cell measures the conditional probability of an institution to be estimated as belonging to the second group when it actually belongs to the first group.

The sum of the conditional frequencies in cells 2 to 10 measures the percentage of misclassified first group institutions. The further we are from the first cell, the more serious the misclassification is. Extending the interpretation to the whole matrix, we can say that the diagonal includes the percentage of correct classification for each of the ten deciles of the true distribution; in the other cells we find the percentages for all possible misclassifications whose severity increases as we move away from the diagonal. As expected, the highest values are on the diagonal and the "strong-misclassification cells" (the furthest from the diagonal) show very small percentages. For example, the first raw of Table 3a shows that, out of the clusters belonging to the first interval of the true distribution of u_j, 73% are correctly classified in the first decile, while 22% and 5% are wrongly classified since they belong, respectively, to the second and third interval of the estimated distribution of $\hat{u}_j$. A very interesting result is that extreme institutions, those belonging to the first and tenth decile of the true u_j distribution, show the highest percentages of correct classification, as shown in cells (1,1) and (10,10). This result is particularly important for practitioners because as we already mentioned they are usually interested in the identification of the "extreme" institutions. This result is also consistent with the literature which states that only extreme performances turn out to be significantly different from the others because of the prediction error variability (Goldstein and Spieghelter 1996).

The most important results of a classification matrix are that on the diagonal, representing the percentage of correct classification of $\hat{u}_j$ for each group of the true u_j distribution. Figure 1 shows the values on the diagonal of the classification matrixes obtained for the three estimation models and different u_j distributions with cs = 30, nc = 100. Regardless of the u_j distribution, the best performing estimation method in terms of ranking quality is always M1.

This result is especially interesting in terms of the comparison of M1 and M3: when the within-between covariates effects are different, even if the true u_j distribution is far away from the normality, the random effects approach performs better that the fixed effects approach in estimating the higher level units effects. However, even with M1, while the percentages in cells (1,1) and (10,10) are quite high (higher than 0.7) for case a. (homoschedastic, Normal u_j distribution), b. (heteroschedastic, Normal u_j distribution) and e. (homoschedastic, symmetric and heavy-tailed u_j distribution), they are quite low for case d. (homoschedastic, symmetric and bimodal u_j distribution). When the true distribution of u_j is Chi-Square (case c.), the classification errors in the two tails are very different: the u_j in the highest positions are quite well classified, while the percentage of correct classification is low for the left-most cell (1,1). This is, of course, due to the positive skewed nature of the Chi-square distribution. In case d. the u_j in the middle of the true distribution are slightly better classified compared to what happen with the other distributions.

In Table 4 we summarise the classification matrix by distinguishing only Top (last decile) and Non-Top schools (the remaining). The table shows the two error probabilities introduced in section 3, $\gamma = \Pr(T_E/NT_T)$ and $\delta = \Pr(NT_E/T_T)$ and their complement to 1, $1-\gamma = \Pr(NT_E/NT_T)$ and $1-\delta = \Pr(T_E/T_T)$, that measure the probabilities of correct classifications. As found before, the models M2 and M3 show very similar classification performances, and M1 is the best estimation models, having the highest correct classification probabilities, $\Pr(T_E/T_T)$, $\Pr(NT_E/NT_T)$, and correspondingly, the lowest misclassification probabilities - $\Pr(NT_E/T_T)$ and $\Pr(T_E/NT_T)$. The effectiveness of M2 and M3 is rather low in terms of $1-\delta$ while their performances are still quite satisfactory in terms of γ.

Table 5 shows the results in terms of $\gamma = \Pr(T_E/NT_T)$ of our simulation study for different u_j distribution and data structure, when the estimation method is M1 and ICC = 0.2. All values are quite small, with the highest value equal to 0.081 that is obtained when $cs = 5$ and $nc = 50$ and u_j has a bimodal distribution (case d.). Again, this confirms that the performance of the considered models is quite satisfactory in terms of γ.

Similarly to the previous results on the Spearman correlation coefficient, showed in Table 2 the error probability γ decreases as the number of clusters or the cluster size increase, regardless of the true u_j distribution. However, conditioning on the same total sample size with different data structure (cs = 30; nc = 50 and cs = 50; nc = 30), we see that only the total sample size affects the probability γ.

Taking the u_j distribution into account, γ is the lowest when the true distribution is Chi-Square. Again, this is due to the asymmetry of the Chi-Square distribution. Note that γ is basically the same when the true u_j distribution is a., b. or e.

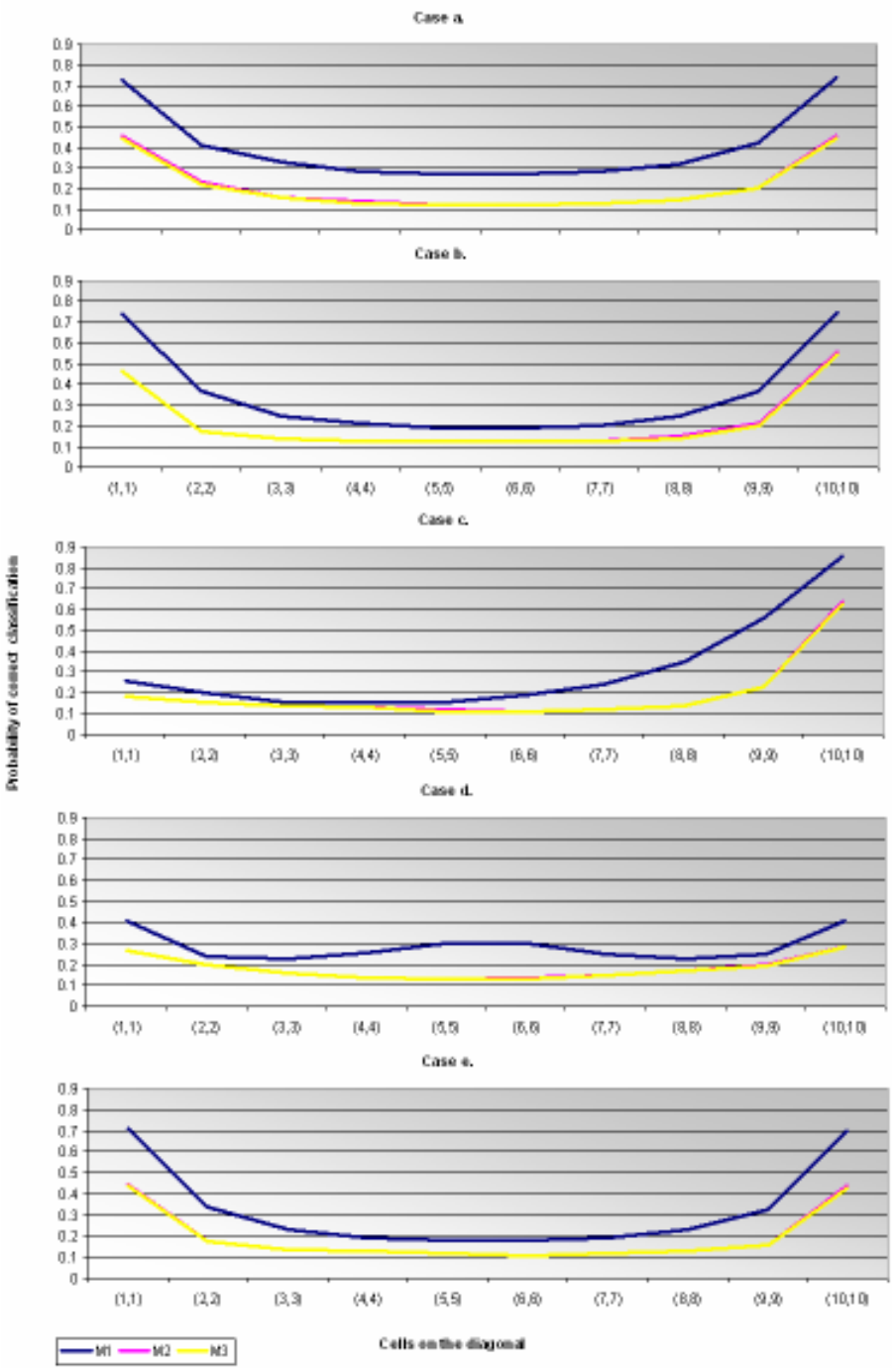

Figure 1. Diagonals of the classification matrixes for the three estimation models and different u_j distributions with cs = 30 and nc = 100

Table 4. Conditional probabilities $\gamma = Pr(T_E/NT_T)$, $1-\gamma = Pr(NT_E/NT_T)$, , $\delta = Pr(NT_E/T_T)$ and $1-\delta = Pr(T_E/T_T)$ for different estimation models, u_j normal and homoschedastic, cs=30 and nc=100

Models	$\gamma = Pr(T_E/NT_T)$	$1-\gamma = Pr(NT_E/NT_T)$	$\delta = Pr(NT_E/T_T)$	$1-\delta = Pr(T_E/T_T)$
M1	0. 029	0.971	0.261	0.739
M2	0.060	0.940	0.539	0.461
M3	0.061	0.939	0.547	0.453

Table 5. Probability of misclassify a Non-Top school as Top, $\gamma = Pr(T_E/NT_T)$, for the estimation model M1 and different u_j distributions, cluster size and number of clusters

True u_j distribution	Cluster size	Number of clusters		
		30	50	100
A (N.Hom)	5	0.059	0.058	0.055
	30	0.035	0.032	0.029
	50	0.030	0.028	0.025
B (N.Het)	5	0.054	0.054	0.053
	30	0.032	0.030	0.028
	50	0.030	0.027	0.025
C (CHI)	5	0.039	0.038	0.036
	30	0.019	0.017	0.016
	50	0.017	0.016	0.013
D (BIM)	5	0.080	0.081	0.079
	30	0.070	0.068	0.065
	50	0.066	0.064	0.061
E (STU)	5	0.055	0.057	0.058
	30	0.036	0.033	0.033
	50	0.031	0.029	0.028

In order to evaluate the role of the ICC on the ranking quality, we carried out some simulations combining the three different estimation models (M1, M2 and M3) for different u_j distributions and ICC values (0.1, 0.2, 0.3) with a fixed data structure (*cs = 30 and nc = 100*). Table 6 shows the results of the simulations in terms of both the Spearman correlation coefficient and $\gamma = Pr(T_E/NT_T)$. As expected, in all scenarios, the higher the ICC, the better the ranking: high values of the ICC indicate a strong school effects, and this facilitates the distinction among schools. In particular, the classification matrixes, here not reported for brevity, show that the positive effect of the ICC on the ranking quality is spread over the entire distribution of u_j. As found in the previous results, the estimation model M1 performs better than the others in all situations.

In our final simulations we assess the role of the difference in the *between* and *within* effects of the covariates included in the model. Let the quantities $\Delta 1 = \beta_1^W - \beta_1^B$ and $\Delta 2 = \beta_2^W - \beta_2^B$ measure the difference in the within-between effects for the two covariates imposed in the data generating model. Given our discussion in Section 2, we expect better performance of model M1 relative to model M2 and M3 for higher values of $\Delta 1$ and $\Delta 2$. In the simulations we vary both the values of $\Delta 1$and $\Delta 2$ in the set {-1; 0; +1}. In particular, Table 7 reports the results for three out of the all nine possible combinations. The results not reported here, but available from the authors upon request, show that the situations characterised by the same absolute value of the sum of $\Delta 1$ and $\Delta 2$ are equivalent in terms of ranking quality. For example, the case $\Delta 1 = \Delta 2 = -1$ is equivalent to the cases $\Delta 1 = -1$ and $\Delta 2 = +1$; $\Delta 1 = +1$ and $\Delta 2 = -1$; and $\Delta 1 = \Delta 2 = +1$. Therefore, what seems to matter is the overall absolute value of the discrepancies in the between and within effects of the covariates and not the sign of the two differences.

Table 6. Spearman correlation coefficients (ρ) and Probability of misclassify a Non-Top school as Top, γ = $Pr(T_E/NT_T)$, for different estimation models, u_j distributions and ICC values

u_j distr	Models	ICC					
		0.1		0.2		0.3	
		ρ	γ	ρ	γ	ρ	γ
a (N.Hom)	M1	0.86	0.04	0.92	0.03	0.95	0.02
	M2	0.52	0.07	0.67	0.06	0.76	0.05
	M3	0.50	0.07	0.66	0.06	0.75	0.05
b (N.Het)	M1	0.70	0.04	0.84	0.03	0.85	0.02
	M2	0.39	0.06	0.56	0.05	0.59	0.04
	M3	0.37	0.06	0.55	0.05	0.58	0.04
c (CHI)	M1	0.69	0.02	0.78	0.02	0.82	0.01
	M2	0.40	0.06	0.52	0.04	0.60	0.03
	M3	0.39	0.06	0.51	0.04	0.59	0.03
d (BIM)	M1	0.81	0.08	0.85	0.07	0.87	0.05
	M2	0.51	0.10	0.66	0.08	0.75	0.07
	M3	0.49	0.10	0.65	0.08	0.74	0.07
e (STU)	M1	0.76	0.04	0.80	0.03	0.88	0.03
	M2	0.41	0.07	0.51	0.06	0.66	0.05
	M3	0.39	0.07	0.50	0.06	0.65	0.06

Table 7. Spearman correlation coefficients and γ= $Pr(T_E/NT_T)$ for different values of the difference $\Delta r = \beta_r^W - \beta_r^B$ (r=1,2) and u_j distributions

u distr	Models	Values of Δ1 and Δ2					
		Δ1= -1; Δ2=-1		Δ1= -1; Δ2=0		Δ1= 0; Δ2=0	
		ρ	γ	ρ	γ	ρ	γ
a (N.Hom)	M1	0.92	0.03	0.92	0.03	0.92	0.03
	M2	0.32	0.08	0.41	0.08	0.93	0.03
	M3	0.32	0.08	0.41	0.08	0.93	0.03
b (N.Het)	M1	0.84	0.03	0.84	0.03	0.84	0.02
	M2	0.24	0.07	0.30	0.06	0.87	0.02
	M3	0.24	0.07	0.30	0.06	0.87	0.03
c (CHI)	M1	0.78	0.02	0.78	0.02	0.78	0.02
	M2	0.26	0.07	0.33	0.06	0.79	0.02
	M3	0.26	0.07	0.33	0.07	0.79	0.02
d (BIM)	M1	0.85	0.07	0.85	0.07	0.85	0.07
	M2	0.32	0.09	0.40	0.09	0.86	0.07
	M3	0.31	0.09	0.40	0.09	0.86	0.07
e (STU)	M1	0.80	0.03	0.79	0.03	0.79	0.03
	M2	0.25	0.08	0.31	0.08	0.81	0.03
	M3	0.25	0.08	0.31	0.08	0.81	0.03

From Table 7 we see that if for each covariate the within and between effects are equal (Δ1 = 0 and Δ2 = 0) the results from the three models are, as expected, almost indistinguishable, irrespective of the true second level error distribution. This is the case also for other values of the ICC, *nc* and *cs* (results of these simulations are not shown here but available upon request). On the contrary, the models become more different and the relative performance of model M1 increases when either the number of covariates with a discrepancy in the between - within effects and / or the absolute value of the discrepancy is increased.

5. Summary and discussion

In this paper we evaluate the quality of the ranking of higher level units (institutions) obtained through multilevel linear regression models, in presence of misspecifications of the cluster-level error term distribution and with respect to different data structures and possible discrepancies in the between and within cluster effects of covariates.

We compared three models that can be used by practitioners in order to rank institutions: two multilevel models (with and without cluster average of first-level covariates) and a one-level fixed effect model with cluster-specific intercepts. Several conclusions can be drawn from our work.

First, the ranking is reliable only for extreme institutions. Consistently with multilevel literature (see, i.e., Goldstein and Healy 1995), we find that it is easier to reliably rank the institutions with extreme performances but it is hard to precisely rank the institutions with average performances. However, we do not think this is a reason to abandon the approach because extremely "bad" and "good" performing institutions are usually the most interesting for researchers and policy makers.

Second, the effect of non-normal errors at the second level can be detrimental also to rank extreme institutions. In particular, a highly asymmetric distribution (e.g., Chi-square) of second-level residuals implies a good ranking quality only of one tail of the distribution and a rather poor quality of the other tail. A bi-modal distribution, on the contrary, produces a low ranking quality for both tails. This highlights the importance of testing for normality of residuals distribution. If non-normality of residuals cannot be easily solved by, for example, transforming the outcome variable, other approaches could be worth to be explored, as non-parametric estimation of random effects. With respect to the data structure, large sample sizes help to increase the ranking quality, while the number and size of clusters, *per se*, play a less important role. We also find that a large ICC facilitates the ranking.

Third, the assessment of ranking quality depends on the research/policy goals. While the performance of multilevel models in individuating the true best-performing (Top) institutions can be unsatisfactory in specific conditions, the probability of classifying a true Non Top institution as a Top institution (error γ) is always very low for all the setups we used in our simulation study. On the other hand, the error probability δ (associated to miss-classifying a true Top institution as Non Top) is sometimes too high.

Finally, discrepancies in the between and within effects of covariates is a crucial point for the quality of the ranking. In all experimental situations, the multilevel model with cluster means, that allows the between and within effects of the covariates to be different, performs much better than the others. Only when the between and within effects are equal for all the covariates, the three models perform very similarly. These results highlight the importance, also for clusters' ranking, to take into account that within-cluster and between-cluster relationships can be very different when dealing with multilevel data structures. These results are in line with similar remarks made in the multilevel literature, for example by Neuhaus and Kalbfleisch (1998) and Skrondal and Rabe - Hesketh (2004).

Concluding, on the basis of our results two "best-practice" can be drawn. First, with the respect to the estimation strategy, it is preferable to start from a more general random effect model like M1, that allows to test for differences in the between and within covariates' effects. If there are no discrepancies, a simpler model M2 or M3 can be employed. Secondly, the suitability of model adjusted ranking should be judged by policy makers on the basis of the losses associated with the different potential errors, which in turn depend on the policy goals. For example, if ranking is implemented to identify and reward the best schools or sanction the worst schools, then policy makers might find misclassifying non-extreme schools as more costly. Our results suggest that the probability of these mistakes is low and the model adjusted ranking is, in this case, satisfactory and useful. On the contrary, if, for example, the accountability system aims at investing on the worst schools to improve their performances, then missing investments due to misclassify extreme schools as non-extreme are more costly. The probability of these misclassifications is higher and a model adjusted ranking approach could not be satisfactory.

Further research is, however, needed to understand the consequences on the ranking quality of other forms of model misspecifications, such as those caused by endogeneity problems, which may arise in presence of measurement error or omitted variables. Moreover, it would be interesting to consider unbalanced data structures and to extend the analysis to the non-linear case.

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DOES THE ECONOMIC CRISIS AFFECT OLTENIA'S ENVIRONMENT?

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Abstract

The global financial crisis, brewing for a while, really started to show its effects in the middle of 2007 and into 2008. On the positive side, some scientists think that the crisis will move people to use less energy and help limit carbon emissions. The global slowdown means people will have less money to buy. This translates into fewer products and goods being manufactured which means fewer natural resources used. On the negative side, other scientists argue that with the financial crisis, there will be less economic activity around the globe within the next few years. This could mean people putting the economy ahead of the environment, although until very recently, the environment got center stage in world attention.

This paper tries to find out if the economic crisis is good or bad for Oltenia's environment.

Keywords: economic crisis, environment, social life.

JEL Classification: N5, O13

1. Introduction

The world is caught between two ongoing crises. The financial crisis has undermined confidence in the global economy and has dragged the world into its worst recession for generations. The other – the sustainability crisis exemplified most acutely by climate change – is more fundamental and has been gathering momentum since the beginning of the industrial revolution.

History has provided us with numerous examples of economic stagnation and breakdown, as well as environmental degradation caused by human activity, even before capitalism existed. But capitalism's central characteristic - the incessant drive to invest and accumulate wealth - gives birth to never - ending economic and environmental crises.

Although the tendency toward economic crises is an intrinsic characteristic of capitalism, there is a second fundamental form of contemporary crisis that is also derived from the relentless pursuit of profits - namely, the rapid growth of ecological degradation. The environment is best viewed as a whole, with interactions and exchanges going on among the living organisms and between organisms and the physical aspects of water, soil, and air. (There is also exchange and interaction between substances in the water, soil, and atmosphere.) Millions of years of evolution have made most natural systems efficient at cycling nutrients and water and allowing energy, generated by green plants using sunlight, to flow as in a gentle stream from one organism to another (that uses the previous one for food), to another, and so on. Most natural systems produce high quality air and water conducive to the continuation of life. Taken together, the vast multitude of organisms, large and small fill all available ecological niches (which they partly create) and few resources are wasted (Magdoff 2002).

The last quarter-century has been marked by capital – in response to the problems of slow growth and lower profits than desired – waging class war, with largely successful attempts to reverse many working- and middle-class gains while inhibiting new increases in wages and benefits for workers. When major financial crises appear – the savings and loan bankruptcies, the Asian crisis of 1997–1998, the near-perpetual third world debt crisis, etc. – the representatives of capital do their best to ensure that capital suffers least, while the pain is spread to the masses.

The struggle over environmental problems – the land, air, and water degraded with poisons and other harmful chemicals, the destruction of large areas of forests, the depletion of nonrenewable resources, and the loss of many species – goes through an ebb and flow similar to the class struggle. When enough people, sometimes even including representatives of capital, are concerned and mobilized over threats to their own health or the long-term well-being of the planet, real progress can occur in cleaning up the environmental mess that is one of the twin crises of capitalist production. Of course, every effort is made by capital to socialize the costs of such cleanups, by using general tax revenues whenever possible (Magdoff 2002).

The current economic crisis is closely linked with housing, and this too has a silver lining. Many dwellings built in the heyday of sub prime lending were oversized homes in distant suburbs far removed from public transit, or second homes in Sunbelt vacation sites far from owners' primary residences. These houses consumed a lot of energy and needed long commutes. Now, many of these exurban/vacation homes are up for sale and it is doubtful that many of them will be occupied for a long time to come. People are staying where they are, moving closer to public transit, and flying less to second homes. This will also produce a substantial decrease in energy use and CO_2 emissions. It's unclear at this point whether the crisis will do more good or more harm for the environment. In the short term, it will certainly slow the increase in carbon dioxide emissions. It will also cause a delay in developing environmentally hazardous projects like Canadian tar sands. But if the crisis also sets back the development of energy alternatives for any significant length of time, it will cancel out any of these positive developments. Many people are waiting and watching what happens in the global financial markets. Likewise, the verdict is still out on the ultimate impact of the crisis on the environment.

How long the crisis will last is anyone's guess at the moment. What is certain is that legislation on climate change issues is taking a backseat to reviving the world economy (Amado de Jesus 2006).

There are two sides to this question. On the positive side (Amado de Jesus 2006), some scientists think that the crisis will move people to use less energy and help limit carbon emissions. The global slowdown means people will have less money to buy. This translates into fewer products and goods being manufactured which means fewer natural resources used.

The people from United States are buying less fuel and building fewer houses. This means less building materials such as steel, glass and bricks- materials that are produced using electricity. Since less fossil fuel is being used to run power plants, as well as produce and transport goods, there will also be less pollution. The rate of deforestation will also be reduced as fewer trees will be cut down due to less consumption of wood and paper.

Some optimists project that the current situation may prompt countries to boost investment in efficiency and clean energy to tackle climate change. This move could result in more international cooperation. Investing in energy efficiency during a recession and spending on renewable and other low-carbon industries also help stimulate the economy.

During economic crisis, more low-scale and down-to-earth projects are expected to be given more attention. Natural lighting, natural ventilation and passive cooling technology will be very cost effective.

Innovative and lightweight structural systems will reduce cost of building materials. Green and renewable energy sources will continue to be in vogue. Collection and recycling of water will prove to be very helpful. Reuse and recycling of materials cannot be overemphasized. Flexible space planning will be more and more adopted.

On the negative side (Amado de Jesus 2006), the pessimists argue that with the financial crisis, there will be less economic activity around the globe within the next few years. This could mean people putting the economy ahead of the environment, although until very recently, the environment got center stage in world attention.

With less money to spend on research for dealing with environmental concerns, important programs may be suspended indefinitely as donations are reduced or driven away from environmentally oriented institutions.

Ambitious plans that could be stopped or reduced in scope include investment in wind, solar and renewable energy, carbon trading, and biodiesel refining and burying carbon dioxide from coal-fired power plants.

Before the crisis, people using public transportation increased, they left their cars at home and car pooling gained popularity, all for the sake of fuel conservation. With the reduced price of oil today, due to the financial crisis, people may just decide to go back to using their cars. It could even dampen their initial enthusiasm to buy hybrid cars.

According to a European Union - Commissioned Study, the global economy is losing more money from the disappearance of forests than through the current banking crisis. It estimates the annual cost of forest loss at between $2 and $5 trillion. The report explains that as forests decline, nature stops providing services which it used to provide essentially for free. Consequently, we have to

resort to building water reservoirs and facilities to sequester carbon dioxide, or farming foods that were once naturally available

2. The crises in Romania

In the current macroeconomic context, Romania is exposed to the effects of economic and financial crisis, which may materialize in the plan of real economy, by slowing down the economical growth and reducing the number of work places

Analysts warn that the "dark clouds" that come from United States will not withdraw soon over world economies. The actors involved in the green sector see themselves forced to adapt their strategies, taking into account new global conditions, the difficulties of accessing credits, the more expensive loans and even closure of some companies. The green economy is going down. And the economic environment of Romania is not exempt from the global effects of the financial crisis. Over the green businesses heavy clouds gathered. In the latter half of 2008 the overall amount spent to fund clean energy related projects dropped 25% and reached 18 billion dollars. This amount will continue to fall at the beginning 2009 (Deleanu 2008). In recent months, global green market has lost money, and companies have cut ruthlessly from investments in alternative energy.

2.1. Financial deprivation, poor policy

The imprint left by the crisis on the environment could be capitalized, (Deleanu 2008), in the way that the concerns for "greening" could be included with priority in the recovery projects of various sectors. Some optimistic analysts believe that this economic crisis will cause a return to nature or a more sober style of living, because of the lack of income intended until recently for consumerism and they think, at the same time, that public funds may have a chance to be used predominantly for the greening of the public sector and for reducing its impact.

At the category “potential effects”, it is considered that the authorities - especially mayors and local councils - will be taken off their environmental responsibilities, again suffering from financial deprivation. Moreover, the European funds intended for Romania will reach their beneficiaries in our country harder. Fund raising phenomenon, as well as environmental funds will be reduced; pressure on nature and natural resources will reduce due to the lack of liquidity, demand for products, precious metal mining and quarrying with obvious impact on the environment, which is already stimulated due to the increasing value of these metals in relation to liquidity, are other effects of the crisis. In the same category, other conclusions can be taken. Poor members of society, already exposed to environmental risks, are even more vulnerable, the more public funds, including European ones, are more difficult to reach, the more working contracts and environmental job contracts awarded by Procurement will be increasingly allocated preferentially.

Drastic cuts. Other analysts believe that the signs of crisis are not very visible in environmental protection, provided that this is not a priority in Romania. "Not when actual constraints had appeared, nor when budgets had not been adapted to the current weak economic situation, the environment was not of age. They believe that once the crisis installed in Romania, the green will be even more left aside (Deleanu 2008).

2.2. Forecast bleak in Romania

The difficult economic situation of Romania has turned upside down the plans of the actors involved in the environmental protection, who were forced to rethink their strategies. The context facing the world economy, and the present situation and the forecast for next year in Romania will result in the reduction / closure of some working capacities, not only of economic agents - producers / importers, but also of those working in the waste management industry - collectors and recyclers. There is already a decrease in the international market waste, especially paper and in the field of plastics.

Reducing worldwide consumption amid economic crisis has resulted in reducing the amount of waste. The amount of waste generated has dropped by 10% in the first three months of this year worldwide. In 2008, the government approved three-fold increase car pollution tax on secondhand cars. Furthermore, the Government increased the amount of the cassation to the "piece" from 800 euros to 1,000 euros. It is predicted that in 2009 60,000 cars will be scrapped, 50% more than in 2008.

The global crisis will curb economic growth of Romania in 2009 after our country was the leader of Europe in 2008 - an increase of 8.9%. The economy could record more than 1.2 million unemployed; say the darkest statistics and announced salary increases could be postponed (Grosereanu 2009).

According to the gloomy forecasts, the unemployment rate will exceed 8% in 2009, and the number unemployed will reach 1.2 million people, given that nearly 500,000 Romanians will return to the country from Spain and Italy and in the context of doubling the number of unemployed in Romania. The most affected are those who work in the construction area, auto parts and clothing areas. Latest statistics indicate that in Romania there are 353,000 officially registered persons, the unemployment rate being 3.9%. In Dolj, in November 2008 there were 22,000 unemployed, the unemployment rate being 7.66%, almost twice the national average.

The main pollutant generating activities that significantly affect environmental quality in the South-West Oltenia Region 4 are (Barbu *et al*. 2008):

In Dolj County, the energy industry based on fossil fuels, mining and quarrying, shipbuilding and railroad cars, chemical industry, wood processing activities, Mechanical engineering and machinery, construction materials industry, rail traffic, road and shipping transport activity, storage and gas distribution, fuels and fuel.

But large companies in Dolj feel the first effects of the crisis. Electroputere Craiova has a list of hundreds of people to be made redundant. About 60% of the employees Aircraft SA Craiova are, at this time, in technical unemployment, because the factory no longer copes economically. It is possible even that the liquidation of the company will follow. Ford Europe has announced that currently there are no financial problems at the plant in Craiova, although the auto giant has serious problems and will enter a restructuring process. Rail and road traffic lowered enough compared to the years 2000-2007. With the decrease of the economic activity, transport also went down..

In Olt County, industry is the main economic activity; the most developed being the steel industry. A delicate situation is found at Alro Slatina. The aluminum manufacturer is the largest in Central and Southeastern Europe, except Russia, and Slatina's economy is mainly based on it. At the end of last year, the majority shareholder, the Dutch concern Vimetco NV, controlled by Russian oligarch Vitaly Machitski announced that it was considering the reduction with 50% of aluminium production, and the dismissal of 1,200 employees. It is clear that some of the production halls are already closed.

The main pollutant generating activities that may significantly affect air quality in Mehedinți County are: production of fossil fuel energy, ship\ and railroad cars building, heavy water chemical industry, paper industry, wood processing activities, food industry; traffic by rail, road and shipping transport operations, storage and gas distribution, fuels and fuel. A large proportion of businesses generating pollutants in Mehedinți have closed some sections, especially the chemical industry and ship and car building industry.

Main industries existing in Gorj are: coal (lignite) mining in basins in Rovinari, Motru, oil and natural gas extraction in ranges Hurezani, Ticleni, Logresti, Capreni, Stoina, producing electricity from thermal power plants Turceni and Rovinari, producing electricity in hydroelectric plants (the rivers: Jiu – Cerna - Olteț and Motru Tismana) Construction products (Târgu Jiu, Târgu Cărbunești), exploitation and wood processing (Târgu Jiu Novaci, Baia de Fier, Tismana Padeş), construction machinery, mining equipment (Târgu Jiu, Rovinari, Motru Jilt). Due to the drastic reduction in orders for coal, all work in mines Motru and Rovinari is much lowered.

Vâlcea county is prevalent in chemical industry and power generation from hydro sources, the representative industries being the extraction of natural deposits (coal, salt, limestone, mica) and processing – wood, plastic etc. Oltchim Râmnicu Vâlcea is one of the leading industrial giants of Oltenia and the biggest polluter in the area. The Oltchim operates at 60% of its capacity because of the financial crisis.

Tourism can cause a negative impact on the environment through: intensive use of water and land by recreational facilities, provision and use of energy resources, the natural changes occurring after construction of infrastructure, air pollution and waste disposal, compaction and soil sealing (destruction of vegetation), disrupting wildlife and residents of the area (because of noise). The continuous growth in the number of tourists and tourism development between 2000 and 2008 led to aggression of the environment: waste water from tourist facilities, pollutants from transport (cars

passing), emissions of pollutants from thermal power plants, uncivilized behaviour toward heritage values. Now this branch of activity is also in decline, and therefore pollution from intensive tourism in Oltenia is decreasing. A poor transport infrastructure, high unemployment, low incomes, too high dependence on agriculture, a low level of industrial activities, lack of quality training, environmental issues, have all led to a decrease in tourism in Oltenia in 2009. In Oltenia, industrial giants announced massive layoffs.

During 2000-2008, the intensity of economic activities lead to further pollution of water, air, soil and subsoil South – West Oltenia region.

Systematic measurements of air quality in Dolj County highlighted, in its NV areas, in Işalnița, Podari and Calafat, annual average concentrations, usually at the maximum allowable, for ammonia, nitrogen dioxide and particulates. The reduction of the industrial activity in 2009 has contributed to the reduction of the amount of particulate matter discharged into the environment. Greenhouse gases are CO_2, CH_4, N_2O, and PFCs, HFCs, and SF_6.

The sectors where emissions of greenhouse gases are the most powerful are: energetic sector, industrial processes, waste, solvent use, agriculture. Air pollution is 50% due to carbon dioxide. The maintenance of a relatively constant amount of CO_2, provides optimum conditions for the development of life. A huge increase of CO_2 concentration is devastating. CO_2 emissions from combustion in energy and processing industries are about. 90% of the estimated total of CO2 emissions regionally. Emissions of CH4 also lead to generating greenhouse effect. They come from: combustion in energy and transformation industries, non-industrial combustion plants, agriculture, and road transport. In two years there was a reduction of N2O over 2000, due mainly to the reduce consumption of chemical fertilizers used in agriculture.

The average values recorded for checked pollutants are comparable to those of the previous year but going down from previous years, probably largely due to the reduction of traffic in cities. Human activities with the most important share in generating greenhouse gas emissions are combustion processes. In the Oltenia region, high power energy complexes work: EC Turceni and C.E. Rovinari, C.E. Işalnița, C.E. Craiova II ROMAGPROD - Turnu Severin. Other sources of emissions for greenhouse gases are: SC OLTCHIM Rm, DOLJCHIM, SC Alro, and S.A Slatina.

In the same time the measurements made on the main rivers of Oltenia, Jiu, Olt, Gilort, etc., for 2005 (Barbu *et al.* 2008a, 2008b), 2006 (Barbu *et al.* 2008a, 2008b, 2009a), 2007 (Barbu *et al.* 2009b), show that the level of pollutants, especially heavy metals is quite high compared to concentrations measured in years 2008 (Barbu *et al.* 2010), 2009. Since 1950-1989, the quality of the waters of the Jiu River has constantly worsened. Because of the restriction of the social-economic activities, after 1990, the situation of the waters of the Jiu River and of the waters in Romania has continually improved. In the same time, in 1990 there is a transfer to a more rigorous management of the environment which also includes legislation according to the international norms.

After 1990, a part of the mines from the Jiu Valley were closed, which had led to a constant reduction of the concentration of the heavy metals from the Jiu River. Until then, a part of the chemism of the waters in the area was determined by the excessively mining practiced in these areas. The trend of pollution in the largest rivers in Oltenia continued in the years of crisis, due to industrial activity compression in coastal cities, due to redundancy in the mining areas (in the case of Jiu River) and due to the closure of production sections of the Oltchim Râmnicu Vâlcea (in the case of Olt River). But pollution of the rivers is still at a high level, especially because of the household and municipal waste due.

In the year 2007, more than half of the population (57.4%) was not connected to public sewers, according to Sustainable Society Index (SSI), developed by the Foundation for Sustainable Society, in partnership with the Ministry of the Environment, the National Agency for Environment Protection and INS. The most affected regions from this point of view were South - Muntenia, where nearly three quarters of the population (71.7%) was not connected to a sewerage system, north-east, with 69.3% of people offline, and South West Oltenia, where the proportion of people not connected to the sewerage system was 68.7%.

In terms of soil, it needs hundreds of years to recover, but can be destroyed in a few years by incorrect dosing. It is indicated that in the last year the sewage concentration in soil was reduced due to the abolition of complex livestock (pigs, cows).

The main effect of mining is the removal of the economic cycle of large plots of land. Landscape impacts created by mining and waste dumps are significant.

Another major issue is the impact generated by waste produced and stored out of control, which clearly affects the quality of environmental factors. With the crisis, both waste generated by industrial activities and by the economic and municipal activities decreased.

4. Results and discussions

Figure 1 shows the quantity of pollutants discharged in the Jiu River by SNP Petrom - Craiova Branch DOLJCHIM through the discharge of wastewater in 2005, 2007, 2009.

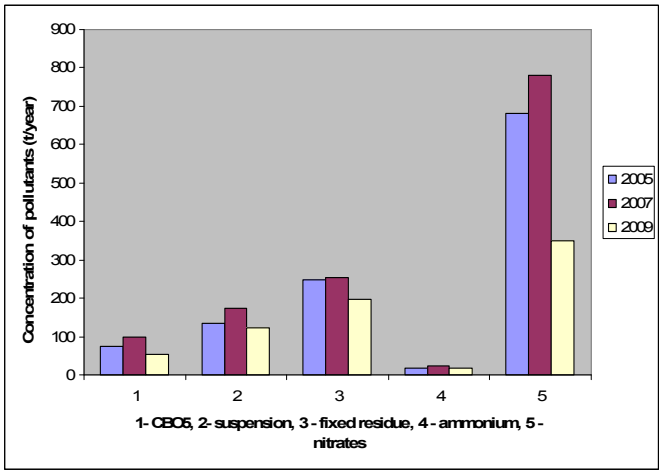

Figure 1. The quantity of pollutants discharged in the Jiu River by SNP Petrom – Craiova

In all cases it is seen that the pollutants increase slightly in 2007, but fall pretty much in 2009.

Figure 2 shows the level of heavy metals in the Jiu River in 2005, 2007 and 2009. Measurements were made at Malu Mare harvesting point. Malu Mare is the point where wastewaters from Craiova City are discharged.

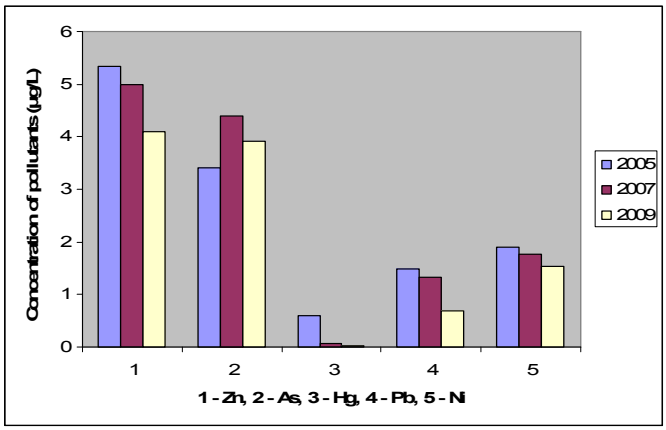

Figure 2. The level of heavy metals in Jiu River

It can be seen that, in general, pollution with heavy metals decreased from 2005 to 2007 and fell further in 2009. The reasons are restricting human activity and use of pesticides in a lesser extent. Heavy metal pollution still persist, however, because heaps of tailings. Measurements were made in June, using mass spectrometry with inductively coupled plasma.

5. Conclusions

All purchases on public money should be "green procurement". This means products and services that have a minimal impact on nature, in all phases: production (renewable materials), use (energy efficient), and post using (recycling), e.g. recycled paper, electric cars, solar panels, food closets in hospitals, schools, etc.

All public investments should also have, as a main objective, harming environment as little as possible. And in the long term: to keep biodiversity, restore ecological balance, to create the premises for sustainable economic development.

In Oltenia was found that at the majority of the economic agents, effluent flows decreased, compared to authorized debits, as a result of reducing or restriction of economic activities. For this reason the main agents had no significant exceeding economic quality indicators, compared to the limits allowed by regulatory acts of water management. WWTP (Wastewater Treatment Plant) is a high degree of physical and moral wear, having insufficient treatment capacity for wastewater flows and this is the negative effect of the crisis on the environment, namely lack of funds for investments in wastewater treatment plants, which is a major problem in water rates. Due to the reducing production, in some areas, the quality of water resources recorded in 2005 an improvement.

As a general conclusion, short-term crisis had a beneficial effect on the environment by reducing emissions of pollutants into the atmosphere, by reducing discharges into the main rivers of Oltenia, following cut down mining operations, tourism, economic, generally, to the Oltenia region. But long term, the economic crisis could have a negative impact on the environment, due to the reduction of funds and investments in the green industry.

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FINANCIAL CRISES AND CYCLIC DEVELOPMENT ACCORDING TO THE APPROACH OF PAOLO SYLOS LABINI

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Abstract

In his "Le prospettive dell'economia mondiale" ("Prospects for the world economy") of 2003 Paolo Sylos Labini analyses the real and financial factors of the American economy and expresses pessimistic forebodings on the future economic trends in the USA and other parts of the world which, in the light of the events occurring as from 2007, can now be seen to have been justified. The aim of this paper is to provide his ideas with a place in the present debate on the American financial crisis and, to this end, the paper is divided into three parts. To begin with we will delineate the approach taken by Paolo Sylos Labini in examining the links between the financial system and economic system, highlighting the classical, Schumpeterian and Keynesian elements contained in it. We will then turn the focus on the four key elements of financial crisis according to Sylos Labini: income distribution, innovation, market forms and debt sustainability. Finally, we will recall some considerations by Sylos Labini on the three themes central to the present debate on the American crisis, namely the rate of interest in monetary policy, the role of the managers, and expectations.

Keywords: Paolo Sylos Labini, financial crises, cyclic development.

JEL Classification: G01, B50, O10.

1. The main characteristics of cyclic development

All Paolo Sylos Labini's considerations on the origins of financial crises are formulated within the theoretical/empirical framework of analysis of economic development. He defines his as an "integrated approach" (micro-macro),[2] since it emerges from an original combination of classical, Keynesian and Schumpeterian elements.

1.1. Cycle and development

Sylos Labini applies the Schumpeterian term *cyclic development* to indicate "economic development whose dynamics follow cyclic trends" (Sylos Labini 1984a). According to Sylos Labini "for Schumpeter «the cycle is the form that economic development takes on in the age of capitalism»" while "models of Keynesian derivation, concern the cycle as such." (Sylos Labini 1983).

"[There is need for a] far more vigorous revival of the Schumpeterian construction, thus gradually contributing to a change in the incredible situation of economic theory, where the static approach still predominates, in a period that sees all sorts of technological and organisational innovations creating constant upheavals in economic life." (Sylos Labini 1990, 458)

[1] This study was made in the context of a research project, AST 2007, entitled "Sviluppo economico e sviluppo civile secondo l'approccio di Paolo Sylos Labini" ("Economic development and civil development according to the approach of Paolo Sylos Labini" (coordinator Prof. Marcella Corsi). We want to thank Alessandro Roncaglia for his suggestions and criticisms and the anonymous referees. The sole responsibility for any error or imprecision is our.

[2] This original operation of synthesis appears by no means obvious, nor immune from possible questioning; in fact, Sylos Labini himself writes: "Thus we have much to gain if we combine certain elements of Keynesian analysis of effective demand with some parts of the Schumpeterian analysis of technological progress and cyclic development of the economy. If we reread the fiercely critical review of the *General Theory* that Schumpeter wrote shortly after its publication (1936) and if we reconsider the reason why Schumpeter rejected the aggregate analysis in the *Business cycles* (pp. 43-44 and 144), a thesis such as we offer here may seem surprising. Let us remember, however, that after the Second World War Schumpeter toned down his criticism considerably" (Sylos Labini 1984a, 107). In a note he adds "In the course of economic theory which I followed in 1949 when I was at Harvard as researcher, Schumpeter dedicated two lectures to the models of Keynesian derivation based on interaction between the multiplier and accelerator; he illustrated them taking a cool but not hostile attitude; indeed, he appeared to consider them analytically useful, albeit only at an auxiliary level, to account for short cycles (Kitchin), as proposed by Metzler in 1941." (Sylos Labini 1984a, 107) (See Keynes 1936, Schumpeter 1939 and 1971, and Metzler 1941)

The key elements affecting cyclic development are, according to Sylos Labini, innovations, forms of markets and income distribution, which condition the dynamics of the main economic variables, i.e. productivity, income, employment, prices and wages.

Let us analyse cyclic development starting from a general, summary scheme in which the variables shown are investments *I*, income *Y*, wages *W*, rate of profit *r*, prices *P*, labour productivity *Π* and employment *L*. The scheme assumes oligopoly[3] as the market form predominating in the economic system.

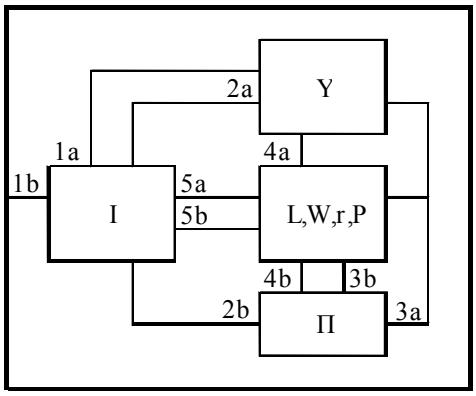

Figure 1

(1) The theoretical starting point of the process is represented by investments, which are the main force for development. According to Sylos Labini, from the point of view of causes, investments can be *autonomous* **(a)**, or *induced* **(b)** if made under economic pressures arriving from increase in income.

(2) From the point of view of effects, investments are composed of two components, one "of development" in the sense of acting mainly to increase productive capacity and so, according to the multiplier principle, to generate income **(a)**, the other "of efficiency" insofar as they serve to save labour and so specifically to increase productivity **(b)**.

(3) Sylos Labini's productivity function combines the principal forms of secondary innovations (as compared with Schumpeterian innovations) as he conceived of them. The increases in productivity derive from impulses exogenous to the economic system (*H*) and from endogenous impulses due to income (*Y*) through the static and dynamic economies of scale (*Smith effect*) **(a)**, absolute cost of labour (cost of labour per unit of product, *B*) which gives rise to organisational innovations (*organisation effect*) **(b)**, and the relative cost of labour (difference between wages and prices of machinery, *G*) which induces efficiency investments in machinery (*Ricardo effect*) **(b)**.[4]

$$\hat{\Pi} = H + \alpha\hat{Y} + \beta\hat{B} + \delta\hat{G} + I \qquad (1)$$

(4) Increases in income and productivity have contrasting effects on the labour market: the former driving in the direction of increased employment and so more power to the unions **(a)**, while the latter, reducing employment, tend to weaken the workers' bargaining power driving towards reduction in wages **(b)**. In this phase the fundamental variables are the cost of labour per unit of product and prices. To clarify this line of reasoning further, let us consider an equation and two identities. The first equation concerns the formation of prices – according to the principle of full cost – in industry, which is the sector Sylos Labini takes for reference since its dynamics condition the development process of the entire economy.

$$P = v + \mu v \qquad (2)$$

[3] See Sylos Labini (1962).

[4] For further discussion of Paolo Sylos Labini's productivity equation, see Corsi, Guarini (2007) and Guarini (2009).

in which P is price, v is the component of variable costs (cost of labour per unit of product, called also Unit Labour Cost – *ULC* –, cost of raw materials, cost of energy) and μ is the proportional margin applied to cover the fixed costs and obtain profit. The first identity refers to the functional distribution of income

$$1 = \left(\frac{W}{\Pi}\frac{1}{P}\right) + (A + Z) \tag{3}$$

where W is the money wage, Π is labour productivity, Z is the share of profits and A is the share of costs other than labour (fixed costs and variable costs such as raw materials, energy, etc.). The second identity is based on the decomposition of Z

$$Z = \frac{K}{Y} r \tag{4}$$

where K is the nominal value of the capital advanced and r is the rate of profit, or in other words the ratio between profits and capital.

In general, the entrepreneurs pursue objective $\hat{W} < \hat{\Pi}$ to increase profits of the share of profits, while the unions aim at having $\hat{W} > \hat{P}$ (which may entail $\hat{W} > \hat{\Pi}$) to increase purchasing power for consumption goods. Sylos Labini analyses the trend in the rate of profit starting from the rate of optimal wage.

(5) The wage rate has a twofold effect on investments: a "demand effect", in that growing wages stimulate consumption thereby, thanks to the accelerator principle, encouraging investments **(a)**, and a "profits effect" in that, *ceteris paribus*, increasing (decreasing) wages limit (raise) profits **(b)**. Taking into consideration the Unit Labour Cost and thus (W/Π), then the wage rate is optimal for development when the *ULC* is stable; in this way consumption increases thanks to growing real wages and increase is also seen in the investments introduced by the steady share of profits. Thus we have a compromise between the demands of the unions and the demands of the entrepreneurs.

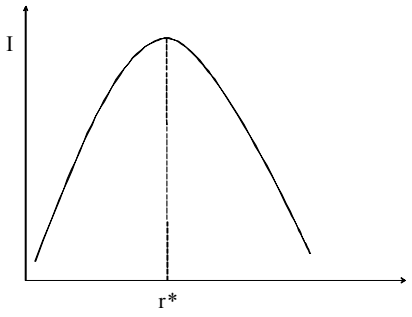

Figure 2

Thus the *optimum* turns out to be $\hat{W} = \hat{\Pi}$ since the positive effect on investments is maximised thanks to increased consumption with minimisation of the negative effect that a drop in the share of profits might have on investments maintaining a steady rate of growth in the share of profits, with final positive effect on aggregate demand. There are, however, exceptions to the *optimum* $\hat{W} = \hat{\Pi}$: it is possible to have an *optimum* (from the point of view of the equilibrium affect on aggregate demand) with $\hat{W} > \hat{\Pi}$ if the other factors of costs are reduced (A) and with $\hat{W} < \hat{\Pi}$ if foreign demand and/or public expenditure increase. With $\hat{W} = \hat{\Pi}$ we have steady share of profits Z and this entails, capital-income ratio being constant, a steady rate of profit r (equation *4*). Thus, for development the need is to maintain profits at an optimal level, with neither positive nor negative excesses.

"Profits are the petrol of the capitalist car: without them, the car stops, but it also stops if there is too much petrol as the engine gets flooded" (Sylos Labini 2004a)

Actually, the optimal rate of profit is to be seen rather as the range of rates since every sector has its own specific optimal value: "[…] in some activities it can even be zero, since these activities would not be performed at zero profit and the means of production used in the activities could be put to more advantageous uses for the economy as a whole" (Sylos Labini 1984a). In this case the optimal is of a dynamic type since it relates to processes of development and thus quite distinct from static optimum analysis in mainstream studies.

"Economists have long discussed a series of «optimums» of a static type – beginning with the issue of the optimal allocation of resources (for the economy) or of specific means of production (for a firm); far more important than these, however, are the «optimums» of the dynamic type" (Sylos Labini 1984a).

1.2. Key elements

The elements characterising cyclic development are, according to Sylos Labini: innovation, market forms and income distribution. The various interactions between these elements generate the various dynamics of development and decline.

As the scheme in Figure 1 illustrates, the development is cyclic because of the alternation of phases in which, from the point of view of investments, the development effect prevails **(2a)** and, from the point of view of wages, the demand effect prevails **(5a),** and phases in which, due to the possible detriment to profits in the previous phase, there prevail the efficiency investments **(2b)** and the profit effect of wages **(5b)**.

There are two important aspects to the interaction between innovations and income distribution. The first has to do with the way the fruits of technological progress are distributed: with $r < r^*$ they go mainly into wages, while with $r > r^*$ they are absorbed into the profits. On the other hand, with $r < r^*$ the innovations are mostly in the fields of technology and labour organisation, when in a prolonged $r > r^*$ situation the innovations become primarily of a financial type. With regard to the interaction between forms of market and innovation we may also add that social division of labour works in the direction of product innovations that entail the formation of differentiated oligopolies, while technical division of labour tends towards process innovations with consequent formation of concentrated oligopoly. Finally, the interaction of forms of market with income distribution entails diverse trends in the real *ULC*. According to Sylos Labini, the prevailing situation in a competitive goods market is $r \le r^*$, while a situation with an oligopolistic market of goods and weak unions (prices rigidly high and wages rigidly low) entails $r > r^*$.

The various forms of markets can also influence the effects of productivity increase on the other economic variables. Broadly speaking, in competition the increase in productivity reduces the price and so the real Unit Labour Cost, $\left(\frac{W}{\Pi}\frac{1}{P}\right)$, remains constant, while in oligopoly, if productivity increases due to the introduction of plant or machinery accessible only to the big firms, these firms do not cut their prices and thus increase profits and/or wages, while if there is only an increase in prices, then the big firms can maintain their privileged position investing yet more, thereby obtaining ever greater rates of growth in productivity. In both competition and oligopoly the increase in productivity boosts the real gains, the former with a reduction in prices, the latter with an increase in the growth rate of the nominal income. Closely bound up with the question of oligopolistic markets is the of price dichotomy issue: according to Sylos Labini, the most competitive sectors (the sectors of agriculture and raw materials) exhibit greater elasticities than the oligopolistic sectors (the secondary and tertiary sectors), and in the labour market, where increasing skills see a differentiated oligopoly taking form, the elasticity decrease.[5]

To sum up, in his approach Sylos Labini combines classical, Schumpeterian and Keynesian elements.

[5] Sylos Labini observes that this point does not appear in Keynes's analysis, where these elasticities are homogeneous in every market with free competition fundamentally prevailing.

	Keynes	Schumpeter	Sylos Labini
Theoretical Pillars	1. Expectations	1. Invention	1. Innovation
	2. Consumption propensity	2. Entrepreneur	2. Market forms
	3. Liquidity preference	3. Banker	3. Income distribution

Figure 3

Cyclic development is characterised by the forces of development and decline, with the rate of profit as their key point. The classical economists consider this variable to be essential for an understanding of the dynamics of economic development, since it underlies accumulation. As Sylos Labini points out, Smith concentrates his analysis on surplus profit as an example of the absence of that free competition that would work in the direction of uniformity in the profit rate. In different contexts, Ricardo points out how deficiency in the rate of profit limits capitalistic development.

According to Sylos Labini, the pillars of the Keynesian approach are expectations, consumption propensity and the liquidity preference, and from this approach he draws upon the multiplier principle and the accelerator principle, the "demand effect" of wages (according to which real wages raise income through consumption) and the important role played by public investments and the unions. On the other hand, he criticises this approach in that it takes as secondary Sylos Labini's three pillars, namely innovation, forms of market and income distribution, while from the Schumpeterian approach it is precisely the idea of cyclic development and the role of innovation which he looks to. According to Sylos Labini, Schumpeter's pillars are invention, the entrepreneur and the banker, with the perception that "the inventor is a man of great intelligence, even a genius, but not necessarily a scientist; the entrepreneur is the innovator, the man who realises the potential of an invention and implements it; the banker is the person who finances the whole operation" (Sylos Labini 1984a). In the case of innovations, there are certain lexical-conceptual differences between Schumpeter and Sylos Labini: the former defines innovations as autonomous (induced) if they are original (improvements in previous innovations), while the latter defines them as exogenous (endogenous) if generated by non-economic (economic) impulses.

Sylos Labini criticises Schumpeter for identifying solely in innovation the *primum movens* of a cycle without considering the driving role of demand and in particular of the role of the State, which are at the basis of Keynes's analysis and which, in Sylos Labini's terms, are defined as public autonomous and private induced. In fact, Schumpeter defines only the innovative firms as "motors", while for Sylos Labini the "motors" exhibit the following characteristics:

"[…] (a) production and productivity increase more rapidly than in the other industries, to the extent that the relative prices tend to diminish; (b) the relative incomes — especially wages and profits — tend to grow; and (c) employment tends to increase more than in other industries". (Sylos Labini 1991, 320)

The Schumpeterian scheme has to be readjusted to account for the scenario in the aftermath of the Second World War, with dominant positions growing in the markets.[6] Nevertheless, a form of competition remains within oligopoly where the agents are large firms and the competitive tools are increasingly complex.[7]

2. The real dynamics of the financial crisis

[6] "The third stage of capitalism is defined by the Marxists as the stage of monopolistic capitalism and by Schumpeter as the stage of trustified capitalism. Personally I prefer to define it as the stage of oligopolistic capitalism. In this stage the Schumpeterian triad loses importance: the individual inventor is ever more frequently replaced by a scientist or group of scientists working in the laboratories of big companies and in public laboratories; the function of the banking system changes, due also to pressures of public spending and the expansion of government securities; and as a rule the innovations do not come in with a host of imitators, but are ever more often implemented by firms already existing. Entry is more difficult" (Sylos Labini 1984a, 78).

[7] "This does not mean that competition disappears: what does tend to disappear, outside agriculture, is atomistic competition; on the other hand, the "competition that counts" is growing ever keener than it used to be; it is «the competition created by new goods, new technologies., new sources of supply of raw materials, new types of organisation (for example, the large control unit)» (Schumpeter 1942, 84; Italian translation., 80). According to Schumpeter, in our times the innovating firm can be large or small but, given the superiority of the large firm in terms of financial resources and the possibility to organise research laboratories, "the competition that counts" tends increasingly to be that of the large firms, while the small firms are increasingly driven to the sidelines. (Sylos Labini 1990, 449)

According to Sylos Labini, financial crises find a place in the process of development in that they represent the main consequence of the persisting inequality $r > r^*$. We will go on to construct an analytic scheme stylising the major mechanisms that can bring about a financial crisis, and consequently economic crisis, within cyclic development. This scheme seems to us to have general validity since, although the main references are to the crisis of '29 and the present crisis, which Sylos Labini analysed in depth, and they are crises which, again according to Sylos Labini, also have features in common with the Asian crises of the 1990s.

Similar phenomena [to the crisis of '29] occurred in Japan as from 1993; the crisis had serious repercussions in various countries of Asia, including Indonesia and the so-called Asian tigers, with the exception of Taiwan, which had deliberately put a brake on the growing relations with Japan to avoid tensions with China. The main preconditions of crisis were similar: progressive rise in profits, wholesale real estate and stock exchange speculation, and eventually a great crisis revolving around the banking system; […]. The crisis also hits South America and the developed countries, but not too hard, thanks also to the financial interventions of the governments of Japan and the United States, and indeed of the International Monetary Fund. Effectively, having been halted in time, financial crisis did not degenerate into lasting real crisis. (Sylos Labini 2000, 76-77)

The basic idea is to trace out some schematic relations that encapsulate Sylos Labini's ideas on financial crises, his aim being to offer not definite forecasts but, rather, theoretical bases upon which assessments of probability might rest:

"[…] in economics, unlike astronomy, precise forecasts are not possible, were it only for the fact that certain variables depend on decisions that cannot be predetermined; we can only formulate previsional hypotheses or assessments of probability, indicating the bases upon which such assessments are made". (Sylos Labini 2002a, 1)

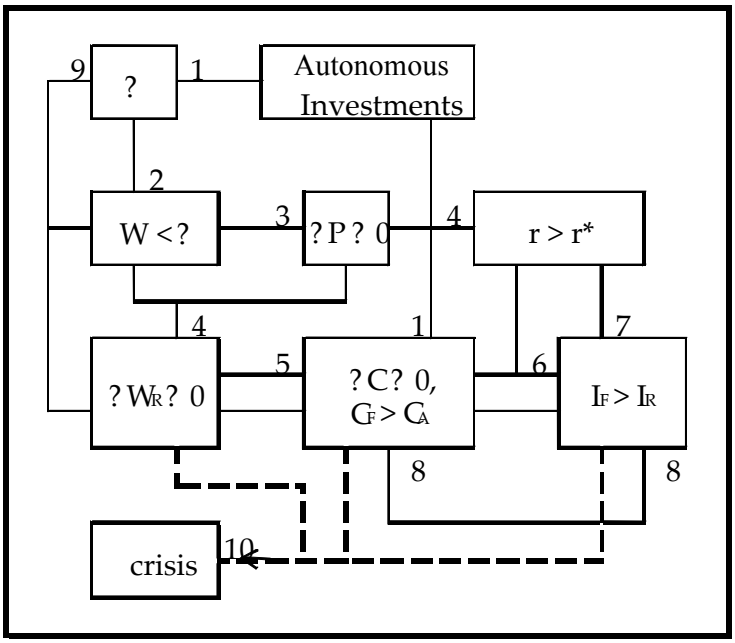

Figure 4

(1) As we have seen, autonomous investments raise labour productivity and by virtue of the multiplier drive income and consumption upwards: in '22, the first of the years leading to the crisis of '29, they involved electricity, automobiles, radio and the press, and in'93, the first of the years leading to the present crisis, they involved information technology, electronics and telecommunications.

(2) In terms of dynamics, bargaining weakness on the part of the unions leads to a rate of wages falling increasingly lower than the rate of productivity. In the case of the '29 crisis, according to Sylos

Labini, the weakness of the unions resulted from the anti-union policies then pursued:

"it was only in the time of Roosevelt, in 1933, that the right to strike was recognised and subsequently, in 1935, with the Wagner law, full union freedom; after 1933 wages became rigid on the downward side and flexible on the upward" (Sylos Labini 2004a, 90)

In the case of the present crisis, on the other hand, Sylos Labini attributed the weakness of the workers in Western countries to international competition and excessive labour flexibility.

"[…] in years of weak development or stagnation a high level of flexibility means a falling level of real wages, with negative effects on the growth of consumption. A…] the very high level of flexibility in that country [the United States] tends to generate contrasting drives harming all. (Sylos Labini 2004a, 135)

(3) Oligopolistic firm positions keep the prices of industrial goods steady, and the prices of agricultural goods and raw materials slightly decreasing due mainly to a reduction in demand. According to Sylos Labini prices today are in general more rigid on the downward side than at the time of the '29 crisis, since oligopolistic positions have been reinforced in all the sectors while the public support for agricultural prices is particularly strong.[8]

(4) All this entails two effects: a rate of profit above the optimal $r > r^*$ and stable real wages. The above normal profits of the large oligopolistic firms are in part transformed into

"very high salaries which the executives award to themselves. In a world dominated by great oligopolistic complexes these salaries do not serve simply to reward the performance of people endowed with considerable or even exceptional capacities, nor indeed are they correlated with «marginal productivity» aspects of their performance; actually, these salaries incorporate part of the surplus profits of oligopoly and serve to qualify the "status" of the executives: thus they become almost, as it were, a «necessity» of the system. If all the big corporations follow a – from this point of view – collusive line of behaviour, then the share of oligopolistic surplus profits channelled this way can grow large indeed". (Sylos Labini 1992, 269-270)

(5) Lack of growth in purchasing power and a decreasing quota of wages hamper growth in consumption and fiscal policy has hardly proved helpful. In fact, with reference to both crises he points out that "with regard to consumption, we must recognise the fact that distributive inequality has grown thanks to fiscal policy favouring the rich; and while military expenditure increased, social spending decreased." (Sylos Labini 2004b, 18)

According to Sylos Labini, increasingly unfair income distribution has been supported not only by fiscal policies, but also by a cultural process thus inclined, that has made the situation socially possible.

"It is to be noted that, as in the 1920s and in the last 10 years in the United States, the watchword in Italy is «enrichez vous!»: the paradoxical aspect is that the poorer categories do not seem to have many objections to this trend, or fashion; far from detesting the rich, the poor seem to admire them, fascinated by the idea of becoming rich themselves; and this, I believe, is the only way to explain how fiscal policies favouring the rich have not come up against significant policy objections in any party. Perhaps judgement of income distribution depends not so much on abstract and immutable ethical criteria of fairness, as on the expectations of the people and, in concrete terms, the functioning of the economy". (Sylos Labini 2002b, 1)

(6) Real investments are driven solely by profits and not by growing consumption, which means growing importance for financial as opposed to real investments. According to Sylos Labini, the former take the form of "credits to distributors and consumers, money and deposits in the banks, stocks and shares, and credits to partner and subsidiary companies, while the latter go into "plant, machinery, equipment and stocks". "[Real investments] generate increase in productive capacity, while [financial investments] serve various functions, such as: preparing resources to finance real

[8] See Sylos Labini (1981).

investments in a subsequent period; enhancing the firm's «security» – or in other words its capacity to get over awkward situations; increasing the capacity to reap gains, in addition to that dependent upon the production of goods" (Sylos Labini 1992, 210)

(7) Thus we see a financial market developing, fed by speculation and supported also by the central and private banks.

"The interests involved are of such proportions that the central bank and major banks, taking part in the speculation at times, implement a policy of support which may prove of long if not infinite duration. For these reasons the speculative bubbles do not immediately collapse." (Sylos Labini 2003a, 269)

Thanks to financial activities this market generates considerable profits, reinvested in the same and since "they are activities that give rise to a redistribution and not an increase in wealth" they are "devoid of any economic function" and so "purely speculative and sterile, or even destructive" and can be considered activities that produce "luxury goods", as termed by Sraffa. (Sylos Labini 1984a, 246) Effectively, Sylos Labini distinguishes between "productive" and "unproductive" profits, in relation to the development in either case. It is a distinction that looks back to the Classical-Sraffian distinction between luxury goods and goods necessary for the perpetuation of the productive process, between productive and unproductive investments, and between productive and unproductive labour.[9]

(8) Debts have a fundamental role: on the one hand they finance consumption, while on the other hand they support firms still investing in the real. However, Sylos Labini's considerations also extend to the State and abroad; in fact, he takes into consideration four types of debt: public debt, debt of families, of firms, and foreign debt. The relative importance of consumption financed C_F by loans as compared with "autonomous" consumption C_A may keep consumption growing, but it also aggravates the fragility of the economic system.

"The importance of real estate speculation lies in that, in America, it has largely boosted the growth of consumption, which has been the motor of the upturn of the last few years and which would on the other hand have been restrained by the sharp increase in the inequality of income distribution. The drive for increasing consumption derived above all from capital gains, real or hoped for, on the strength of which families were able to obtain bank loans. This explains why the bursting of the real estate speculative bubble has rather more serious effects than a stock market crash." (Sylos Labini 2005a, 18)

Sylos Labini considers debts a decisive element for modern capitalism: the process of accumulation underlying development would be unimaginable without resort to debt for part or all of the value of the investment, given that internal financing often fails to cover the entire sum needed. If, during periods of development, debt is in fact a means of development, in periods of crisis it becomes a heavy burden weighing on recovery.

"Thus, while in a favourable economic situation debts translate into expenditure, thereby fuelling effective demand, in unfavourable conditions the debts contracted to pay debts coming to maturity entail a reduction in effective demand, which fuels a negative spiral". (Sylos Labini 2003a, 273)

For Sylos Labini, an element taking on a decisive role for the duration of the crisis is the sustainability of the debt conceived essentially as the negative difference between the nominal rate of interest and nominal rate of income growth; a sustainable situation is one in which an economic agent (private or public) faces a loan cost below the benefit obtained from the investments made on the strength of that loan. Thus the problem touching directly on sustainability is to verify whether the investments (private or public) are productive or unproductive. He starts from the relations set out by

[9] "The distinction between profits favourable or unfavourable to the development process, like the distinctions between goods necessary for perpetuation of the productive process and luxury goods, and between productive and unproductive investments are linked to the distinction between productive and unproductive labour proposed by the Classical economists and reproposed in new and original terms thirty years ago by Alberto Breglia in a short but important article" (Sylos Labini 1984a, p.246-247). (See Breglia, A. 1953).

Pasinetti (1998a, 1998b)[10]:

$$S^p / Y - [(i - g)D / Y] \quad (5)$$

where S^p is the primary budget surplus (net of interest), Y is the nominal gross domestic product, i the nominal rate of interest, g the rate of growth in income, and D the volume of the debt. However, he holds that in order to evaluate the sustainability of the debt it suffices to focus on relation $(i - g)$.

"Taking account of the primary budget surplus and the ratios S^p / Y and D / Y means coming closer to reality considering the capacity of the state or private agents to pay interest, but the substance remains the same. Effectively, starting from the evident consideration that the ratio D / Y remains stable when D and Y grow at the same rate, it will suffice to examine the trend in the difference $i - g$ to judge whether problems will arise in the sustainability of debts, whether private or public". (Sylos Labini 2003a, 278)

(9) When prices do not fall and wages decrease the endogenous impulses to increases in productivity due to the Smith effect, the Ricardo effect and the organisation effect slacken, autonomous investments alone remaining as principal driving force.

(10) For this reason crisis breaks out when the speculative bubble explodes, effective demand collapses and in general the economic system, no longer centred on the real economy, goes awry. The debts become unsustainable: the public debts call for a reduction in spending or a hike in taxes, or indeed new debts, but at ever higher interest rates (thereby aggravating the unsustainability), while the family debts lead to a drastic fall in consumption, and the indebted firms are obliged to cut their investments.[11] The unsustainability of the debts prolongs and deepens crisis:

"The motor of cyclic development consists in innovations: the greater they are, the broader will be the scope they offer investments, and the longer the phase of prosperity. At the same time, however, the speculative waves wax stronger, the managers' errors become more frequent and the debts grow, their volume conditioning the duration of crisis once the phase of prosperity ceases." (Sylos Labini 2003a, 268)

All this entails falls in income and employment. As an immediate solution, Sylos Labini proposes a recipe aiming mainly at reduction of debts and fostering growth through a trade policy agreed upon with the other partners.

"It is my opinion that Keynes's recipe does not apply today, since funding deficit spending entails the sale of securities, driving interest upwards; moreover, the increase in demand would also swell imports, thus worsening the foreign debt. The need is in some way to lighten long-term debts and agree upon a policy to launch, with the support of the WTO, a series of trade agreements serving to stimulate reciprocal expansion of the markets: exactly the opposite of the policy adopted by the major governments in the 1930s, and the opposite of the course in America has embarked upon […]." (Sylos Labini 2003a, 15)

3. Sylos Labini's approach and the recent literature on financial crises

In our last section here we will be looking at certain original elements in Sylos Labini's approach relating to various themes discussed in the literature on financial crises: monetary policy, the role of the managers and expectations.

3.1. Monetary policy

Looming large in the current debate are theories on the type of manoeuvre that the Central Bank must perform on the interest rate in times of crisis. To put it in a nutshell, based on the quantitative theory of money the monetarist approach considers the optimality of shifts in the interest rate in terms of the quantity of money intended to be obtained for the purposes of a particular inflationary targets, while in the post-Keynesian approach the element conditioning the effectiveness of the level of the

[10] See Sylos Labini (1948, 1998, 2004b).
[11] See Sylos Labini (2005a).

interest rate lies in the expectations not only of the firms, but also of the banks. Sylos Labini held a measure of monetary policy to be effective if, taking into consideration the principle of debt sustainability, it determines an increase (decrease) in the difference between interest rate and rate of income growth if the aim is restrictive (expansive). On the monetarist approach he has this to say:

"When, to cope with inflation, the central bank decides to raise the short-term interest rate – the official discount rate – it can achieve its aim if it sets the rate of discount over the nominal income growth rate […]: only thus can it bring about a reduction in investments, employment and the unit cost of labour while at the same time determining a fall in the demand for raw materials and oil. This, and not the line indicated by monetarism, can curb inflation" (Sylos Labini 2004a, 88)

On the other hand, with reference to the post-Keynesian approach and an expansive monetary policy, he writes:

"[…] the difference (i-g) turns our thoughts to reflect on the Keynesian liquidity trap: the analysis departs from the, albeit important, limits of the monetary sphere – banks and firms – to enter the real economy, in that it affects the income trend. In fact, to avoid problems of sustainability, a zero increase in income would logically speaking call for zero interest, while a reduction of income would call for negative interest" (Sylos Labini 2003a, 279).

Consistently with his entire approach, Sylos Labini deems it indispensable to accompany monetary policy with structural policies vis-à-vis the real economy. For example, the expansive monetary policy that fostered overdevelopment of the financial market entailed a "doped" recovery of the economy in that a very low interest rate, while rendering debts sustainable, reinforced the debt-dependence of consumers in sustaining consumption, given the increasing inequality of income (Sylos Labini 2004a, 88)

3.2. The role of the managers

With regard to the debate on the excessive power of the managers during the tumultuous development of the financial markets, there is in the first place an incisive indictment by Sylos Labini above all from the social point of view:

"The rapacity and greed of the big managers of our times make Karl Marx's most scathing descriptions of the capitalists of his time sound like understatements. Not only economic life, but social life as a whole are contaminated." (Sylos Labini 2002c, 1)

Moreover, to prevent situations entailing overweening power for the managers and thus inefficient behaviours, Sylos Labini suggests reconsidering the possibility of implementing worker participation in firms:

"Can worker participation drastically reduce the abuses of the big managers? Yes, and for obvious reasons: worker participation prevents barriers between workers and the board of directors - the workers themselves contribute to managing the firm and thus it becomes hard to commit abuses. In all this the market mechanisms remain intact. […] Worker participation is a matter for the relatively large firms, organised as public companies. Particular forms of worker participation are conceivable for the medium-sized firms, which are often the most dynamic. For the small and very small firms, prevalent in Italy, worker participation is, as it were, in the very nature of things: in a firm of ten people all the workers have, in one way or another, a part in all the decisions." (Sylos Labini 2002c, 1)

3.3. Expectations and uncertainty

Another point dealt with in the recent literature is the significant role played by expectations and uncertainty in bringing about the onset of financial crisis, and in this respect it is, by analogy, worth seeing what Sylos Labini had to say with reference to Keynes and the crisis of '29. Here Sylos Labini looks to objective analysis of the events and not subjective factors, and consequently, while recognising the importance of expectations, he criticises the Keynesian approach as being excessively "psychological".

"The issue of psychological assumptions is closely bound up with the issue of expectations: indeed, the latter is part of the former. To avoid any misunderstandings, I must point out that I certainly do not mean to deny the importance of expectations or, in general, the importance of psychological or subjective factors. Nevertheless, if the economist does not mean to encroach on the profession of the psychologist, and wishes to avoid pseudo-explanations that end up by begging the question, he must clarify *why* certain expectations are formed rather than certain others: only if (and to the extent that) the impulses depart from his field of study can he assume them as given externally. The case for criticism arises when expectations are assumed as *primum mobile* or - and this is the most frequent case – when the reasons underlying expectations or other impulses are indicated in vague and generic terms, and not effectively explained." (Sylos Labini 1984a, 256-7)

Sylos Labini sets out to account for a phenomenon by identifying the objective elements and not describing "psychological" elements without the necessary examination, precisely because introduced by an economist.

"He held these factors to be of a psychological nature, which is undeniable; but the issue is a matter of the origin of speculative waves, and simply to put these waves down to irrational expectations is hardly a real explanation." (Sylos Labini 1991, 298)

And this led to a different interpretation of the primary causes of the crisis of '29.

"Basically, the boom did not originate in the American stock exchange, as Keynes suggested, from a wave of irrational expectations, but from a huge shift in income distribution favouring profits. The financial crash that followed that boom had those extraordinary consequences due to the real variables of the economy that we all know, above all production and employment". (Sylos Labini 1991, 298)

4. Conclusion

As we have sought to demonstrate, Sylos Labini's observations on financial crises form an integral part of his analysis of the processes of cyclic development. Thus, according to Sylos Labini, the major causes of every financial crisis have to do with the real economy and in particular with the distribution of income, forms of market and innovation. The Sylos Labini approach is an innovative combination of the Classical, Schumpeterian and Keynesian approaches and can offer an original contribution to the present debate on the American financial crisis with respect to three issues: monetary policy, the role of the managers and expectations. Finally, two further evaluations formulated by Sylos Labini are to be taken into account when analysing this crisis:

1. The crisis offers an important opportunity for an understanding of economic realities,

"Paraphrasing the title of a study that brought fame to the economist Kenneth Arrow (*learning by doing*), I would speak of *learning by suffering* since, perhaps, we learn only by suffering. In other words, the lecture I refer to [*Sylos Labini proposes a new Bretton Woods*] can take place after a period of no minor difficulties. We can only hope that it is not a matter of real upheavals". (Sylos Labini, 1984b, 18)

2. Economic analysis should be not only logical-theoretical in nature, but also historical; otherwise, it lapses into mere abstraction,

"The various observations I have brought together in my hypothetical fifth approximation belong to a preliminary study of the cyclic process of development in a given country in a given period: Italy after the Second World War, in this case. I am of the conviction that studies of this kind, in which theoretical analysis is chemically combined with historical research, are essential if our aim is not a flight of fancy but endeavour to understand the realities in which we live." (Sylos Labini 1991, 321)[12]

[12] See Sylos Labini (2005b).

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THE INFLUENCE OF TRANSFORMATIONAL LEADER UPON ORGANIZATIONAL CULTURE

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Abstract

The need to promote reform is so widespread in today's business society that participatory, democratic, relations-oriented and considerate leadership styles are needed in order to create progressive organizations. The type of leadership that combines all these attributes is the transformational one. Transformational leaders stimulate their associates to view the world from new perspectives, angles, and informational sources, they are motivated by a sense of mission to recreate the organization to survive in a challenging external environment.

The paper deals with the importance transformational leaders have in the process of organizational change.

Key words: *transfornational leadership*, *transformational leaders, organization, organizational culture, change.*

JEL Classification: M12, L2

1. Introduction

In the late 1970's, as a response to the need for a new type of leadership, James MacGregor Burns, a political scientist and social historian, defined transformational leadership and drew the distinction between this style and the transactional leadership one. According to him transformational leadership increases not only the leaders' but also the followers' level of motivation and moral and determines them to become more active. Transformational leadership" occurs when one or more persons *engage* with others in such a way that leaders and followers raise one another to higher levels of motivation and morality". (Burns 1978, 20)

Several researchers, Bass (1985), Bennis and Nanus (1985), Kouzes and Posner (1988), Tichy and Devanna (1990), Bass and Avolio (1990), continued to study and define transformational leadership starting from Burns' idea. Bass and Avolio (1990) also took into consideration the contributions of Bennis and Nanus (1985), Tichy and Devanna (1990) when postulated the formal concept of transformational leadership. Bass asserted (1990b:21) that transformational leadership" occurs when leaders broaden and elevate the interests of their employees, when they generate awareness and acceptance of the purposes and mission of the group, and when they stir their employees to look beyond their own self-interest for the good of the group". According to him (1990a, 53) this transcending beyond self-interest is for the interest of the "group, organization, or society".

Transformational leadership differs substantially from the transactional one being more concerned about progress and development. Burns (1978) regarded transformational leadership as opposite to transactional leadership, while, according to Bass (1985), a leader makes use of both transformational and transactional leadership style, even if the transactional and transformational dimensions are separate. Bass (1990a, 53) considered we can speak about transactional leadership in case leaders" exchange promises of rewards and benefits to subordinates for the subordinates' fulfillment of agreements with the leader". According to Daft (2002) a transactional leader acknowledges the followers' needs and defines the exchange process for meeting those needs. Tracey & Hinkin's (1998, 220-236) point of view is that transactional leadership is based on bureaucratic authority and organizational standards, focused on task completion, and relies on reward and punishment, while transformational leadership is a process that motivates people by making appeal to higher ideals and moral values, defining and articulating a vision of the future, and founding a base of credibility. If the transactional leader makes use of the authority and power that already exists in the organization (Davidhizer, Shearer 1997, 16-21) and transactional leadership is a networking of power (Schuster 1994, 39-43), the transformational one motivates people to work and create change and adds to the quality of people's and organization's life. Stephen King (1994, 7-9) differentiates between

transformational and transactional leadership styles by referring to the former as a leader of innovation and the latter as a manager of planning and policy. In Mink's (1992, 21-23) opinion new pathways inside an organization are created by transformational style, while the transactional one depends on the existing structures. In the final analysis transformational leadership is a process of building commitment to organizational objectives and then empowering followers to accomplish those objectives, the consequence of which is the enhanced performance of the followers.

2. Characteristics of Transformational Leaders

Ackoff (1999, 20-25) defined the transformational leader as one who formulates an inspiring vision, facilitates the vision, encourages short-term sacrifices, and makes pursuing the vision a fulfilling venture. Finkelstein and Hambrick stated (1996, 71) that the daily, apparently" minute actions by executives can have a major effect on organizational functioning and performance". Leaders' descriptions often highlight external behavior that functions within internal, external, and relational contexts. The internal context of the individual's behavior represents the foundation for transformational leadership. Leaders must firstly experience personal inner transformation, personal renewal, considered (Herrington et all 2000) as important means by which they change themselves internally before being able to influence the transformation of others. The leaders' developmental process, resulted in internal changes, generates emotional ties between them and followers (Popper and Zakkai 1994, 3-7). Dixon (1998, 26-29) speaks about transformational leaders' inner characteristics, self-confidence, inner integrity, honesty, and personal values, that influence the leader's behavior and renders it effective. The inner connection of the leader's life experience with transformational behaviours is the key constituent of effective performance, and the resulting behavior conducts to external behaviors that impact upon the transformation of the organization and its culture. A transformational leader's behavior is motivational and creates an impression that the leader has the competence and vision to achieve success (Keller 1992, 489-501); an effective leader communicates more with his behavior that with words, consequently his relational behavior affects the organization and behavioral changes are requisite to change culture (Trahant et all 1997, 17-21). A transformational leader becomes a source of inspiration to his followers through his commitment to them, his perseverance to a mission, willingness to take risks, and strong desire to achieve; he believes in promoting continuous improvement of the followers, broadens and changes their concerns and interests, generates awareness and acceptance of the group's purposes and mission, stimulates followers to look beyond their own self-interest for the benefit of the group. The most successful leader spends the majority of his time developing and nurturing effective relationships. His influence has, in the main, two sides which Schuster (1994, 39-43) terms as *deep thinking* and *empathy*: he influences the followers' way of thinking, stimulates them to enhance curiosity and creativity in problem solving and thinking, encourages and listens to them respectfully, assists their developmental process, share power with them (Davidhizer and Shearer 1997, 16-21) and create a dynamic relational context that motivates them to act on their behalf and for the benefit and needs of others. Such leaders influence the organizational culture by attracting internally motivated people.

3. The Influence of Transformational Leaders upon the Organizational Culture

By providing a vision for change (Bennis and Nanus 1985) transformational leaders provide change and movement inside an organization (Burns 1978, 20). A clear sense of goals and ability to see the processes of change over a long period of time are necessary for guiding organization towards new directions; they promote a vision of the future based on a strong sense of purpose and passionate inspiration (Hersey and Blanchard 1996) that assists them in fulfilling the main goal: *the change, progress, and development of the organization*.

Understanding change as a process is what transformational leaders want to obtain from the followers and, to achieve this, they must define clear concepts and have future orientation toward problem solving, create operational cultures which encourage and support learning (they themselves are life-long learners) because an important factor in the change process is for each person to become and remain a continual learner (Mink 1992, 21-23). According to some authors (Herrington and Bonem 2000) a fresh look at trends, which implies continuous information flow, and feedback from front-line, highly experienced people, proficient in the performance of duties, are necessary in the change process.

Culture inside an organization can be hindrance for the leader, who must become aware of the importance of their influence upon the organizational culture and make continuous efforts in this respect. Unlike transactional managers who work within an existing structure, transformational leaders work to change the organization, cultural change becoming a prerequisite for the transformational leadership process. If the culture itself becomes transformational, then it will produce an environment for more effective individual growth and organizational performance (Bass and Avolio 1993, 112-121). Transformational organizations' culture is meant to insufflate a sense of determination, long-term commitments, and mutual interests; it must be founded on shared interdependence, on everybody's willingness and disposition to put the organization and the team above personal interests. Transformational leaders influence three areas of the organizational culture: the internal mindset of the people in the organization, the culture among the people of the organization, and the culture beyond the people of the organization. (Bruce and Russel 2004)

In influencing the internal mindset new behaviors develop inside the organization and the culture takes on a new dynamic. Transformational leadership has to create a ready-for-change, innovative, willing to adapt environment; to achieve this, it is necessary for a transformational organization to operate from inside towards outside, namely to" get inside the people they are trying to help and develop" (1992, 21-23). Leaders help their followers to overcome their inner mental reservations and inhibitions, creates personal relationships with emphasis on mutual understandings, familiarity and two-way communications; the followers gain self-confidence, become aware of their abilities and skills, understand their role inside the organization and how they connect to its mission, and, consequently, commit themselves to their jobs, their coworkers, and the whole organization. (Avolio et all 1991, 9-16)

When it comes to the way transformational leaders influence culture inside the organization one can say that followers trust charismatic leaders, their capacity to overcome obstacles, feel proud to be associated with them. Leaders serve as role models, support optimism, mobilize commitment, and focus on the followers' needs for growth so the effectiveness increases because they all reach common goals for the organization and for themselves. When culture and values in an organization begin to be considered as assets productivity and innovation improve. Transformational leaders must address external forces that may have a significant impact on the organizational success. Change has its own way from the inner self, through the organization, and then to the external environment in which organization is challenged to survive because individual growth and development must be related to the organization's success in the external dynamic environment.

Kotter (1995, 59-67) settled an 8 - stage process change model to be applied inside the organization to be changed:

Create a sense of urgency. By establishing, developing and increasing the level of urgency the leader stirs up the motivation to get things moving. He achieves this by removing the sources of complacency among the followers, explaining the need for the change and the future growth resulted and the opportunities resulted from change.

Building a powerful guiding coalition. To lead change, the leader needs to bring together a coalition. The coalition comprises people with power, expertise, credibility, and leadership: This is done through building levels of trust and promotes shared objectives. To make most people understand the change necessity, it is important to share information and knowledge within the organization as they are usually reluctant to the idea of change. Kotter asserted that there is a need in a changing organization to create a change coalition that is going to guide the vision, sell that vision to others.

Create a clear vision and strategy. Vision considered as a central component of all great leadership had, in the literature concerning leadership, a lot of definitions, all of which include a mental image or picture, a future orientation, and aspects of direction or goal. Vision provides guidance to an organization by articulating what it wishes to attain. The leader works with the group to build a picture of success by initiating ideas, brainstorming, and strategic thinking, encouraging divergent and creative thinking, challenging others constructively, envisaging the future. Then he creates a strategy to execute the vision.

Communicating change to buy - in. The leader needs to constantly and powerfully communicate his vision, so that followers accept it as a challenging task, accept it and be aware of the role they play.

Empowering employees. Empowering is about enabling or authorizing followers to think, behave, take action, and control work, making decisions in autonomous way, trust them to do the right thing, not limit their tools or access to information.

Short-term wins. Short-term wins within a short time frame are essential since they are visible and show that change is producing results. Without this, employee critics and negative thinkers might hurt change progress. The leader recognizes and rewards employees involved in the improvements.

Consolidate gains into initiatives. Gains must be consolidated by increased attention to change structures and processes that did not fit within the vision.

Incorporate changes into the culture. Leader should anchor the changes in the organization corporate culture, to show how new approaches, behaviour and attitudes improved performance. Change should become part of the core of the organization and the new behaviour should become the norm.

4. Conclusions

In an ever-changing world, transformational leaders are prerequisite for organizations as they focus upon the organization's change and progress and organizational culture change. Their purpose is to alter the existing structure and influence people to believe to performance based on purpose and vision. Excellent transformational leaders have a high degree of integrity, are motivated to lead organization through its people to higher levels of performance, use authority and power to inspire and motivate them to trust and follow their example, to learn and grow continually. Appealing to values and emotions, transformational leaders mobilize theirs followers toward reform, providing new directions, new inspirations, and new behavioral patterns for their organization. Followers become more aware of the importance of valued organizational outcomes and the leader provides strategies for attaining those outcomes.

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PREDCITING REAL ECONOMIC GROWTH IN FRANCE, GERMANY, NEW ZEALAND, AND THE UNITED KINGDOM

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Abstract

The growth rate of real GDP per capita is modeled and predicted at various time horizons for France, Germany, New Zealand, and the United Kingdom. The rate of growth is represented by a sum of two components – a gradually decreasing trend and fluctuations related to the change in country-specific age population. The trend is an inverse function of real GDP per capita with constant numerator. Previously, similar models were developed and validated for the USA and Japan.

Keywords: real GDP per capita, modeling, prediction, population.

JEL Classification: E1, E3, O4, O5

1. Introduction

The end of the first decade of the 21st century highlighted acute and deep problems in the conventional economics. It failed again in predicting sharp falls in real growth rate often called recessions. The irony of it is that the mainstream economists only gain strength instead of shame which usually accompanies poor description and prediction. The new motto is - the crisis allows understanding economic processes better. Seemingly, the economics profession wins again and again. This is not a fair win, however. It is an overall loss for everybody – the absence of clear understanding easily transforms into a negative emotional excitation, as one can see from the stock market behavior. The real problem with the description of economic processes is that no other science, including physics, can overcome economics despite numerous claims (Bouchaud 2008). Without a valid quantitative theory of economic processes this hopeless situation will last forever (Kitov 2009). To be valid any scientific theory must fit observations and predict new effects or future evolution. Unfortunately, the current economic paradigm denies, without any formal or empirical proof, the possibility to develop a deterministic economic theory. Such a theory does exist, however.

Three years ago we introduced a new concept describing the evolution of real Gross Domestic Product (GDP) as driven by the change in specific age population and the attained level of real GDP per capita (Kitov 2006a, 2008, 2006b, 2009). According to this model, the growth in real GDP per capita (for the sake of brevity, below we often omit "per capita") in developed countries is characterized by an annual increment, as expressed in dollars per year, which is constant over time, and all fluctuations around the long-term trend defined by the increment can be explained by the change in the number of people of country-specific age population. Therefore, real GDP would be growing as a linear function of time, when no change in the population of relevant age is observed. As a rule, in Western Europe the cumulative growth in the specific age population during the last 60 years is negligible and thus the cumulative input of the population component is close to zero. In the USA, the overall increase in the specific age population is responsible for about 20% of the total growth in real GDP since 1960 (Kitov (2008). The presence of constant increment implies that the rate of growth of real GDP is an inverse function of the attained level of real GDP itself.

Our model of real economic growth was first derived from data for the United States (Kitov 2006a) and Japan (Kitov 2006c). Since all GDP time series are intrinsically non-stationary ones we have conducted a comprehensive statistical analysis including tests for cointegration (Kitov et al 2009). Both the Engle-Granger and Johansen approaches confirmed the presence of a cointegrating relation between real GDP and the specific age population, which is nine years in the USA and eighteen years in Japan. In this paper, we demonstrate the possibility to predict the evolution of real GDP in France, Germany, New Zealand, and the United Kingdom. Due to shorter time series for these countries, no econometric (statistical) techniques are used to validate the concept except obvious visual fit between dynamic and cumulative time series. The remainder of the paper consists of two

Section and conclusion. Section one introduces the model. Section two summarizes principal results for the four studied countries.

2. The model and data

Real GDP per capita is a measured macroeconomic variable characterized by a long-term predictability for a large developed economy (Kitov 2006a, 2008, 2006b, 2009, 2006c). The evolution of GDP is driven by the change in the number of "s"-year-olds, where s is a country-specific age, on top of a trend fully defined by the attained level of GDP. Under our framework, the speed of economic growth, i.e. the first derivative of GDP with respect to time, at any given time can be defined by a constant annual increment, as expressed by the following relationship:

$$dG(t)/dt = A \quad (1)$$

where G(t) is the absolute level of the GDP at time t, A is an empirical and country-specific constant. When all population driven fluctuations around the trend are removed, A becomes a time independent constant (Kitov 2006b), and the solution of ordinary differential equation (1) is as follows:

$$G_t(t) = At + B \quad (2)$$

where $G_t(t)$ is the trend trajectory of the GDP, $B=G_t(t_0)=G(t_0)$, t_0 is the start time of the studied period. So, the rate of growth of the GDP along the trend line, $g_t(t)$, is:

$$g_t(t) = dG_t/G_t \cdot dt = A/G \quad (3)$$

Relationship (3) implies that the (trend) rate should be asymptotically declining to zero over time.

Now, following our general approach of the two sources of real economic growth, one can write an equation for the growth rate of real GDP per capita, $g_{pc}(t)$:

$$g_{pc}(t) \equiv dlnG(t) = 0.5dlnN_s(t) + g_t(t) \quad (4)$$

where $0.5dlnN_s(t)$ is the halved rate of growth in the number of s-year-olds (nine years in the United States) at time t. The factor of 1/2 is common for developed countries, except Japan where it is likely 2/3 (Kitov 2006b).

When reversed, relationship (4) defines the evolution of the number of s-year-olds as a function of real economic growth:

$$d(lnN_s(t)) = 2(g_{pc} - A/G(t))dt \quad (5)$$

Equation (5) is a formal one, i.e. it should never be interpreted as if real economic growth defines the contemporary number of s-year-olds.

In quantitative terms, the start point of the evolution has to be characterized by (actual) initial specific age population. However, various population estimates (for example, post- and intercensal one) potentially require different initial values and coefficient A. Hence, there is intrinsic uncertainty in both defining parameters.

Instead of integrating (5) analytically, we use relevant annual readings for all the involved variables and rewrite (5) in a discrete form:

$$N_s(t+\Delta t) = N_s(t)[1 + 2\Delta t(g_{pc}(t) - A/G(t))] \quad (6)$$

where Δt is the time step equal to one year. Notice that instantaneous trend is A/G(t), i.e. the attained level of the GDP, not the trend one - $G_t(t)$. Equation (6) uses a simple discrete representation of time derivative of the population estimates, where the derivative is approximated by its estimate at point t.

Both time series g_{pc} (or equivalently, G(t)) and N_s are independently measured variables. In order to obtain using (6) the best prediction of $N_s(t)$ one has to vary coefficient A and (only in the

range of uncertainty of corresponding population estimates) the initial value – $N_s(t_0)$. The best-fit parameters can be obtained by some standard technique minimizing the RMS difference between predicted and measured series. In this study, only visual fit between curves is used. As a result, this approach might not provide the lowermost standard deviation.

Relationship (6) can be interpreted in the following way - the deviation between the measured growth rate of GDP per capita and that defined by the long-term trend is completely defined as a half of the change rate of the number of s-year olds. We would like to stress that the reversed statement is hardly to be correct - the number of people of some specific age cannot be completely, or even in any significant part, defined by contemporary real economic growth. Specifically, the causality principle prohibits the present to influence the birth rate nine years ago. Econometrically speaking, the number of s-year-olds has to be a weakly exogenous variable relative to real economic growth, as shown to be valid for the US.

Availability of high quality data is a crucial condition for successful modeling. However, the quality of GDP and population estimates in developed countries is inferior to that in physics. Among many others, we would like to mention likely the main problem - numerous revisions to definitions. Essentially, GDP has been measured in randomly varying units since the very beginning. Unfortunately, there is no procedure to correct the past measurements because necessary information is missing and statistic agencies openly declare the non-compatibility of data over time. In addition, the number of s-year-olds is significantly biased by balancing among adjacent age groups (Kitov 2006a).

Nevertheless, quantitative modeling of GDP is possible and demonstrates a reasonable statistical reliability (Kitov 2009). In order to avoid the influence of fluctuations in exchange rates between various national currencies, we use only GDP expressed in 1990 US dollars converted at Gary-Khamis PPPs, as presented by the Conference Board (2009). Relevant population estimates have been retrieved from national statistical agencies: France – the INED (http://www.ined.fr), Germany – the SBD (http://www.destatis.de/jetspeed/portal/cms), New Zealand – SNZ (http://www.stats.govt.nz), and the UK – NSO (http://www.statistics.gov.uk).

3. **Results**

We start the modeling with France. This is one of the biggest developed countries providing information on population age distribution. The model of GDP growth for France has been obtained by trial-and-error method using a discrete form of (4). The empirical constant A and the defining age have been varied in order to fit the amplitude and timing of observed peaks and troughs. The best fit value is $320 (1990 US dollars) and eighteen years. In the left panel of Figure 1, observed and predicted curves for the period between 1970 and 2009 are presented. Superficial visual inspection allows suggesting that the agreement between the curves does not contradict our concept, which was originally developed for the USA. The only principal difference between the US and France is that the defining age for France is eighteen years. This age occurred to be the defining one also for Japan (Kitov 2006c).

There are original estimates of the number of 18-year-olds in France, which can be used for the prediction of the past GDP figures. The future GDP can be predicted only by extrapolation of younger age populations. For example, the number of 10-year-olds in 2000 can be used as a proxy to the number of 18-year-olds in 2008. Moreover, it is possible to transform an age pyramid for a given year into the distribution of 18-year-olds, with the accuracy of extrapolation decaying with the distance from the given year. In this study, the number of 5-year-olds in 2001 is the reference distribution. So, using this age we are able to estimate the evolution of GDP till 2014. A better prediction could be obtained after censuses, which usually provide a well balanced single year of age distribution. In France, the last general population census was in 1999. By itself, the accuracy of population estimates is difficult to evaluate, but many features unveil artificial character of the procedure for population age pyramid (Kitov 2006a). In any case, one cannot help observing very good correspondence between the slowdowns in both curves in the beginning of 1990s and 2000s.

A high-amplitude fluctuation in the first time derivative is a common feature for almost all measured macroeconomic variables. This is a direct manifestation of measurement errors associated with numerous limitations in relevant measuring procedures and inappropriately small time step. In the USA, the average annual growth in real GDP per capita during the latter 20 years is around 2% with

the average uncertainty of 1 percentage point, i.e. the annual estimates are of the same order of magnitude as corresponding uncertainty. Before these problems are resolved, the time step should be larger than one year.

As an intermediate measure one can smooth all time series in order to cancel out measurement noise. There is a variety of smoothing techniques, some of them very complicated, but even a moving average is enough for the original data in Figure 1. In the right panel, the original predicted and observed curves are smoothed with a three - year moving average, MA (3). After 1985, the curves are very close. This supports the assumption that the fluctuations were chiefly induced by measurements and thus are effectively suppressed by destructive interference. Before 1985, the curves suffer a slight divergence, which can be an indication of the problems with the extrapolation over 20 years back in the past and with the reliability of GDP measurements. According to the predicted curves, France will not suffer significant recession in the next four to six years, but it is likely that a short recession period will hit France in the near future.

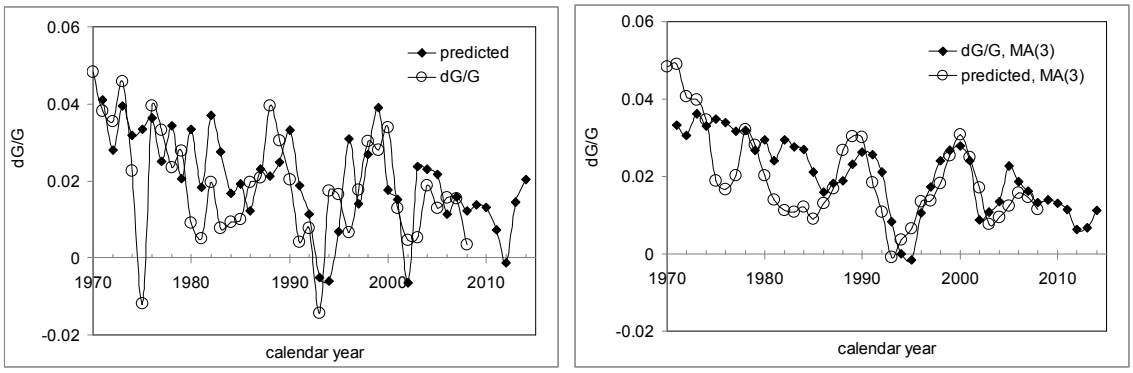

Figure 1. Observed and predicted rate of real GDP growth in France. The predicted curve is obtained from relationship (2) with A=$320 (1990 US dollars). Left panel: original curves. Right panel: the original curves smoothed with MA (3). One should not expect a recession period before 2012.

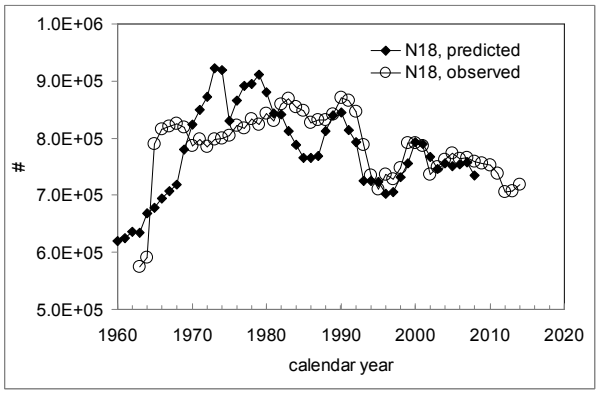

Figure 2. Observed and predicted number of 18-year-olds in France. The former variable is extrapolated from the number of 5-year-olds in 2001 with a 13-year shift, and the latter from the observed real GDP per capita.

Having the annual GDP estimates, one can use (6) to calculate the number of 18-year-olds in France. Figure 2 illustrates results of the inversion between 1963 and 2009. In general, the observed and predicted curves are very close after 1985. Before 1985, the curves diverge in minor details, but both show a sharp increase in the 18-year-old population after 1960. This is a major feature which has higher importance for the model than smaller deviations. In the past, population estimates in developed countries were not too reliable.

In alphabetical order, the next country to predict the evolution of real GDP per capita is Germany. The best fit constant A=$260 and the defining age is eighteen years. The age distribution from 2002 allows a prediction at an 18-year horizon. From Figure 3, one can expect a slow-down in

2009 and likely a recession in 2011. Here, we would like to accentuate that the prediction of the 2009 slowdown could be obtained in 2002, i.e. seven years before it happened! The estimates of population age structure are slightly noisy, however. Otherwise, the agreement between the observed and predicted curves is excellent after some years of turbulence associated with the reunification.

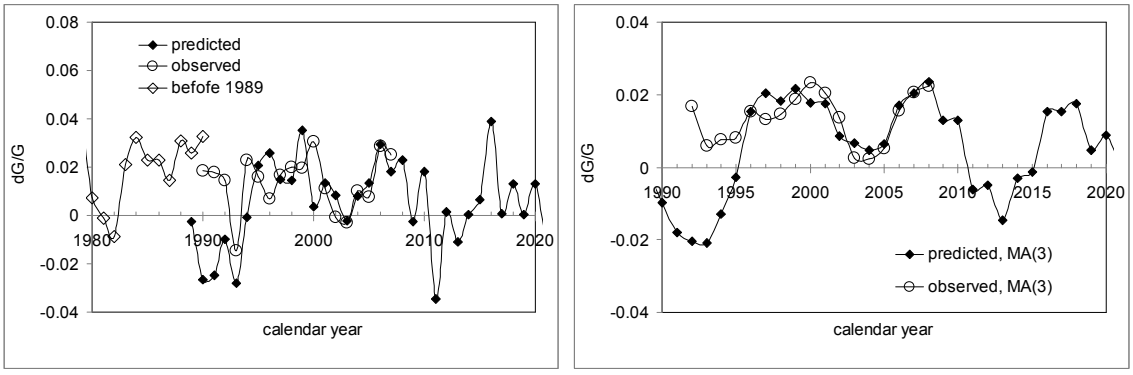

Figure 3. Observed and predicted rate of real GDP growth in Germany after the reunification. The predicted curve is obtained from relationship (2) with A=$260 (1990 US dollars).
Left panel: original curves. Right panel: the original curves smoothed with MA (3). One should not expect a recession period before 2011, but the year of 2009 is very close to a recession.

The model for New Zealand is also obtained by trial-and-error method. Empirical constant A and the specific age have been varied in order to fit amplitude and major features of the observed curve. The best fit value is A=$220 (1990 US$), i.e. less than in France and Germany. The specific age population in New Zealand is 14 years, which is different from that in the US, Japan, France, and Germany. The age pyramid enumerated by the 2006 census was extrapolated in the past and in the future in order to estimate the number of 14 – year - olds in (4).

Figure 4 presents observed and predicted GDP for New Zealand. As for other countries, the original readings of GDP were obtained from the Conference Board. Both curves in the left panel are characterized by high-amplitude oscillations likely associated with measurement errors. Therefore, in the right panel of Figure 4, the original curves are smoothed with MA (5) and MA (3), respectively. Without prejudice to the mainstream economics, we have failed to find such a good prediction of real GDP elsewhere. Shape, amplitude, and timing of the curves are in an excellent agreement after 1980. There is no danger of a deep recession in New Zealand, but the rate of real economic growth will be very low (~0.5% per year in average) in the years to come. Before 1980, data are likely not reliable due to significant revisions to relevant definitions.

Finally, the United Kingdom presents an interesting case, where one can introduce a structural break in the model, i.e. in the predicted time series. Figure 5 displays original and smoothed curves for both observed and predicted GDP between 1972 and 2009. There is a distinct break around 1991 in both time series, which is described by a step in A from $400 to $500. The curve before 1991 is also shifted by 1 year relative to that after 1991. This implies the change in the specific age, which is nine years after 1991.

Both segments of the predicted curve explain the 1991 recession. Because of the break, the 1991 reading cannot be modeled. Since 1995, the observed growth rate has been hovering around 2% per year. It is a very difficult time series to model. The absence of changes with time means that any variable constant over the same period perfectly explains the observed pattern. Even the smallest difference of 0.5% is seen as a larger deviation, as the right panel of Figure 5 shows. In any case, the rate of GDP growth in the UK will likely remain above the zero line.

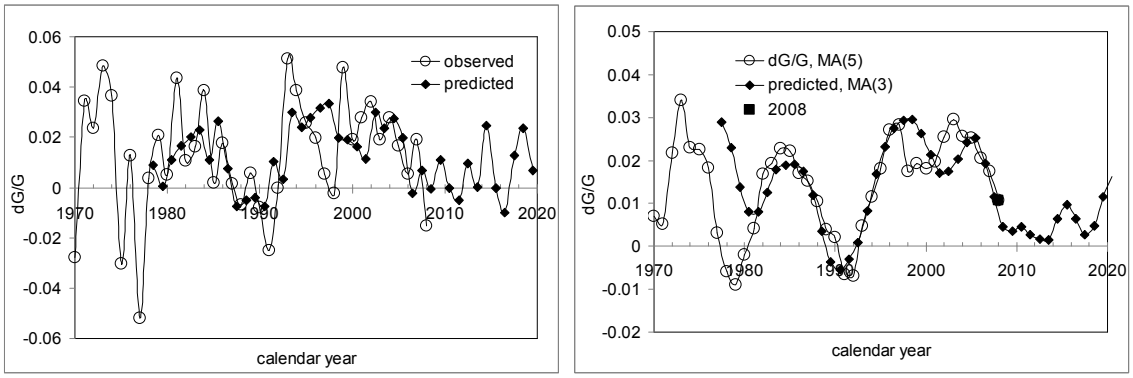

Figure 4. Left Panel: Observed and predicted growth rate of real GDP per capita in New Zealand. Right panel: The observed curve is smoothed with a 5-year moving average. The predicted rate is smoothed with MA (3). One can observe an outstanding agreement between the smoothed curves. Red circle uses the reading for 2008.

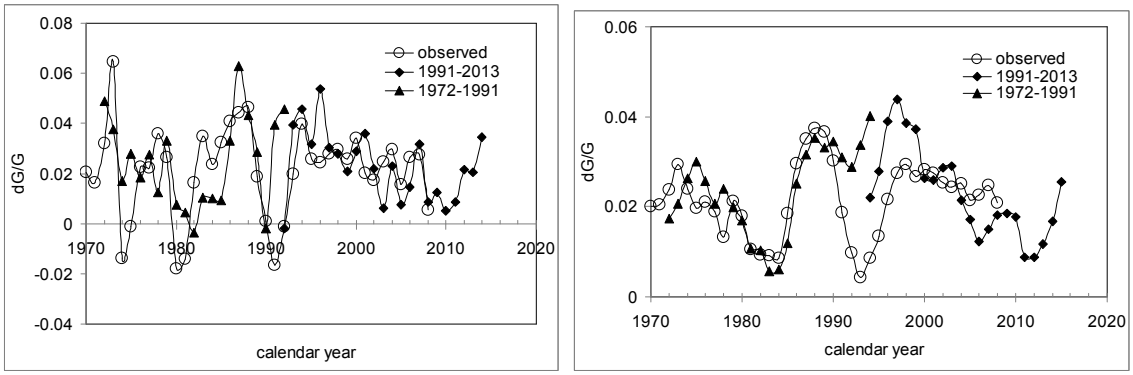

Figure 5. Observed and predicted rate of GDP growth in the United Kingdom after 1972. The predicted curve is obtained by relationship (4) with A=$400 before 1991 and A=$500 after 1991 (1990 US$). Left panel: original curves. Right panel: the predicted curves are smoothed with MA (3) and the observed one with MA (5). One should not expect any recession in the UK.

4. Conclusion

We have developed an empirical model which defines the evolution of real GDP per capita using only two parameters – the attained level of GDP itself and the number of people of specific age. In this paper, general results of empirical modeling in four developed courtiers are presented. France, Germany, New Zealand, and the United Kingdom extend the set of successfully modeled cases to six. Three of these four countries are the biggest developed economics after the US and Japan, which were also successfully modeled. New Zealand is a smaller economy with tight economic links to Australia. Nevertheless, it demonstrates a good degree of independence on external factors.

This study is a logical step in the validation of our model for real economic growth. More countries modeled, extensions in historical time series, and improvements in data quality increase robustness and predictive power of the model. We are confident that all models, including those developed for macroeconomic variables, must fit observations, when claimed to be scientific ones.

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THE RELATIONSHIP BETWEEN OUTPUT GROWTH AND INFLATION: EVIDENCE FROM TURKEY

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Abstract

In this study, a bi-variate Generalized Autoregressive Conditional Heteroscedasticty model is used in order to investigate the Granger causality relationships between output growth, inflation rate and their uncertainties. Our test results show that the existence of Granger-causality is observed from nominal uncertainty to inflation, from nominal uncertainty to real uncertainty, from output growth to real uncertainty, from output growth to nominal uncertainty and from inflation to nominal uncertainty. These findings prove that theoretical predictions of Cuikerman and Meltzer (1986), Okun (1971) and Friedman (1977) are valid for the period 1986, 6 - 2007, 1 for Turkey. On the other hand, 'Short-run Phillips Curve' and 'Taylor Effect' have proven empirically to be invalid for Turkey for this sample period. Moreover, we deduce that Turkish inflation is affected by the output growth through the nominal uncertainty channel.

Keywords: inflation, output growth, uncertainty, Granger-causality, bi-variate GARCH.

JEL Classification: C22, E0

1. Introduction

High inflation rate is the major problem of Turkish Economy like all the other developing countries. In recent years, this prolonged high inflation rates are beginning to decrease where this phenomena leads to an improvement in the conditions of Turkish economy. From the Friedman (1977) paper, we know that increasing average inflation induces high levels of inflation uncertainty. Moreover, high inflation uncertainty is one of the important obstacles in making investment decisions for the private sector. Thus, decreasing investment results in low levels of output which shows declining levels of growth. Shortly, these inefficiencies, created by inflation uncertainties, can be summarized by deterioration of relative prices, additive risk primaries on long-run investment project by risk-averse investors and increasing interest rates. In order to cope with these inefficiencies, central banks implement contractionary monetary policies. For the Turkish case, covering the period 1986:6-2007:1 the Central Bank of the Republic of Turkey attempts to execute same kind of policies. In this period, Turkish monetary authority implemented several stabilization programs and monetary policies; from these attempts only the last stabilization program reached its goals which established price stability in Turkey.

In this study, we use bi-variate Generalized Autoregressive Conditional Heteroscedasticty (GARCH) model and Granger causality test for analyzing the aforementioned issues. By using bi-variate GARCH model, we obtain inflation and output uncertainty which we will use them as separate variables in Granger causality test. Finally by using these 4 variables, we obtained 12 bidirectional causality relationships.

In section 2, we discuss the theoretical relationships and empirical researches about the links between these variables. In section 3, estimation and identification of bi-variate GARCH model and Granger causality test are given. Finally, Section 4 concludes.

2. Theoretical relationships and empirical findings

In economics literature, we can find economic interpretation for the predicted bidirectional causality relationships between nominal (inflation) uncertainty, real (output growth) uncertainty, output growth, and inflation.

First discussion about the relationship between inflation and inflation uncertainty takes place in Okun (1971). According to Okun, monetary policy becomes unpredictable in high inflationary periods and this situation causes positive relationship between inflation and inflation uncertainty. Furthermore, Friedman (1977) argued that higher inflation leads to more uncertainty about inflation. According to Okun and Friedman, policy makers have pressure on themselves in order to decrease high levels of

inflation rates[1]. Therefore, the high inflation rates are reduced by implementing contractionary monetary polices which induce recession to the economic system. Ball (1992) gives theoretical explanation to Okun's and Friedman's hypothesis as a part of theoretical model which uses asymmetric information game. Moreover, positive relationship between inflation and inflation uncertainty has been argued by Flemming (1976) as well. According to Flemming, as inflation rate increases governments tend to announce more unreliable stabilization programs. Nonetheless, there are also theoretical arguments about negative relationship between inflation and inflation uncertainty. Pourgerami and Moskus (1987) claim that economic agents undertake more investment to anticipate inflation in high inflationary periods and this aspiration leads to a reduction in nominal uncertainty. Theoretical model of this hypothesis has been studied by Ungar and Zilberfarb (1993).

Positive relationship between inflation and nominal uncertainty has been detected in empirical studies for Turkey. For instance, Nas and Perry (2000) find positive relationship between these variables for the three sub periods in between 1960-1998. While, Çetin (2004) finds a positive relationship for the period covering 1985-2003, Telatar (2003) finds a negative relationship for the period covering 1987-2001. Erdoğan and Bozkurt (2004) state that the consequence of high nominal uncertainty for the Turkish economy covering the period 1985-2003 is high due to the volatile inflation rates. Artan (2006) employ long-term co-integration and short-term error correction models for the period covering 1987-2003 for Turkey and he stated that the results of these analyses denote that there is a relationship between inflation and inflation uncertainty.

One of the theories that explain causality relationship from nominal uncertainty to inflation takes place in Cukierman and Meltzer (1986). Cukierman and Meltzer (1986) use the framework of Barro and Gordon's model. By using this model, Cuikerman and Meltzer (1986) denote that an increase in uncertainty about money supply growth and inflation will elevate the optimal average inflation rate because it supply an encouragement to the policymaker to generate an inflation surprise in order to stimulate output growth. Hence, we can conclude that Cukierman and Meltzers' (1986) analysis demonstrate the way, how higher nominal uncertainty leads to more inflation. Furthermore, Holland (1995) states that, if a central bank has a stabilization intention, an increase in inflation uncertainty will be responded by tight monetary policy. Thus, this stabilizing motive of central bank reduce the inflation rate, where this process minimize the real cost of nominal uncertainty. The causal relationship between nominal uncertainty and inflation is investigated empirically by Grier and Perry (1998), Wilson (2006), Fountas *et al.*(2002), and Fountas and Karanasos (2007). These studies record both positive and negative relationship between inflation uncertainty and inflation for different countries and different periods. For the Turkish, case Nas and Perry (2000) find negative relationship between nominal uncertainty and inflation except one of the sub-samples. Telatar (2003) and Çetin (2004) could not find any relationship between inflation uncertainty and inflation for the period that they analyze for Turkey.

In economics literature, it is difficult to find out relationship between output growth and real uncertainty quite frequently (Fountas and Karanasos (2006). This connection can be explained with two theoretical relationships: 'Short-term Phillips Curve' and 'Taylor's Effect'. With respect to Phillips Curve, increase in output level causes rise in inflation. According to Friedman's and Okun's hypothesis, this situation increases inflation uncertainty. Taylor (1979) argues that, increasing nominal uncertainty leads to a decrease in real uncertainty. Therefore, there occurs a trade off between inflation uncertainty and real uncertainty (the so-called Taylor Effect) which constitutes a positive relationship between output growth and real uncertainty. The causal relationship between output growth and real uncertainty is investigated empirically by Fountas *et al.* (2002), in which they find significant statistical positive relationship between output growth and real uncertainty for Japanese economy for the period covering 1961-1999, and Fountas and Karanasos (2006), in which they report negative relationship between output growth and real uncertainty for Germany and U.S. Furthermore, Çetin (2004) finds negative relationship for 1, 4, 8 and 16^{th} lags and positive relation for only 12^{th} lag for Turkey. As can be seen from the theoretical explanation, there is a negative causal relationship in between output growth and real uncertainty. In empirical studies such as Fountas *et al.* (2002), neither the causality from inflation uncertainty to real uncertainty nor real uncertainty to inflation uncertainty

[1] Policy makers avoid movements that are directed to decrease inflation, because they are aware of the fact that contractionary policies create recession.

could be found for Japan with using data from 1961-1999 periods. While, Çetin (2004) could not observe any meaningful causality from inflation uncertainty to real uncertainty for 1985:01-2003:11 period as well, but he found positive meaningful causality from real uncertainty to inflation uncertainty for 1, 4 and 8 lags covering this period.

Necessary theoretical relationships can be found in economics literature to explain the relationship between output growth and nominal uncertainty. Because of short-term Phillips Curve effect, rate of inflation will increase when output growth occurs (Briault 1995). According to Friedman's and Okun's hypothesis, rises in inflation rates will increase nominal uncertainties, which in turn will create a positive relationship between output growth and inflation uncertainty. Furthermore, if Pourgerami's and Moskus's hypothesis occur, negative relationship will arise between these variables. In empirical studies, Fountas *et al.* (2002) could not found any causality from output growth to inflation uncertainty with using data from 1961-1999 periods for Japan. Çetin (2004) also could not found any relationship, like Fountas *et al.* (2002), between output growth and inflation uncertainty for the period 1985-2003 for Turkey.

3. Empirical study and the model

In this study VAR-GARCH (Vector Autoregressive-Autoregressive Conditional Heteroscedasticity) model is used. By using this model, conditional means and variances of inflation and real output growth and co-variances among each other are estimated simultaneously. After employing the lag test, we have found that VAR (5) model is suitable for our model:

$$y_t = \phi_{y0} + \sum_{i=1}^{5} \phi_{yy,i} y_{t-i} + \sum_{i=1}^{5} \phi_{y\pi,i} \pi_{t-i} + \varepsilon_{yt} \quad (1a)$$

$$\pi_t = \phi_{\pi 0} + \sum_{i=1}^{5} \phi_{\pi\pi,i} y_{t-i} + \sum_{i=1}^{5} \phi_{\pi y,i} \pi_{t-i} + \varepsilon_{\pi t} \quad (1b)$$

π_t and y_t denote the inflation rate and real output growth, respectively. Residual vectors can be showed as $\varepsilon_t = (\varepsilon_{\pi t}, \varepsilon_{yt})'$. It is assumed that ε_t is conditionally normal with mean vector 0 and covariance matrix H_t. That is $(\varepsilon_t / \Omega_{t-1}) \sim N(0, H_t)$, where Ω_{t-1} is the information set up time t-1. Following Bollerslev (1990), it is imposed that the constant correlation GARCH (1, 1) structure on the conditional covariance matrix H_t.

$$h_{\pi t} = w_\pi + \beta_\pi h_{\pi,t-1} + a_\pi \varepsilon^2_{\pi,t-1} \quad (2a)$$

$$h_{yt} = w_y + \beta_y h_{y,t-1} + a_y \varepsilon^2_{y,t-1} \quad (2b)$$

$$h_{\pi y,t} = \rho \sqrt{h_{\pi t}} \cdot \sqrt{h_{yt}} \quad (2c)$$

Where $h_{\pi t}, h_{yt}$ represent the conditional variances of the inflation rate and output growth, respectively. Furthermore, $h_{\pi y,t}$ is the conditional covariance between $\varepsilon_{\pi t}$ and ε_{yt}. And parameter restrictions are given as: $(w_i), a_i > 0$, $\beta_i \geq 0$, for $i = \pi, y$ and $-1 \leq \rho \leq 1$.

According to Bollerslev (1990), constant correlation model is computationally most useful model among rival models. Bollerslev (1990) stated that the correlation matrix can be determined by the log-likelihood function, resultant in a drop in the number of parameters to be optimized. Furthermore, it is quite easy to manage the parameters of the conditional variance equations during the optimization so that h_{it} is always positive. Another important thing that we must think is related with assumptions of VAR (5)-GARCH (1, 1) model that is used according to the study of Bollersley (1990). In this direction, we estimate the systems of equation (1) and (2) using the Berndt *et al.* (1974) numerical optimization algorithm (BHHH) to obtain the maximum likelihood estimates of parameters and to estimate the asymptotic covariance matrix of the coefficient as consistent.

In our empirical study, in order to determine VAR process, optimal lag - length algorithm of the Akaike (AIC) and Bayesian (BIC) information criteria are used. Both information criteria choose VAR(5) model. Similarly, the chosen GARCH (1, 1) model corresponds to the smallest estimated value of both information criteria. Nominal uncertainty and real uncertainty are obtained from estimated conditional variance of inflation and output growth equations. Totally four variables with two new variables obtained from here will be subject to 12 different Granger causality test.[2]

In this study, Consumer Price Index (CPI) and Industrial Production Index (IPI) represent price level and output (production amount), respectively. The data have monthly frequency and range from 1986:6-2007:1. Inflation is obtained by measuring the monthly difference of the log CPI:

$$y_t = \log\left(\frac{CPI_t}{CPI_{t-1}}\right)$$

Real output growth is measured by the monthly difference in the log of the IPI:

$$y_t = \log\left(\frac{IPI_t}{IPI_{t-1}}\right)$$

Unit root test of the inflation rate and the growth rate are performed by using ADF (Augmented Dickey -Fuller) and PP (Phillips-Perron) tests. The results of these tests are given in Table 1.

Table 1. Unit Root Tests

	ADF test statistic	Phillips-Perron test staitstics
Output growth	-7.499	-8.141
Inflation	-10.129	-34.870

* All test statistics at the % 1 significance level

As seen from Table 1, both inflation and growth rate do not imply any unit root. So, they are stationary.

AIC and BIC criteria are employed in order to identify VAR lag and the results are presented in Table 2[3]. As seen in Table 2, the lowest values are found for estimated VAR(5)-ccc-GARCH(1,1) by using AIC and BIC criteria.

Table 2. Model Selection Criteria

	AIC	BIC
VAR(5)-Univariate GARCH(1,1)	-3362.25	-2898.48
VAR(5)-ccc- GARCH(1,1)	-3378.25	-2942.59
VAR(5)-dvec-GARCH(1,1)	-3370.25	-2920.53
VAR(5)-Fv- GARCH(1,1)	-3266.25	-2633.84
VAR(5)-BEKK	-3338.25	-2832.32

* Constant Conditional Correlation (ccc) GARCH (1,1) is selected with the AIC and BIC criteria. dvec represents for diagonal-vector, Fv represents full vector parameterization, BEKK represents positive definite parameterization (BEKK) that enforces a positive definite covariance matrix.

Therefore, the most appropriate structure selected for the study is VAR (5)-ccc - GARCH (1, 1) model among other models.

Table 3 shows estimated coefficient of VAR (5) - GARCH(1,1) model. The conditional mean and variance equations for output growth are given in equation (1) and equation (2) respectively. The sum of estimated inflation coefficients is -0.042. Furthermore, the conditional mean and variance equations for inflation are given in equation (2) and equation (3) respectively. The sum of estimated output growth coefficients is 0.838. The ARCH parameter is calculated as 0.360 and 0.426 for output growth and inflation equation respectively.

[2] The advantages of this modeling according to rival models are explained in the study of Fountas *et al.* (2002).

[3] Results are available upon request

Table 3. Estimates of the VAR-GARCH Model [4]

$$y_t = \underset{(0.001)\,[3.738]}{0.005} - \underset{(0.019)\,[0.802]}{0.015}\, y_{t-1} + \underset{(0.060)\,[2.208]}{0.132}\, y_{t-2} + \underset{(0.049)\,[0.194]}{0.009}\, y_{t-3} - \underset{(0.040)\,[3.509]}{0.143}\, y_{t-4} - \underset{(0.044)\,[2.414]}{0.108}\, y_{t-5} \quad (1)$$

$$- \underset{(0.035)\,[7.758]}{0.273}\, \pi_{t-1} + \underset{(0.031)\,[13.292]}{0.424}\, \pi_{t-2} - \underset{(0.025)\,[15.067]}{0.387}\, \pi_{t-3} + \underset{(0.049)\,[7.660]}{0.376}\, \pi_{t-4} - \underset{(0.037)\,[4.810]}{0.182}\, \pi_{t-5} + \varepsilon_{y_t}$$

$$h_{y_t} = \underset{(0.000)\,[7.587]}{0.010} + \underset{(0.087)\,[4.133]}{0.360}\, \varepsilon^2_{y,t-1} + \underset{(0.114)\,[2.052]}{0.234}\, h_{y,t-1} \quad (2)$$

$$\pi_t = \underset{(0.001)\,[5.368]}{0.005} + \underset{(0.011)\,[1.909]}{0.021}\, y_{t-1} - \underset{(0.026)\,[1.730]}{0.045}\, y_{t-2} - \underset{(0.029)\,[1.362]}{0.009}\, y_{t-3} - \underset{(0.023)\,[1.630]}{0.039}\, y_{t-4} - \underset{(0.023)\,[0.334]}{0.007}\, y_{t-5} \quad (3)$$

$$+ \underset{(0.049)\,[12.565]}{0.620}\, \pi_{t-1} - \underset{(0.020)\,[2.837]}{0.058}\, \pi_{t-2} + \underset{(0.046)\,[1.908]}{0.089}\, \pi_{t-3} - \underset{(0.027)\,[2.314]}{0.064}\, \pi_{t-4} + \underset{(0.026)\,[9.639]}{0.258}\, \pi_{t-5} + \varepsilon_{\pi_t}$$

$$h_{\pi_t} = \underset{(0.000)\,[5.606]}{0.0001} + \underset{(0.161)\,[2.636]}{0.426}\, \varepsilon^2_{\pi,t-1} + \underset{(0.051)\,[1.980]}{0.101}\, h_{\pi,t-1} \quad (4)$$

$$h_{y\pi,t} = \underset{(0.053)\,[2.301]}{0.122} \sqrt{h_{y_t}.h_{\pi_t}} \quad (5)$$

* While the values in the brackets that are under the estimated coefficients denote standard errors, square brackets show t statistics.

In output growth equation, value of GARCH parameter shows how long a shock affects volatility. GARCH parameter for output growth is 0.234 and less than 1. In this situation, long term effect of a shock on output growth will be small. In the same way, ARCH and GARCH parameters for inflation are found to be 0.426 and 0.101, respectively. Value of GARCH parameter that is being less than estimated in output growth equation means long term effect of a shock will be much lower. In both equations, ARCH parameters are greater than GARCH parameters which mean short term effect of both shocks are heavier than their long term effects. The sum of the ARCH and GARCH parameters for output growth and inflation are 0.594 and 0.527, respectively. That means that current information is not important for the forecast of the conditional variances for long horizons.

Table 4. Residual Diagnostics

	Inflation Equation	Output Equation	Cross Equation	Critical Value (at %5 significance level)
$Q(4)$	5.25	3.06	2.52	9.48
$Q(12)$	17.60	17.20	5.83	21.02
$Q^2(4)$	1.55	2.05		9.48
$Q^2(12)$	5.41	7.20		21.02

* Ljung-Box Test statistics are given in this table.

Ljung-Box Q statistics are calculated at 4 and 12 lags for the levels, squares, and cross-equation of the standardized residuals for the estimated VAR (5) - GARCH(1,1) model. The results are shown in Table 4. The conditional correlation is close to zero which means the residual covariance between equations is statistically significant. Briefly, we can say that serial correlation problem is corrected in the estimated GARCH (1,1) models and it's residuals.

After this stage, Granger-causality test can be applied to provide some statistical evidence on the nature of the relationship between average inflation, output growth, nominal uncertainty, and real

[4] For the 1994 crisis, we use dummy variable for the inflation equation, IPI index is seasonally filtered by X11.

uncertainty. Granger-causality test is applied for 1, 4, 8, and 12 lags. When the test statistic is statistically significant, sums of the lagged coefficient and sign of it is declared in the table.

Granger-causality test that is applied to four different variables for the period 1986:6-2007:1 is provided by Table 5.

Table 5. Granger-causality tests results between inflation, output growth, nominal and real uncertainties

	1 Lag	*4 Lag*	*8 Lag*	*12 Lag*
Panel A: Causalities to Growth				
$\pi_t \rightarrow y_t$	1.944	1.727	1.107	0.642
$h_{y_t} \rightarrow y_t$	2.363	1.318	1.382	1.619
$h_{\pi_t} \rightarrow y_t$	2.334	0.431	0.750	1.248
Panel B: Causalities to Inflation				
$y_t \rightarrow \pi_t$	0.051	0.348	0.338	0.669
$h_{y_t} \rightarrow \pi_t$	1.429	0.936	1.136	0.954
$h_{\pi_t} \rightarrow \pi_t$	0.009	(+)2.068***	(+)2.144**	(+)1.727**
Panel C: Causalities to Real Uncertainty				
$y_t \rightarrow h_{y_t}$	(-)5.762**	(-)4.291*	(-)3.154*	(-)2.408*
$\pi_t \rightarrow h_{y_t}$	0.072	0.734	0.769	0.892
$h_{\pi_t} \rightarrow h_{y_t}$	0.243	0.199	0.427	(+)1.913**
Panel D: Causalities to Nominal Uncertainty				
$y_t \rightarrow h_{\pi_t}$	0.821	1.655	(-)2.498**	(-)1.930**
$\pi_t \rightarrow h_{\pi_t}$	(+)27.939*	(+)8.732*	(+)4.928*	4.025
$h_{y_t} \rightarrow h_{\pi_t}$	0.066	0.395	0.448	0.730

F statistics are reported *, ** and *** denote the significance level at the 0.01, 0.05 and 0.10 levels,
(+) indicates that the sum of the coefficients on related variable is positive,
(+) indicates that the sum of the coefficients on related variable is positive.

As an example ($\pi_t \rightarrow y_t$) means, inflation does not Granger-cause output growth.

Granger-causality to output growth, inflation, nominal uncertainty and real uncertainty are given in panel A, B, C, and D of Table 5, respectively. Granger-causality test is statistically significant from nominal uncertainty to inflation; from nominal uncertainty to real uncertainty; from output growth to real uncertainty; from output growth to nominal uncertainty and from inflation to nominal uncertainty[5]. Theoretical relationships are given in section 2.

Panel B provides evidence that null hypothesis of inflation uncertainty does not Granger-cause inflation is rejected at the 5% level or better. The sum of the coefficients on lagged inflation uncertainty in the inflation equation is positive. Therefore, our key result is that inflation uncertainty significantly raises average inflation. Thus, we provide empirical support to Friedman's and Cuikerman and Meltzer's hypothesis, respectively.

[5] In the bi-variate GARCH estimation inflation variable is significant for 5 lags in the first equation where output is dependent variable. But, in the Granger Causality test, we compute that inflation does not Granger Cause output, this results seem to be a contradiction when we think that the estimation and the variables are same kind. However in the bi-variate GARCH model, we are estimating the both equation simultaneously and modeled residual as a GARCH process. Hence, the estimated t values are belonging to expected inflation where we use the inflation variable it self in Granger Causality test. On the other hand, Granger Causality tests are the results of F-test, thereby it is not important to examine the t test unless we are dealing the direction of causality. In the estimation of Granger Causality test for the lag four, we have found that the first and the third lags are significant where the second and fourth lags are not. This is an evidence of the above mentioned arguments. In terms of these reason, the results are not a contradiction, they are the natural outcome.

Panel D provides evidence that null hypothesis of inflation does not Granger-cause inflation uncertainty is rejected at the 1% level. The sum of the coefficients on lagged inflation uncertainty in the inflation equation is positive. Therefore, our key result is that inflation significantly raises inflation uncertainty. Thus, we provide empirical support of Friedman's and Okun's hypothesis.

We find evidence that increased nominal uncertainty raises real uncertainty in Panel C. While a statistical meaningful relationship is found at 5% significance level at 12 lag, this relationship could not be found for remaining lags. The direction of the relationship obtained by the sum of the coefficients is positive. Hence, Taylor's hypothesis which is given as theoretical explanation for this relationship is not valid. Weak empirical findings contradict with theoretical explanation.

Panel D provides evidence that null hypothesis that output growth does not Granger-cause nominal uncertainty is rejected at the 5% level. The sum of the coefficients on lagged output growth in the nominal uncertainty equation is negative. Therefore, our key result is that output growth significantly lowers nominal uncertainty. One can find necessary theoretical background for the causal effect of output growth on nominal uncertainty. More output growth would be accompanied by more average inflation according to Short-run Phillips Curve (Briault, 1995). Furthermore, increasing inflation rates leads to more inflation uncertainty due to Friedman's and Okun's hypothesis. In summary, increasing output growth leads to more nominal uncertainty. Instead of Friedman's and Okun's hypothesis, Pourgerami and Moskus (1987) hypothesis can be influential in the second phase. In this situation, increasing output growth leads to less nominal uncertainty which we can conclude that causal effect of output growth on nominal uncertainty is negative. This theoretical reasoning is contradicted with the above arguments where we claim that Friedman's and Okun's hypothesis is valid. Hence, it is better to give a different theoretical explanation for this empirical result. In empirical literature, which deals with the bi-directional relationship between output growth and inflation, there is considerable amount of study which finds negative causal effect of output growth on inflation for Turkey (Kökocak and Arslan, 2006). Thus, with this new finding, we can construct a new theoretical reasoning for our empirical result. In this case, more output growth would be accompanied by more average inflation on the contrary to Short-run Phillips Curve. Furthermore, decreasing inflation rates leads to less inflation uncertainty due to Friedman's and Okun's hypothesis. In summary, increasing output growth leads to less nominal uncertainty which shows that Friedman's and Okun's hypothesis is still valid and is not contradicted with the above arguments. Thus, we find a negative relationship between output growth and nominal uncertainty by using Friedman's and Okun's hypothesis. Furthermore, for the transmission channel of this relationship Omay and Hasanov (2010) can be examined for Turkey.

Panel C provides evidence that null hypothesis that output growth does not Granger-cause real uncertainty is rejected at the 5% level or better. The sum of the coefficients on lagged output growth in the real uncertainty equation is negative. Therefore, our key result is that output growth significantly lowers real uncertainty. By using 'Phillips Curve' and 'Taylor Effect', Fountas and Karanasos (2006) explain the positive causal effect of growth on real uncertainty. In our situation, we have proven empirically that these hypotheses are not valid for Turkey. Moreover, both of the hypotheses provide counter effects between these variables. If we follow the method of Fountas and Karanasos (2006) for giving theoretical explanation for the causal effect of growth on real uncertainty, we will obtain negative causal effect of growth on real uncertainty, because of the mentioned reasons: More output growth would be accompanied by less average inflation on the contrary to Short-run Phillips Curve. On the one hand, decreasing inflation rates leads to more inflation uncertainty due to Friedman's and Okun's, hypothesis; on the other hand more inflation uncertainty leads to less real uncertainty which we provided the empirical reasoning above. In summary, increasing output growth leads to less real uncertainty, which indicates a negative causal effect of output growth on real uncertainty.

The below flow diagram shows the bidirectional causality relationships between nominal uncertainty, real uncertainty, output growth, and inflation:

Figure 1. Flow Diagram of Relationship

From this diagram, we can easily trace the direction and sign of the relationships. Furthermore, this diagram has proven the consistency of the relationships. Therefore, we can conclude from the diagram that the directions of the relationships are dominated[6] by the output growth. This conclusion needs some explanation. After 2001, we have seen that the Turkish inflation rate decrease gradually from %40 to under %10. Khan and Senhadji (2001) use an unbalanced panel method in order to determine threshold effects of inflation-growth nexus for a large sample of 140 countries. They find the thresholds to be around 10-11% for developing countries. On the other hand, they conclude that, the effects of inflation on growth to be statistically insignificant or positive on low inflation regimes, and statistically significant and negative on high inflation regimes. In order to have detailed information of this literature, Arin and Omay (2006) can be further read. From this conclusion, we can state that Turkey pass to low inflationary regime after 2001. Moreover after 2001, Turkish GDP grows in a high level which is induced by foreign capital. When we look at the flow diagram, we deduce that Turkish inflation is affected by the output growth by nominal uncertainty channel. Hence, this channel will be very important in the coming days, when we think about the Global Economic crises. This induced growth will decline and this decline will lead to high levels of inflation.

4. Conclusion

In this study, we have investigated bidirectional causality relationships between nominal uncertainty, real uncertainty, output growth, and inflation. Our test results show that existence of Granger-causality is observed from nominal uncertainty to inflation, from nominal uncertainty to real uncertainty, from output growth to real uncertainty, from output growth to nominal uncertainty and from inflation to nominal uncertainty. These findings prove that theoretical predictions of Cuikerman and Meltzer (1986), Okun (1971) and Friedman (1977) are valid for the period 1986:6-2007:1 for Turkey. Moreover, 'Short-run Phillips Curve' and 'Taylor Effect' have been proven empirically to be invalid for Turkey for this sample period. On the other hand, it is important to emphasize that these findings are not contradicting (do not contradict) with each other.

Moreover, we deduce that Turkish inflation is affected by the output growth by nominal uncertainty channel. Hence, this channel will be very important in the coming days, when we think about the Global Economic crises. High levels of growth which is induced by foreign capital will decline and this decline will lead to high levels of inflation. In order to solve this problem, the Central Bank of the Republic of Turkey has to resolve this structural problem of Turkey. Further avenues for research include applying the very same methodology to sub-samples for Turkey in order to check whether different periods have the same dynamics.

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INDO - BRAZILIAN TRADE: TRENDS, COMPOSITION AND FUTURE

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Abstract:

India and Brazil are among the fastest growing economies of the world and are widely projected as major economies of future. Indo-Brazil links go back five centuries. In recent years, relations between Brazil and India have grown considerably and co-operation between the two countries has been extended to diverse areas such as science and technology, pharmaceuticals and space. Bilateral trade has jumped to USD 3.12 billion in 2007, from a mere USD 488 million in 2000. The two sides have set a target of USD 10 billion trade by 2010. Though it will be a small fraction of trade of each country and with the existing trends it may be a challenging target to achieve. Due to large size of economies and high growth rates as well as growing political will from both sides, the bilateral trade will grow further and would have significant impact on global trade and economy.

Keywords: India, Brazil, trade, IBSA, emerging economies.

JEL Classification: F14, F41, F43.

1. Introduction

India and Brazil are among the fastest growing economies of the world and are widely projected as major economies of future (Goldman Sachs, 2003, 2007). India's links with Brazil go back five centuries. Portugal's Pedro Alvares Cabral is officially recognised as the first European to "discover" Brazil in 1500. Cabral was sent to India by the King of Portugal soon after the return of Vasco de Gama from his pioneering journey. Cabral is reported to have been blown-off course on his way to India. Brazil became an important Portuguese colony and stop-over in the long journey to Goa. This Portuguese connection led to the exchange of several agricultural crops between India and Brazil in the colonial days. Indian cattle were also imported to Brazil. Most of the cattle in Brazil are of Indian origin. Diplomatic relations between India and Brazil were established in 1948. The Indian Embassy opened in Rio de Janeiro on May 3, 1948. It shifted to Brasilia on August 1, 1971 (Brazil's capital had moved to Brasilia in 1960) (Indian Embassy, Brazil, 2008). In recent years, relations between Brazil and India have grown considerably and co-operation between the two countries has been extended to such diverse areas as science & technology, pharmaceuticals and space. The two-way trade in 2005 nearly doubled to US$ 2.34 billion from US$ 1,207 billion in 2004 (Indian Embassy, Brazil, 2008). India's trade with Brazil has jumped to 3.12 billion dollars in 2007, from a mere 488 million dollar in 2000. The two sides have set a target of 10 billion dollars trade by 2010(PTI, 2008).Both countries have focused on strengthen the cooperation and trade in recent past. This has been supported by highest level visits namely Man Mohan Singh visit of Brazil in 2006 and Brazilian President visits to India in 2007, besides trade ministers visits.

Apart from being major bilateral trade partners, India and Brazil are the two most important members of the Group of 20, a pressure alliance of the developing countries in the World Trade Organisation, working for a balanced multilateral Doha trade deal (PTI, 2008). "India and Brazil must continue to be close partners in the UN, WTO and international for on issues such as social development, health care, sustainable economic development and poverty alleviation," Nath said. He said the two countries are together in "reformulating the big questions that affect foreign policy and trade at the international level" (PTI, 2008).This paper studies Indo-Brazil trade, with a focus on this decade i.e. 2000s. It consists of two more sections besides the introduction part. Next section studies various aspects of bilateral trade and the last section is conclusion part.

2. Indo-Brazilian trade

Though the relationship between the two countries is more than five centuries old, the Indo-Brazil trade has not progressed much. Considering the potential that the region offers, an integrated programme "Focus: LAC" was launched in November, 1997 by the Commerce Ministry (Commerce Ministry, 2004). From a mere $ 20 million in 1998 India's trade with Brazil has jumped to 3.12 billion dollars in 2007. The two sides have set a target of 10 billion dollars trade by 2010 (PTI, 2008). Table 1 highlights the bilateral trade during last four years. The trade balance is on Brazilian side.

Table 1. Recent Indo – Brazil Trade Trends

Period	2002-03	2003-04	2004-05	2005-06	2006-07
EXPORT	479.03	275.62	678.17	1,090.61	1,452.31
%Growth		-42.46	146.05	60.82	33.16
India's Total Export	52,719.43	63,842.55	83,535.94	103,090.54	126,262.68
%Growth		21.10	30.85	23.41	22.48
%Share	0.91	0.43	0.81	1.06	1.15
IMPORT	316.79	313.52	792.40	893.06	990.91
%Growth		-1.03	152.74	12.70	10.96
India's Total Import	61,412.13	78,149.11	111,517.44	149,165.73	185,604.10
%Growth		27.25	42.70	33.76	24.43
%Share	0.52	0.40	0.71	0.60	0.53
TOTAL TRADE	795.82	589.14	1,470.57	1,983.67	2,443.22
%Growth		-25.97	149.61	34.89	23.17
India's Total Trade	114,131.56	141,991.66	195,053.38	252,256.27	311,866.78
%Growth		24.41	37.37	29.33	23.63
%Share	0.70	0.41	0.75	0.79	0.78
TRADE BALANCE	162.25			197.56	461.40
India's Trade Balance	-8,692.70	-14,306.55	-27,981.49	-46,075.19	-59,341.42
Exchange rate: (1US$ = Rs.)	*48.3953*	*45.9516*	*44.9315*	*44.2735*	*45.2849*

Note: The country's total imports since 2000-2001 does not include import of Petroleum Products (27100093) and Crude Oil (27090000)

Source: Commerce Ministry, Government of India.

The major Indian exports to Brazil include mineral fuels, mineral oils and products of their distillation; organic chemicals; and, pharmaceutical products as shown in Table 2. Man-made staple fibres; electrical machinery and equipment and parts thereof; and, nuclear reactors, boilers, machinery and mechanical appliances has shown highest growth rate in 2006-2007.

Table 2. Top ten Indian Exports to Brazil (USD)

ITEM	2007	2006	(variation)%
Mineral Fuels, mineral oils and products of their distillation	1.091.690.930	757.687.925	44,1
Organic Chemicals	304.919.077	229.931.461	32,6
Pharmaceutical Products	107.893.985	80.905.830	33,4
Nuclear reactors, boilers, machinery and mechanical appliances	94.582.613	45.842.816	106,3
Man-made Filaments	81.918.651	44.506.023	84,1
Iron and Steel	32.491.774	35.982.947	-9,7
Plastics and articles thereof	47.200.181	35.386.659	33,4
Man-made staple fibres	65.467.679	28.388.980	130,6
Electrical Machinery and Equipment and parts thereof	61.873.060	27.203.698	127,4
Tanning or Dyeing Extracts; Tannins and their colouring matters	34.537.600	24.959.895	38,4
Others	242.352.519	163.142.266	
TOTAL-ALL PRODUCTS	**2.164.928.069**	**1.473.938.500**	**46,9**

Source: Indian Embassy in Brazil, 2008.

Ores, slag and ash; animal of vegetable fats and oils and their cleavage products; and, iron and steel are the major exports of Brazil to India as shown in Table 3. Ores, slag and ash; animal of vegetable fats and oils and their cleavage products; organic chemicals has shown highest growth rates in 2006-2007.

Table 3. Top ten Brazilian Exports to India (USD)

ITEM	2007	2006	(Variation) %
Mineral Fuels, mineral oils and products of their distillation	533.416	200.220.259	-99,7
Ores, Slag and Ash	288.825.317	146.403.231	97,3
Animal of vegetable fats and oils and their cleavage products	184.798.100	107.783.696	71,5
Iron and Steel	99.698.789	86.680.666	15,0
Aircraft, spacecraft, and parts thereof		82.925.193	- -
Nuclear reactors, boilers, machinery and mechanical appliances	93.914.229	79.787.655	17,7
Organic Chemicals	62.351.334	45.629.564	36,6
Electrical Machinery and Equipment and parts thereof	34.509.763	30.578.649	12,9
Rubber and articles thereof	10.824.500	22.986.445	-52,9
Raw Hides and Skins (other than furskins)	15.145.924	17.047.972	-11,2
Others	167.253.077	116.542.252	
TOTAL-ALL PRODUCTS	**957.854.449**	**936.585.582,00**	**2,3**

Source: Indian Embassy in Brazil, 2008.

3. India-Brazil-South Africa (IBSA) Initiative

India, Brazil and South Africa have started a tripartite dialogue namely India – Brazil - South Africa (IBSA) dialogue. The first meeting of this cooperation was held at Brasilia, Brazil in 2003. The second meeting was held in New Delhi in 2004.The ministers agreed that the IBSA countries can reinforce the economic strength of each other by synergising their complementarities in areas of industry, services, business and technologies and create a market of 1.2 billion people, 1.2 trillion dollars of GDP and foreign trade of 300 billion dollars. They further agreed to consider signing of a trilateral cooperation agreement to promote and facilitate trade among the three countries (Indian Embassy, 2004). By and large, IBSA aims to promote South-South co-operation and dialogue. Part of the objective of the formation of IBSA was to increase trade relations and global debates - climate change, nuclear issues, World Trade Organization (WTO) processes and the three heads of state believed that they needed to come together to create a critical mass through which to articulate the agenda of the South. Trade now stands at approximately US$6-7 billion. There is a target to increase this to US$10 billion in the next two years. This is based on realities that are achievable (SAGI, 2007). In terms of trade, IBSA countries are among the top developing countries. Their growing significance in international trade is shown by the way India has doubled its global trade share from 0.8% in 2000 to more that 1.2%. Similar trend can be seen in the South African and Brazilian trade. Their intra trade more than three fold the decade 1994-2004. IBSA countries can reinforce the economic strength of each other by creating a market of 1.2 billion people, 1.8 trillion dollars of GDP and foreign trade of nearly 600 billion dollars. In recent years, there has been a qualitative and quantitative leap in intra-IBSA trade. From a mere $ 20 million in 1998 and $ 800 million in 2002, Indo-Brazil trade has reached $2.5 billion; India-South Africa trade has also exceeded $4 billion this year. These trends indicate that IBSA trade is close to the $ 10 billion target set for this year (FIEO, 2007).

4. Recent Bilateral Initiatives

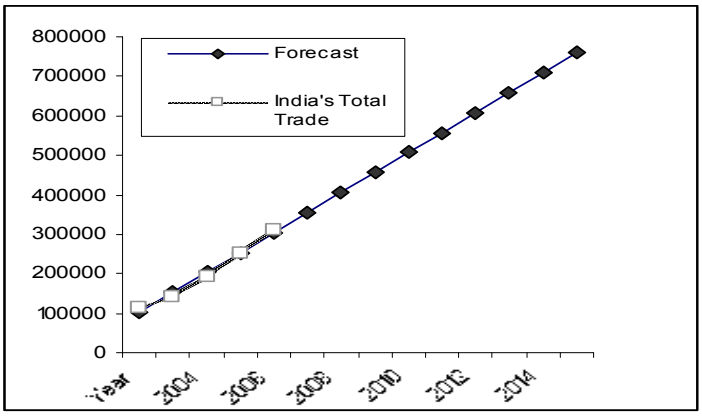
Both countries have taken interests in recent years for promotion of bilateral trade and co-operation. Seven accords were signed between India and Brazil during the visit of the Brazilian President, Mr Luis Inacio Lula da Silva, to New Delhi in June 2007 - at the head of a 100-strong business delegation. Among the accords signed, two stand out, namely, that between the oil companies

ONGC and Petrobras and that which will enable ISRO to develop the Brazilian earth station to receive signals from Indian remote-sensing satellites. Both the Indian oil sector and the space effort are in a high-growth phase and the ties with Brazil are expected to lend further practical teeth to what has been already been achieved (Indiamart, 2007).

Commerce and Industry Minister Kamal Nath and Brazilian Minister of Development, Industry and Foreign Trade Miguel Jorge, discussed measures to treble the bilateral trade to 10 billion dollars in the next three years from the present level of 3.12 billion dollars. Besides, the two ministers reviewed the global economic slowdown and how the two emerging market economies can maintain their growth to avert deeper crisis in the world economy. "In the face of slowdown in global economy, India and Brazil have to play the role of engines of growth. It is not only important for India and Brazil but also for the world economy," Nath told reporters after the meeting. The business cooperation has picked up in the fields of information technology, bio-technology and pharmaceuticals. Almost all the major Indian pharmaceutical firms have established their presence in Brazil with supply of generic drugs, finished formulations and establishment of manufacturing units. Ranbaxy and Strides Labs have turnover of 40 million dollars each from Brazil. India is also looking to Brazil for cooperation in production of bio-fuel, ethanol. Jorge also met Petroleum and Natural Gas Minister Murli Deora (PTI, 2008).

5. Future of Indo-Brazil Trade

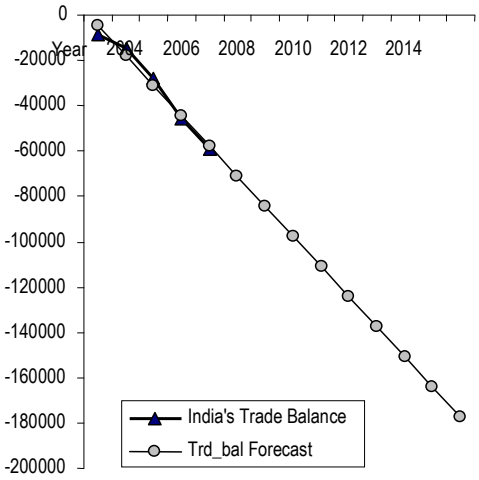
India and Brazil have immense potential for bilateral trade in the future. With the commerce ministry in India and its counterpart in Brazil agreeing to treble trade in the next three years, one can expect trade in new areas between the countries. Millennium, the target of 10 billion dollars might be hard to achieve. It can be seen from the graphs 1(a) the bilateral trade exhibits strong linear trends (R^2=.985 and ANOVA exhibiting highly significant values of .001). The Equation 1 given below shows us the linear time-series equation of the bilateral trade between India and Brazil. With the current growth rate it is projected that the bilateral trade may be below the 5 million mark.



Graph 1(a). Trend-line for India's Total Trade with Brazil

$$Y_{tot\_trd} = 51339.45 + 50573.05\ x \qquad (1)$$

However with development of new areas like nuclear energy and growth of Indian tertiary sectors like petroleum distillation, heavy machinery and chemicals, one can expect the bilateral trade to follow a more exponential growth in the coming years.



Graph 1(b). Trendline for India's Trade Balance with Brazil

$$Y_{trd\_bal} = 8640.345 - 13306.6\ x \qquad (2)$$

An area of concern for India in the long-term can be the balance of trade situation, where, in the last five years it has been strongly tilted towards Brazil's exports to India specially in the areas of Mineral Fuels and Ores as can be observed from the Graph 1(b) and also Table 3. The current trends given by Equation 2 suggest that the balance of trade situation will also grow with the growth of trade.

Table 4. Ratio of Itemwise Brazils Export to India and India`s Export to Brazil

ITEM	Ratios
Mineral Fuels, mineral oils and products of their distillation	0.000489
Ores, Slag and Ash	Not Applicable
Animal of vegetable fats and oils and their cleavage products	Not Applicable
Iron and Steel	3.068432
Aircraft, spacecraft, and parts thereof	Not Applicable
Nuclear reactors, boilers, machinery and mechanical appliances	0.992933
Organic Chemicals	0.204485
Electrical Machinery and Equipment and parts thereof	0.557751
Rubber and articles thereof	0.229332
Raw Hides and Skins (other than furskins)	Not Applicable
Others	0.480879
TOTAL - ALL PRODUCTS	**0.000442**

However if we observe Table 4 which shows the itemwise ratio of the exports that Brazil made to India and vice-versa, for the year 2007, we can see that except for Iron and Steel, Brazilian exports to India have been larger than the Indian exports to Brazil. Thus India can hope that the balance of trade can somewhat improve in the coming years.

If we look at the total value of the trade balance in Rupee terms, we will observe that the growth in the balance of trade has been quadratic. The regression equation for trade balance in rupees is given as equation (3)

$$Y_{trd\_bal\_Rs} = 139850.4375 + 161241.523\ x + 71720.91\ x^2 \qquad (3)$$

Model Summary

Multiple R	R Square	Adjusted R Square	F Value	Sig
.99650	.99302	.98604	142.216	.007

This suggests that against a volatile dollar the balance of trade situation may also fluctuate strongly thus influencing bilateral trade between the two countries.

6. Conclusion

India and Brazil are the two major emerging economies. The bilateral link is centuries old but trade has not grown much till the recent initiatives taken by the two countries. From a mere $ 20 million in 1998 India's trade with Brazil has jumped to 3.12 billion dollars in 2007. Still it is a small fraction of the overall trade of each country. India and Brazil are growing fast and there is huge potential for further growth in bilateral trade. The two sides have set a target of 10 billion dollars trade by 2010. The major Indian exports to Brazil include mineral fuels, mineral oils and products of their distillation; organic chemicals whereas ores, slag and ash; animal of vegetable fats and oils and their cleavage products are major Brazilian exports to India. It is not only the bilateral trade, the two countries has joined hands with South Africa to promote India – Brazil - South Africa cooperation and trade. Besides this, the two countries are co-operating at multilateral agencies like World Trade Organization (WTO) negotiations.

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COMPETITION AND ECONOMIC GROWTH: A CRITICAL SURVEY OF THE THEORETICAL LITERATURE

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Abstract

The paper examines the relationship between competition and economic growth, in the theoretical framework described by endogenous growth models, but with a specific interest in the policy implications. In this perspective, the key issue in the debate can be presented as follows: do competition policies always create the best conditions for promoting innovation and growth? Or do they also produce some disincentives for the investment decisions in R&D, such to limit the development of industries with higher innovation? In order to answer these questions, the paper presents a survey of the theoretical literature on competition and growth and it discusses the main models of endogenous growth, both the ones based on horizontal innovation, and the ones based on vertical innovation. In particular, specific attention is paid to the most recent models of Schumpeterian growth, which show the existence of a non-linear relationship between competition and growth, by considering either the initial degree of competition or the distance from the technological frontier. Finally, the review of the previous models of endogenous growth allows drawing some conclusions about further and possible developments of research on the relation between product market competition and economic growth.

Keywords: expanding product varieties, increasing product quality, incentives for innovation, creative destruction, escape-competition effect, distance to frontier.

JEL Classification: O31, O33, O34, O41

1. Introduction

The present paper presents some of the most important developments in the theoretical literature on the relationship between competition and economic growth. The questions that lead such discussion are the following ones. How can competition affect the relevant factors for long-run growth? Does competition always have a positive impact on productivity growth? Or can it also produce a negative effect?

Many different aspects must be considered in order to discuss this issue. According to a common view, also supported by empirical evidence, competition can generate strong incentives for innovation, because firms can succeed in a really competitive environment only if they are able to introduce significant improvements in the quality of the products and in the efficiency of the production processes. But, on the contrary, in the analysis of Schumpeterian models of endogenous growth, competition policies which reduce the monopoly rents gained by successful innovators can also lower the incentives for the investments of firms in R&D, and then compromise the future perspectives for technological progress.

Some explanations have been proposed to reconcile these different views and to understand which of these aspects prevails, and under which conditions. In order to tackle the issue, we will firstly present the basic models of the literature on endogenous growth theory and after we will discuss some of the solutions suggested in the recent theoretical literature on Schumpeterian growth models. Finally we will draw some conclusions about the current state of the literature in order to identify new directions for future research.

2. Endogenous Growth Theory

The main theoretical contributions for the analysis of the relationship between competition and economic growth have been offered in the macroeconomic literature on endogenous growth theory. This literature aims at explaining long-term per capita growth by endogenizing technological progress that is by treating the rate of technological change as an endogenous variable of the model, which is determined by a series of process innovations and product innovations.

In endogenous growth literature, technological progress is modelled either as an expansion of the number of product varieties or as an improvement of the quality of products[1]. In the first case, technological change is presented as horizontal innovation, given that the introduction of a new type of product doesn't imply a displacement of existing varieties, and then productivity increases because of the presence of more product varieties. In the second case, technological progress is defined as vertical innovation, because higher quality products replace existing varieties, and then innovation determines immediate obsolescence of previous innovations (creative destruction).

Both types of endogenous growth models are characterized by the presence of two or three sectors: a sector of final goods, purchased by consumers; a sector of intermediate goods (or capital goods), used for producing consumption goods; a research sector, developing new ideas for product or process innovations. In some cases the firms engaged in the intermediate sector are also involved in the research activity, since the elaboration of a new idea allows to produce either a new variety of capital goods (in case of horizontal innovation) or a higher quality capital good able to replace the existing ones (in case of vertical innovation).

While the market of final goods is generally assumed to be perfectly competitive, the market of intermediate goods is composed of firms having a given market power. So, an important issue for the theoretical analysis is how to introduce a market structure consideration in a macroeconomic model of endogenous growth. So, it is necessary to identify an appropriate measure of market power which can be easily embedded in the analytical framework, in such a way to derive a clear prediction about the relation between the degree of market power, or inversely the degree of competition, and the growth rate of the economy.

3. Endogenous Technological Change

In this section we present the basic paradigm of the endogenous growth models with horizontal innovation, which is the analysis of Endogenous Technological Change proposed by Romer (1990). This model considers a two sector - economy: a sector of final goods, which is perfectly competitive; a sector of intermediate goods, which includes firms having a given market power (to be measured according to the Lerner index). The firms of the intermediate sector directly run the research activity.

The producer of final goods employs labour (L_i) and a combination of N different types of intermediate goods (X_{ij}) according to the following Cobb-Douglas production function:

$$Y_i = AL_i^{1-\alpha} \cdot \sum_{j=1}^{N} \left(X_{ij}\right)^{\alpha} \quad \text{where} \quad 0 < \alpha < 1,\ A > 0 \tag{1}$$

This formulation implies an assumption of independence between different types of capital goods. In fact, given the additively separable form used for the various components $(X_{ij})^{\alpha}$ of capital input, the marginal product of an intermediate good is independent of the employed quantity of another intermediate good. This assumption is important in the case of the introduction of a new type of intermediate product: since it is not a substitute good neither a complementary good, the usage of the new capital good doesn't affect the marginal product of the existing varieties. On the contrary, in the models of endogenous growth with vertical innovation, since the innovation allows to produce a substitute good of higher quality, the employment of this capital good (having higher marginal product) implies the obsolescence of the existing products of lower quality.

The intermediate sector is composed of research firms, which are involved both in R&D activity and in production of capital goods. In fact they produce intermediate goods using an innovative idea, protected by a perpetual patent, which was elaborated thanks to R&D activity. This implies that each research firm supplying a capital good has the monopoly on this type of product. The decisions of these firms about research and production are articulated according to a two-stage decision process: in the first stage, each firm decides whether to devote an amount of resources to R&D activity, considering the present discounted sum of profits obtainable in the future through the exploitation of a new idea and comparing them with R&D cost; in the second stage, after inventing a new product variety, the firm has to determine the price of the capital good in order to maximize profits.

[1] For a more complete treatment of endogenous growth theory, see Barro and Sala-i-Martin (2004), Aghion and Howitt (1998), Aghion and Howitt (2009).

Regarding the first stage, the cost of R&D activity is defined as a decreasing function of the number of existing product varieties, because the availability of some previous ideas makes easier to elaborate a new idea, and then to invent a new intermediate good. This implies that the generation of an innovative idea produces a positive externality for the labour productivity of future researchers, who will have access to a greater stock of knowledge. This assumption is expressed through the following law of motion for the production of new designs (N_t):

$$\dot{N}_t = \frac{1}{\eta} N_t L_R \qquad \text{where } \eta > 0 \tag{2}$$

So the variation of the number of designs depends positively on the number of existing ideas and on the amount of labour employed in the research activity. If $\dot{N}_t = 1$, the invention of a new idea requires a labour input equal to η/N_t and then the cost of invention is equal to $\eta w_{Rt} / N_t$.

Given these assumptions, the firms are willing to invest in R&D activity only if they expect that the present discounted value of profits coming from the exploitation of a new idea is equal to the cost of research activity[2]. In such case, the free-entry condition must be written as follows:

$$V(t) = \frac{\eta w_{Rt}}{N_t} \tag{3}$$

The instantaneous profit flow of a firm *j* producer of capital goods is given by:

$$\pi_{jt} = L_Y A^{\frac{1}{1-\alpha}} (1-\alpha)\alpha^{\frac{1+\alpha}{1-\alpha}} \tag{4}$$

Given the profit function π_{jt}, the present discounted value of profits from the exploitation of a new design of intermediate good is equal to:

$$V(t) = \underbrace{L_Y A^{\frac{1}{1-\alpha}} (1-\alpha)\alpha^{\frac{1+\alpha}{1-\alpha}}}_{\pi_{jt}} \cdot \int_t^{\infty} e^{-\bar{r}(t,\upsilon)(\upsilon-t)} d\upsilon \tag{5}$$

If this condition is satisfied, research firms elaborate new ideas protected by a patent and then produce new capital goods. Each firm is a monopolist with regard to the intermediate good produced, and then it can apply a profit margin over the marginal cost. Assuming that marginal cost is equal to 1, the research firm *j* maximizes the following profit function:

$$\pi_j = (P_j - 1)\left(\frac{A\alpha}{P_j}\right)^{\frac{1}{1-\alpha}} L \tag{6}$$

Then the firm *j* determine the price P_j, which is equal to:

[2] In this case we assume that the firms in the intermediate sector are involved in the research activity and then have to decide whether and how much invests in R&D. But we could also suppose, without changing the results of the model, that the production of intermediate goods and the research activity are carried out by different firms, on the condition that research sector is perfectly competitive. So, in this hypothesis, research firms which invent a new design may license it to the producers of capital goods for a price equal to the cost of the new invention. Then the firms operating in the intermediate sector are willing to buy the license only if they expect that the present discounted sum of profits coming from the exploitation of the new design is equal to the price of the license, and then to the cost assumed by the research firm to invent the new product.

$$P_j = \frac{1}{\alpha} > 1 \tag{7}$$

Substituting P_j in the profit function π_j, we can rewrite the present value of returns *V(t)*:

$$V(t) = LA^{\frac{1}{1-\alpha}}\left(\alpha^{\frac{1+\alpha}{1-\alpha}} - \alpha^{\frac{2}{1-\alpha}}\right)\cdot\int_0^{\infty} e^{-\bar{r}(t,\upsilon)\cdot(\upsilon-t)}d\upsilon \tag{8}$$

Given the price, it is possible to determine the Lerner index, which is defined as the difference between the price and the marginal cost, divided by the price:

$$L = 1-\alpha \tag{9}$$

Obviously, this result for the Lerner index depends on the formulation of the production function for final goods. Anyway, it can be useful in order to identify a good indicator for the degree of competition, and then to evaluate the effects of market structure on the growth rate of economy, as determined in the model. In fact, given that the Lerner index is an appropriate measure of market power, we observe that market power is a decreasing function of α. So α can be considered as a parameter indicating the degree of competition in a market.

Now we have to consider the consumption side of the economy. In this model households consume final goods by maximizing the utility function subject to the budget constraint:

$$\max_{c_t} U = \int_0^{\infty} \frac{c_t^{1-\vartheta}-1}{1-\vartheta} e^{-\rho t}\,dt \qquad \text{s. t. } \dot{a}_t = \frac{da_t}{dt} = wL + r_t a_t - c_t \tag{10}$$

where $\vartheta > 0,\ \rho > 0$.

From the solution of this optimal control problem we obtain the Euler equation:

$$\gamma_{c_t} = \frac{\dot{c}_t}{c_t} = \frac{1}{\vartheta}(r_t - \rho) \tag{11}$$

At this point we can analyze the general equilibrium of the economy.

As we have seen in the description of R&D costs, the research sector uses labour as an input for the production of new ideas. In fact, the invention of a new product is the result of the creative activity of a researcher, who employs his work for this purpose. This implies that in the model labour is used both in the final sector (L_Y) and in the research sector (L_R), but not in the intermediate sector. So we can write a feasibility condition for the total amount of labour input in the economy:

$$L \geq L_Y + L_R \tag{12}$$

In equilibrium, since all the labour input is employed, this feasibility condition must hold as equality. Moreover labour is assumed as a homogenous input and then it is remunerated by the same wage, whatever sector employs it. So we have:

$$w_t = w_{Yt} = w_{Rt} \tag{13}$$

From the profit maximization problem in the sector of final goods, we obtain the real wage:

$$w_{Yt} = w_{Rt} = A^{\frac{1}{1-\alpha}}(1-\alpha)\alpha^{\frac{2\alpha}{1-\alpha}}N_t \tag{14}$$

From the solution of the utility maximization problem of the household, we have the Euler equation. It can be shown that the growth rate of per capita consumption (c_t) is equal to the growth rate

of the other variables N_t, Y_t and w_t. This implies the existence of a balanced growth path (BGP), where all the variables grow at a constant rate. Then, by the Euler equation, also the interest rate r_t is constant in the BGP. So we can compute the interest rate as the ratio between the instantaneous profit flow (in equilibrium $\pi_t = \pi_{jt}$) and the present discounted value of innovation *V(t)*:

$$r_t = \frac{\pi_t}{V(t)} = \frac{L_Y A^{\frac{1}{1-\alpha}} (1-\alpha)\alpha^{\frac{1+\alpha}{1-\alpha}}}{\frac{\eta w_{Rt}}{N_t}} \tag{15}$$

In order to determine the growth rate of the economy in the balanced growth path, but also the amount of labour in the final sector and in the research sector, it is necessary to solve a system of equations, including the interest rate, the feasibility condition for labour market and the innovation rate, given the Euler equation as a stability condition of the system. The solutions of this system of equations are:

$$L_Y = \frac{L\vartheta + \eta\rho}{\vartheta + \alpha} \qquad L_R = \frac{\alpha L - \eta\rho}{\vartheta + \alpha} \qquad r = \frac{\alpha(L\vartheta + \eta\rho)}{\eta(\vartheta + \alpha)} \qquad \gamma_{y_t} = \frac{\alpha L - \eta\rho}{\eta(\vartheta + \alpha)} \tag{16}$$

The most interesting result for our purposes is the last one, corresponding to the growth rate of the economy in a balanced growth path. In order to understand the effect of competition on the growth rate of income per capita, we differentiate γ_{y_t} with respect to α, given that this variable can be considered as a good indicator for the degree of competition in the market.

$$\frac{\partial \gamma_{y_t}}{\partial \alpha} = \frac{(L\vartheta + \eta\rho)}{\eta(\vartheta + \alpha)^2} > 0 \tag{17}$$

Given the sign of the derivative, we can conclude that in this model the effect of competition on growth is always positive. Such positive relation between competition and growth can be explained endogenously through a resource allocation effect regarding labour input. In fact, as competition increases in the intermediate sector, and so the price of capital goods decreases, the producers of final goods tend to substitute labour input with capital input. If there is full employment in the economy, this causes a reallocation of labour from the final sector to the research sector. So, given that the rate of innovation, measured as the growth rate of product varieties, is an increasing function of the labour employed in the research sector, a rise of L_R produces an increase of the innovation rate, and then of the growth rate.

But this explanation requires some additional observations. A first critical consideration concerns the idea of a perfect mobility of workers between final sector and research sector, which is based on the initial assumption about the homogeneity of labour input and then on its corollary about the equality of real wages across different sectors. So it is worth to verify whether, supposing different wage levels for workers in the final sector and in the research sector, the results of the model about the growth rate and the effect of competition on growth remain unchanged. In fact, a distinction of wages, based on the level of human capital for different workers, may attenuate the magnitude of the resource allocation effect coming from a rise of competition in the market.

A second critical observation regards the determinant role played by the scale effect of labour supply in R&D sector, in order to explain the growth rate of the economy and then also the relation between competition and growth. In fact, the resource allocation effect, subsequent to an increase of the degree of competition, explains the positive effect of competition on growth, just because an expansion of labour supply in R&D sector produces a rise of the growth rate of product varieties, equal to the growth rate of income per capita.

But this specification of the rate of technological progress is not necessarily consistent with the empirical evidence, as reported by Jones (1995). In fact he presents some data about the increase of

the number of researchers in many industrialized countries over the years 1970-1990, showing that a wider employment of labour in R&D sector doesn't imply automatically a rise of the growth rate of the economy. This is because the output of research activity is not deterministically produced from a given quantity of inputs, but it depends also on the outcome of a stochastic factor.

Then the idea that Jones wants to develop is the construction of a research-based growth model, able to explain the growth process without exploiting any scale effect induced by the amount of labour employed in R&D sector. In particular, in order to maintain the basic structure of R&D based models, he introduces the following law of motion for the number of product varieties:

$$\dot{N}_t = \frac{1}{\eta} L_R N_t^{\varphi} l_R^{\varphi-1} \tag{18}$$

where N_t is the number of product varieties; the value of the exponent φ defines the measure, positive or negative, of the externalities induced by the existing stock of knowledge for productivity of research activity; L_R is the amount of labour employed in the research activity and exploited for the invention of new ideas; l_R is the amount of labour engaged in the research sector but not useful for promoting technological progress because of duplications in the research process. In equilibrium $L_R = l_R$, so the contribution of research work for the rate of technological progress is expressed by L_R^{λ}, where $0 < \lambda \leq 1$.

This specification of the research equation solves two issues: it allows to consider different types of externalities, both positive and negative, coming from the amount of existing varieties; it permits to eliminate any scale effect of labour supply from the determination of the growth rate. But the counterpart of this specification is that the long-run growth rate, obtained from the growth rate of product varieties, is dependent on exogenous parameters such as φ, λ and n (which is the growth rate of population). In fact, the growth rate is equal to:

$$\gamma = \frac{\lambda n}{1-\varphi} \tag{19}$$

In this case, the alternative specification of the research equation implies another problem for the determination of the growth rate, given that the model is not able to explain endogenous growth. In fact, the determinant role of these exogenous parameters contradicts the idea of a technological progress, which is endogenously generated by product and process innovations, intentionally and rationally promoted by economic subjects. So, in this case, the elimination of scale effects doesn't guarantee that the model can offer useful answers for the determinants of the growth rate. For these reasons, it is worth to examine the endogenous growth models based on vertical innovation, which provide more exhaustive explanations about the determinants of technological progress as well as on the relation between competition and growth.

4. A Model of Growth through Creative Destruction

The endogenous growth literature based on vertical innovation exploits the original intuition of Schumpeter about creative destruction for developing some analytical models, aimed at showing the effects of market structure on the incentives for innovation and then on technological progress.

According to Schumpeter (1934), the basic element of capitalism is the process of creative destruction, meant as the continuous change of the economic structure, due to the invention of new products and new methods of production, which replace the previous ones and then erode the profits of the existing firms. This idea is formally developed in the paper by Aghion and Howitt (1992), who construct a model of endogenous growth, presenting the innovation process as in the patent-race literature in industrial organization.

In this framework industrial innovations improve the quality of products, in particular of the intermediate ones employed in the manufacture of final commodities. As a consequence, the intermediate good of higher quality replaces the previous ones, which are less productive and then are subject to a process of obsolescence. The firm which introduces such innovation thanks to a new idea obtains a patent and can exploit it in a monopolistic position; at the same time the other producers of

the intermediate good completely lose their profits because their products are not demanded anymore. This implies that the monopolistic rents gained by a firm owner of a patent last only until a higher quality product is invented.

Aghion and Howitt consider a simplified economy composed of three sectors: a final sector, an intermediate sector and a research sector. Labour is employed in all the sectors but it is an heterogeneous factor: unskilled labour (*M*) is used only in the final sector; skilled labour (*N*) is occupied both in the intermediate sector and in the research sector; specialized labour (*R*) is employed only in the R&D sector.

The sector of final goods is generally assumed to be perfectly competitive. There firms produce an homogeneous consumption good, according to the following per capita production function:

$$y_t = A_t x_t^{\alpha} \qquad \text{where } 0<\alpha<1 \tag{20}$$

In particular, A_t is a technological parameter related to the usage of the intermediate good. Given that there are different versions of the intermediate good, such that each one is better than the previous ones, A_t can be expressed as $A_t = A_0\ \gamma^t$, where A_0 is the initial value of the productivity parameter while $\gamma>1$ is the factor measuring the growth of productivity as a consequence of the invention of a higher quality product; finally t indicates the time interval starting from the t^{th} invention and ending to the $t+1^{st}$ invention.

Because of the process of creative destruction, the intermediate sector is monopolized by a firm owner of a patent, which sets a price for the intermediate product x_t equal to:

$$p_t = \frac{w_t^N}{\alpha} > w_t^N \tag{21}$$

where the price is determined by charging a mark-up given by $1/\alpha$ over the marginal cost equal to the wage. Given the price, it is possible to determine the Lerner index, which is equal to $L=1-\alpha$. For the same reasons explained in the previous paragraph, α can be considered as a parameter indicating the degree of competition in a market.

Finally, the research sector employs both skilled labour and specialized labour in order to develop new ideas. But the innovation process is stochastic, since the length of time required for creating a new product depends on the arrival rate of innovation, modelled according to a Poisson distribution. This rate is also determined by the amount of labour employed in R&D activity, because a greater number of workers in research activity increase the probability of introducing a higher quality product in the market. In fact the arrival rate of innovations is given by $i= \lambda\varphi\ (n_t\ ,\ R)$, where λ is a constant parameter indicating the intensity of discovery probability and where n_t is the amount of skilled labour used in the research sector.

The research sector is assumed to be perfectly competitive: so the firms are willing to conduct R&D activity if the flow of expected revenues from research is equal to the cost of research. Then the firms choose the amount of labour input by maximizing the following profit function:

$$\pi_R = \lambda\varphi(n_t, R)V_{t+1} - w_t^N n_t - w_t^R R \tag{22}$$

In this specification of the objective function R&D activity is financed by the outside research firms, which expect to discover a new idea in order to obtain the value V_{t+1} coming from the exploitation of the $t+1^{st}$ innovation. In fact, the incumbent monopolist has no incentives for financing research activity because, even if a new idea was discovered, it would get an expected flow of profits only equal to $V_{t+1}-V_t$. Then, assuming $R=0$, the FOC from the profit maximization for n_t defines the arbitrage condition in R&D:

$$w_t^N = \lambda\varphi'(n_t)V_{t+1} \tag{23}$$

This equation means that research firms are willing to hire a new skilled worker if the wage equals the marginal productivity coming from an additional research worker.

In general, the value of innovation V_t is the present discounted value of the monopoly profits that an intermediate firm can gain for a time period, until an innovation occurs with a probability defined by the arrival rate of innovation. Then, the necessary condition for financing research activity can be expressed as:

$$V_t r = \pi_{x_t} - V_t \lambda \varphi(n_t) \tag{24}$$

Assuming that the financial sector is perfectly efficient, households are willing to buy shares of the intermediate firm if and only if the flow of monopoly profits in the interval t is equal to the income obtainable from investing an asset V_t in riskless securities at an interest rate r.

Using previous results, we can obtain the following condition expressing the equality between the marginal cost of research (on the LHS) and the marginal benefit of research (on the RHS):

$$\frac{(N - n_t)^{\alpha-1}}{\lambda \varphi'(n_t)} = \frac{\gamma \frac{1-\alpha}{\alpha}(N - n_{t+1})^{\alpha}}{r + \lambda \varphi(n_{t+1})} \tag{25}$$

This equation also shows the relationship between research employment in time t and in time $t+1$, given that all the other terms are constant. In particular, n_t is negatively dependent on n_{t+1}, for an effect related to the process of creative destruction. If a greater amount of skilled labour is expected to be employed in research in the next period, the arrival rate of innovation increases and then the marginal benefit of research decreases; consequently, research firms are willing to hire a smaller amount of workers.

A stationary equilibrium in the model exists for a given value of n^* such that $n_t = n_{t+1}$, that is the amount of skilled labour in the research sector n remains constant. Now, we want to determine the optimal level of n which corresponds to the stationary equilibrium. Then, assuming the linear research technology $\varphi(n_t)=n_t$ and considering that in the stationary equilibrium $n_t=n_{t+1}=n$, $x_t=x_{t+1}=x$ and also $w_{t+1}=\gamma w_t$, we can rewrite the arbitrage condition and the value of $t+1^{st}$ innovation and then compute the optimal level n*:

$$n^* = \frac{\lambda\gamma \frac{1-\alpha}{\alpha} N - r}{\lambda\left[1 + \gamma \frac{1-\alpha}{\alpha}\right]} \tag{26}$$

In order to understand the effect of competition on research employment and ultimately on growth, we differentiate the expression for n^* with respect to α and we notice that the sign of the derivative is negative. Then, an increase of the degree of competition in the intermediate sector implies a decrease of the amount of skilled labour employed in the research sector. In fact, if α rises, the price of the intermediate good p_t diminishes and then the monopolistic profits of the intermediate firm owner of the patent decrease. This explains why the incentives for investment in R&D sector are smaller in a more competitive market. It can be shown that a positive value of research employment can exist only if the market for intermediate goods is not a perfectly competitive one. Otherwise, there are not enough incentives for financing research activity.

Finally, we are interested in determining the growth rate of the economy in the equilibrium. In a balanced growth path, real output y increases when a new idea is discovered and implemented in the production of an intermediate good: it occurs with a probability defined by the arrival rate $\lambda\varphi(n^*)$ and in this case the productivity parameter of the production function grows by a factor $\gamma>1$. Then the average growth rate of the economy, expressed in log of real output, is given by:

$$g_y \equiv \ln y(\tau+1) - \ln y(\tau) = \lambda\varphi(n^*)\ln\gamma \tag{27}$$

In conclusion, the average growth rate of the economy g_y is an increasing function of the arrival rate of innovation $\lambda\varphi(n^*)$ and then of the optimal amount of skilled labour in research n^*, given that

$\varphi'(n^*) > 0$. As a consequence, the observations proposed for the negative relation between n^* and α hold for the relation between g_y and α. In fact, the average growth rate g_y is a decreasing function of the degree of competition α or, reversely, an increasing function of the Lerner index $1-\alpha$. Since the engine of endogenous growth is research activity, an increase of competition which reduces the monopoly rents gained by a successful innovator diminishes the incentives for R&D activity and so reduces the average growth rate of the economy.

5. Corporate Governance, Competition Policy and Industrial Policy

Although the Schumpeterian model of endogenous growth predicts a negative relationship between competition and growth, some empirical works developed in the following years, such as Geroski (1995), Nickell (1996) and Blundell, Griffith and Van Reenen (1999), have observed a positive correlation between product market competition and innovative activity. For this reason some new models of endogenous growth have been successively proposed in order to reconcile the theoretical predictions with the empirical evidence. The main extensions of the Schumpeterian growth model, elaborated in order to tackle this issue, have been developed in several directions: classifying firms according to their objectives, such to distinguish profit-maximizing firms and managerial firms; introducing the idea of a step-by-step innovation; differentiating industries and countries on the basis of their distance to the technological frontier. Each of these aspects will be examined in the following paragraphs, starting from the present one.

In general, the endogenous growth framework presented in the previous sections assumes a modelling of the decision-making process of each firm, which is based on the idea of a profit-maximizing firm. But this assumption about the behaviour of firms is not consistent with the observation of real world, where many firms managerially conducted follow different objectives in production and innovation decisions. In particular, this issue regards large firms, which are owned by many shareholders and are administered by managers usually different from owners. Moreover – what is more important - large firms are more engaged in research activity than small firms: empirical evidence suggests that most R&D expenditure is financed by firms of large size, since they have more financial resources, and that consequently the majority of new patented ideas is discovered by these firms[3].

For this reason, it is important to examine whether the conclusions of the basic Schumpeterian model about competition and growth are destined to be reversed in a different framework, where firms are not profit-maximizes but are guided by a conservative management, interested in preserving private benefits from control and in minimizing effort at the same time. The relevance of the principal-agent relationship in innovation decisions of managerial firms is presented in the article by Aghion, Dewatripont and Rey (1997), where the effect of competition on innovation crucially depends on the type of firm: it is negative for profit-maximizing firms, but it is positive for managerial firms.

A first important assumption is that in the final sector firms produce a homogeneous good according to the following Dixit-Stiglitz production function:

$$y = \int_0^N A_i x_i^{\alpha} \, di \qquad 0<\alpha<1 \tag{28}$$

This formulation implies that each firm uses at the same time the intermediate goods supplied by N different firms, where each intermediate variety i is monopolistically produced by a specific firm and has a productivity level measured by the parameter A_i. Then, more varieties of intermediate product can coexist, even if they correspond to a different technological level. From the profit-maximization problem of final firms the price for the intermediate good i is given by:

[3] To give an idea of this observation, Aghion and Griffith (2005), showing a pattern seen across a large number of datasets, consider the number of patents taken out at the U.S. Patent Office by firms listed at the London Stock Exchange and distribute firms according to their size, measured by the amount of sales. Then they observe that the smallest firms, located in the first decile, account only for 2% of the number of patents, while the largest firms in the tenth decile account for almost 50% of the number of patents.

$$p(x_i) = A_i \alpha x_i^{\alpha-1} \tag{29}$$

Intermediate firms have to take two types of decision. Firstly, given the evolution of technology, they have to decide when to buy a new technology, which is the most recent one: this allows improving the efficiency of the production processes, but it also implies some adjustment costs in terms of reorganization of the production structure. Secondly, given the available technology in each moment, they have to determine the level of production. In order to examine this two-stage decision process let solve the model backward.

The production decisions are taken by intermediate firms according to the usual paradigm of profit maximization. Then, assuming a production function with a one-to-one technology $x_{t,\tau} = l_{t,\tau}$, where $x_{t,\tau}$ is an intermediate good of vintage τ produced in time t, an intermediate firm determines the amount of output by maximizing the following profit function:

$$\pi_{t,\tau} = \underbrace{A_\tau \alpha x_{t,\tau}^{\alpha-1}}_{p_{t,\tau}} \cdot x_{t,\tau} - w_t x_{t,\tau} \tag{30}$$

Defining the productivity-adjusted wage ω as $\omega = w_t / A_\tau$ and considering that in a steady state both the leading-edge technology A_τ and the wage rate w_t grow at the same rate g, the output flow of the intermediate firm is:

$$x_{t,\tau} = \left(\frac{w_t}{\alpha^2 A_\tau} \right)^{\frac{1}{\alpha-1}} = \left(\frac{\omega}{\alpha^2} \right)^{\frac{1}{\alpha-1}} e^{\frac{g(t-\tau)}{\alpha-1}} \tag{31}$$

where $u \equiv t - \tau$ is the age of the firm's technology. Then the productivity-adjusted profit flow of an intermediate leading-edge firm (for which $t=\tau$) is:

$$\pi = \tilde{\pi}(\omega) = \frac{\pi_{t,\tau}}{A_\tau} = \frac{1-\alpha}{\alpha} \omega \left(\frac{\omega}{\alpha^2} \right)^{\frac{1}{\alpha-1}} \tag{32}$$

In order to understand the decisions of intermediate firms about technological adoption, we must take into account that they have to face a fixed operating cost (also in terms of labour), defined as $k_{t,\tau}$, such that $k_{t,\tau} = w_t k e^{\rho(t-\tau)}$. So the net profit flow of an intermediate producer can be rewritten as:

$$\Pi_{t,\tau} = \left\{ \pi e^{-\frac{g(t-\tau)}{1-\alpha}} - \omega k e^{\rho(t-\tau)} \right\} e^{gt} = \psi(\omega, g, u) e^{gt} \tag{33}$$

where $\psi(\omega, g, u)>0$ for $u=0$ and $\psi(\omega, g, u)<0$ for u large, and also $\psi_u<0$.

Moreover, an intermediate firm which is interested in using a new technology has to bear a sunk cost f (in labour units) in order to implement the leading-edge technology, then the adoption cost is $f_\tau = f w_\tau = f \omega e^{g\tau}$. In a steady state, where each intermediate firm takes the leading-edge technology every T units of time and the age of the firm's technology is uniformly distributed on the interval $[0, T]$, the aggregate flow of new technological adoptions per unit of time is $1/T$ while the aggregate flow of research labour is $n = f/T$. Finally, given that technological adoption implies an increase of growth rate by $\ln \gamma$ per unit of innovation, the steady-state growth rate is:

$$g = \frac{\dot{A}}{A} = \frac{\ln \gamma}{T} \tag{34}$$

So, assuming that the size of the technological step is fixed, the innovation rate, as well as the growth rate of the economy, depends on the length of time interval T for the adoption of a new technology[4]. The timing of innovation is determined by the intermediate firms and this decision is taken by managers depending on their objective function.

Then we consider the case of non profit-maximizing firms, which are directed by managers having the following utility function:

$$U_0 = \int_0^{\infty} B_t e^{-\delta t} dt - \sum_{j \geq 1} C e^{-\delta \left(T_1 + \ldots + T_j\right)} \tag{35}$$

where B_t is the private benefit that managers gain from controlling a firm in time t, such that $B>0$ if the firm has survived up to t and $B=0$ otherwise; C is the private cost that managers have to face for adopting a new technology; δ is the subjective discount rate of managers. This utility function is the objective function that managers maximize in order to determine the optimal time for technological adoption. This means that, according to a lexicographic preference ordering, managers are interested in keeping a positive net financial wealth, just enough for covering the adoption cost, such that they can exploit the private benefit of control. At the same time, once satisfied this objective, they want to delay the next innovation as much as possible, in order to avoid the private cost related to technological adoption.

But, at a given point, managers have to innovate because otherwise profits would become negative and then they would lose the firm's control. In fact the function $\psi(\omega, g, u)$ has an inverted U shaped trend with respect to T, so it is increasing for small values of T, decreasing and even negative for large values of T. This implies that firms have to adopt a new technology for avoiding insolvency and then bankruptcy. As a consequence, the maximum time interval $\widetilde{T}$ for technological adoption is defined in such a way that the profits accumulated until the innovation (on the RHS) are equal to the adoption cost at that date (on the LHS), as it appears from the following equation:

$$\omega f e^{-(r-g)T} = \int_0^T \underbrace{\left[\tilde{\pi}(\omega) e^{-\frac{gu}{1-\alpha}} - \omega k e^{\rho u} \right]}_{\psi(\omega, g, u)} e^{-(r-g)u} du \tag{36}$$

From this equation, it is possible to intuitively explain the reason why more competition may cause a reduction of the optimal time interval $\widetilde{T}$, and then a sooner adoption of a new technology. In fact, an increase of the degree of competition, lowering the flow of profits, reduces the amount of financial wealth of the intermediate firm and then diminishes the period of time when conservative managers can keep the same technology without incurring the firm's insolvency and then bankruptcy.

In order to better understand this effect of a tougher competition, we have to identify an appropriate measure of competition whose variation produces significant changes on the flow of profits of intermediate firms. Given that the production of final goods requires the usage of various intermediate products, whose substitutability is indicated by the parameter α, a change of this parameter can be interpreted as a variation of the degree of product market competition.

[4] Aghion and Griffith (2005) propose a simplified version of the endogenous growth model with principal-agent problem, where the intermediate producers have to choose not the frequency of innovations, but the size of the productivity improvements. Anyway, the result is the same which is obtained in the discussed paper: for profit-maximizing firms, an increase of product market competition implies a reduction of the optimal size of innovation, while, for non profit-maximizing firms, it causes an increase of the size of innovation, since a rise of competition reduces the free-cash available for managers and then acts as an incentive mechanism to invest more in technological improvements. Also debt financing is an instrument which reduces managerial slack and induces managers to react more quickly to exogenous variations of market competition.

For this purpose, the equilibrium condition for the technological adoption policy must be combined with the labour market clearing condition in the steady state, which is defined as follows:

$$\frac{e^{\rho T}-1}{\rho T}\cdot k+\frac{f}{T}+x_{t,\tau}\cdot\left[\frac{1-e^{-\frac{\ln\gamma}{1-\alpha}}}{\frac{\ln\gamma}{1-\alpha}}\right]=L \tag{37}$$

where, on the LHS, the first term is the aggregate operating cost, the second term is the aggregate demand for research labour and the third one is the aggregate demand for manufacturing labour. Using the labour market clearing condition for obtaining the amount of leading-edge demand $x_{t,\tau}$ and substituting it in the equilibrium optimal adoption policy, the reduced-form arbitrage equation is:

$$f e^{-rT+\ln\gamma}=\int_0^T\left\{\frac{1-\alpha}{\alpha}\left[\frac{\frac{\ln\gamma}{1-\alpha}}{1-e^{-\frac{\ln\gamma}{1-\alpha}}}\right]\left[L-\frac{f}{T}-\frac{e^{\rho T}-1}{\rho T}\cdot k\right]e^{-\frac{\ln\gamma\, u}{T(1-\alpha)}}-k e^{\rho u}\right\}e^{-\left(r-\frac{\ln\gamma}{T}\right)u}du \tag{38}$$

As it can be verified from a comparative statics analysis, an increase of the degree of competition, measured by the degree of substitutability α between intermediate products, determines a decrease of the net profit flow, as indicated by the expression in curly brackets and corresponding to the function $\psi(\omega, g, u)$. This reduction of the net financial wealth for intermediate firms works as an incentive scheme for conservative managers in order to anticipate the adoption of the most recent technology. Then, after an increase of α and a decrease of the value $\psi(\omega, g, u)$, the optimal time interval for technological adoption by each intermediate firm is $\widetilde{T}_1$, such that $\widetilde{T}_1<\widetilde{T}_0$, where $\widetilde{T}_0$ is the optimal adoption policy chosen before the variation of the degree of product market competition. Finally, substituting the new optimal adoption policy $\widetilde{T}_1$ in the growth rate, we obtain:

$$g_1=\frac{\ln\gamma}{\widetilde{T}_1}>\frac{\ln\gamma}{\widetilde{T}_0}=g_0 \tag{39}$$

This means that in a context with non-profit maximizing firms, guided by a conservative management, an increase of competition produces an increase of the innovation rate as well as of the growth rate of the economy. On the contrary, an industrial policy aimed at subsidizing the firms' investments in innovation through a reduction of the sunk cost for technological adoption *f* generates an opposite effect, given that it allows a conservative management of non-profit maximizing firms to further delay the time of adoption of a new technology.

This model with principal-agent problem shows how the introduction of a different assumption about the behaviour of firms in innovation decisions may radically change the conclusions about the effect of competition on growth. In this case, more competition plays an innovation-enhancing role especially for process innovations in intermediate firms, because the acquisition of a new technology allows producing more efficiently and then to avoid a fall of the net profit flow, otherwise dangerous for the financial situation of each firm[5].

[5] A similar conclusion about the preference of managerial firms for process innovation is obtained, in a different theoretical framework, in the paper by Cellini and Lambertini (2008), where the behaviour of managerial firms regarding investment in product and process innovations is analyzed through a differential game approach. The presented result is that firms managerially conducted tend to overinvest in process innovations, if compared with profit-maximizing firms. In general, managers are interested in increasing the level of production because of the type of incentives. Assuming that operative costs depend on the effort in

On the contrary, no effect is observed about product innovation, since the number of intermediate goods N is fixed. In fact, in this model, a further product differentiation would mean an increase of the N varieties of intermediate goods and then would imply an exogenous rise of the degree of competition. If this occurred, the increased competition in the intermediate sector would induce more innovation for the producers of capital goods, but always in terms of process innovations.

The reasonable conclusion here presented about the innovation choices of managerial firms however departs from a quite contradictory presentation of the internal decision-making process: in fact production decisions (how many units of intermediate good to produce) are taken according to the solution of a profit-maximization problem, while innovation decisions (when to buy the most recent technology) are taken according to the solution of a utility-maximization problem of the managers' objective function. The idea to articulate the decision criteria of a managerial firm in a different way, depending on the type of choice that managers have to adopt, may denote a lack of internal coherence in the construction of the model. Perhaps more consistent conclusions about the behaviour of managerial firms might be reached if both production and innovation decisions were modelled according to a univocal paradigm corresponding to managerial incentives.

6. The Inverted-U Relationship between Competition and Innovation

In this section, we will consider the idea of a step-by-step innovation, as developed in the article by Aghion, Harris, Howitt and Vickers (2001) and presented with the support of the empirical evidence in the paper by Aghion, Bloom, Blundell, Griffith and Howitt (2005). These models modify a basic assumption of the Schumpeterian model introducing a more gradualist idea of the innovation process: the firms with an initially lower technology cannot immediately acquire a technological leadership through innovation, because they firstly have to reach the same level of the firms with the leading-edge technology and only after they can compete in order to achieve the leadership in the industry. This different assumption is sufficient for producing new theoretical results because it changes the incentives which induce the investments of firms in research.

In the models of step-by-step innovation, what really matters for profitability of firms is the technological advantage of a firm compared with the position of the other firms. From this point of view, the markets can be in two different states: if the existing firms have the same technological level, and then they present the same unit costs, this is a neck-and-neck industry; if a firm has a better technology than the other firms, and then it bears lower production costs, this is an unlevelled industry. The type of competition which is considered in the model is an intra-industry competition between duopolists, producers of two goods highly substitutable each other, x_{Aj} and x_{Bj} .

In the production activity, each firm can invest in research in order to reach a higher technological level and then to reduce production costs. In this case, the cost of research in units of labour is equal to:

$$\psi(n) = \frac{\beta n^2}{2} \tag{40}$$

where n is the innovation rate, that is the probability of moving one technological step ahead, measured by a Poisson hazard rate. This function holds both for the leader and for the follower, but also for neck-and-neck firms. In particular, if m is the technological gap between the leader and the follower, n_m (n_{-m}) is the innovation rate for a firm being m steps ahead (behind).

Assuming that firms are owned by households, the equilibrium condition in capital markets is defined by a set of Bellman equations for a leader, for a follower and for neck-and-neck firms. Let explain the general intuition: the annuity value rV (where V is the present discounted value of a firm) must be equal to the effective profit flow of the same firm, measured after subtracting R&D cost, plus the expected capital gain arising when the firm moves one step ahead, less the expected capital loss occurring when the other firm improves its technology by one. Each firm maximizes the Bellman equation in order to choose the appropriate R&D intensity.

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process innovations, a manager wants to reduce marginal cost, such that it is possible to further rise the level of production.

In order to illustrate the working of the model, let consider the case where the maximum technological gap between leader and follower is given by *m=1*, as in the paradigmatic hypothesis presented in the original paper by Aghion, Harris and Vickers (1997). In the one-step case, if the industry is unlevelled, only the follower has incentives to innovate, in order to catch up with the leading-edge technology, while the leader is not willing to undertake any innovation, because the follower would imitate its previous technology and then the gap would always be equal to 1. Otherwise, if the industry is a neck-and-neck one, each firm is interested in innovating in order to obtain the technological leadership in the industry. Given these observations and assuming that $\beta=1$, the Bellman equations can be written as follows:

Leader: $$rV_1 = \pi_1 + n_{-1}\left(V_0 - V_{-1}\right) \tag{41}$$

Follower: $$rV_{-1} = \pi_{-1} + n_{-1}\left(V_0 - V_{-1}\right) - \frac{\left(n_{-1}\right)^2}{2} \tag{42}$$

Neck-and-neck: $$rV_0 = \pi_0 + n_0\left(V_1 - V_0\right) + n_0\left(V_{-1} - V_0\right) + \frac{\left(n_0\right)^2}{2} \tag{43}$$

Substituting the FOC for the follower and for the neck-and-neck firms in the system of Bellman equations and solving the system for n_0 and n_{-1}, we obtain the following results:

$$n_0 = -r + \sqrt{r^2 + 2\left(\pi_1 - \pi_0\right)} \tag{44}$$

$$n_{-1} = -\left(r + n_0\right) + \sqrt{r^2 + n_0^2 + 2\left(\pi_1 - \pi_{-1}\right)} \tag{45}$$

In order to study the effect of an increase of competition on innovation decisions of firms, we use as indicator of competition the value of π_0, that is the profit flow of neck-and-neck firms. In fact, given that they have the same technology and then the same production costs, the duopolists engage a Bertrand competition, where the degree of the competition is denoted by the reduction of price p_j (in fact $p_j = p_{Aj} = p_{Bj}$ must hold in equilibrium) and then by the decrease of profits π_0. For instance, a smaller amount of π_0 means a lower level of collusion between oligopolist firms, and then a higher degree of competition in the market. The different effects of a rise of competition (and then of a decrease of π_0) on innovation can be analyzed by differentiating the innovation rates n_0 and n_{-1} with respect to π_0. In fact:

$$\frac{\partial n_0}{\partial \pi_0} < 0 \quad \text{and} \quad \frac{\partial n_{-1}}{\partial \pi_0} > 0 \tag{46}$$

For a neck-and-neck firm, a decrease of π_0 (because of a stronger competition) implies an increase of R&D intensity: so the firm is induced to invest more in research since post-innovation rents (π_1) are sensibly higher than pre-innovation rents (π_0). In fact, thanks to innovation, a neck-and-neck firm can obtain the technological leadership (escape competition effect). On the contrary, for a follower firm, a decrease of π_0 causes a reduction of R&D intensity: given that in the one-step case a move ahead means the acquisition of the leading-edge technology, and then after innovation the duopolists are neck-and-neck competitors, a diminution of π_0 implies a decrease of post-innovation rents. As a consequence, for a higher degree of competition, the difference between post-innovation rents (π_0) and pre-innovation rents (π_{-1}) is smaller, so the incentives for innovation are weaker (Schumpeterian effect).

In order to analyze the combined result of the two effects for an industry, we are interested in determining the average innovation rate in the steady-state. Let define μ_1 (μ_0) as the steady-state probability of being an unlevelled (neck-and-neck) industry. Since these are the only possible states for an industry, $\mu_0 + \mu_1 = 1$. Then the steady-state equilibrium in this Markov process is given by:

$$2\,\mu_0 n_0 = \mu_1 n_{-1} \tag{47}$$

This means that in the steady state the probability that a neck-and-neck industry becomes an unlevelled one (because one of the duopolists innovates) must be equal to the probability that an unlevelled sector becomes a neck-and-neck one (because the follower innovates). So the average innovation rate is equal to:

$$I = \mu_0\, 2\, n_0 + \mu_1 n_{-1} = \frac{4\, n_0\, n_{-1}}{2\, n_0 + n_{-1}} \tag{48}$$

In order to understand the effect of competition on innovation, we can derive the average innovation rate I with respect to π_0 . But, in this comparative statics exercise, we cannot determine the sign of the derivative, so the effect of competition on innovation is ambiguous. Hence it is necessary to use a graphical representation of the average innovation rate I as a function of the profit level for neck-and-neck firms π_0, that is $I = f(\pi_0)$, substituting the values of n_o and n_{-1}. Then, considering the values of the function $I = f(\pi_0)$ for a domain $\pi_0 \in (0,10)$, figure 1 shows an inverted-U relationship.

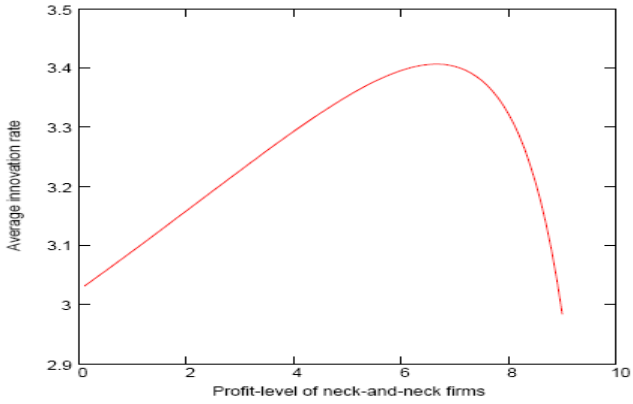

Figure 1. The Inverted U-Relationship between Competition and Innovation
Source: Aghion, Bloom, Blundell, Griffith and Howitt (2005)

As already mentioned, π_0 is a measure of collusion between the duopolists: in fact, for $\pi_0 \to 0$ the collusion is absent, so there is a very high degree of competition; while, for $\pi_0 \to 10$, the collusion is really strong, so there is not any competition at all. For this reason, if we want to observe the effect of competition on innovation, we have to observe the trend of the function from the right to the left.

For a low degree of competition (and then for a high level of collusion), when π_0 decreases the average innovation rate is increasing, because the escape-competition effect prevails: indeed, the firms operating in neck-and-neck industries are induced to invest in research activity, in order to improve their profits thanks to the difference between pre-innovation rents (π_0) and post-innovation rents (π_1). For low levels of competition, the proportion of neck-and-neck industries (or with close technological rivals) is higher, and in fact these are the industries where the escape-competition effect is more relevant.

Instead, for a high degree of competition (and then for a low level of collusion), when π_0 decreases the average innovation rate is decreasing, because the Schumpeterian effect dominates: indeed, the technological followers working in unlevelled industries are discouraged from promoting R&D activity. For high levels of competition, the fraction of unlevelled industries is greater, and in fact these are the industries where the Schumpeterian effect is more significant.

So, for a given industry, the relationship between competition and innovation can be clearly described as an inverted-U relation. But, if we are interested in describing such relationship at an aggregate level, we also have to consider the technological structure of each industry. In other words, we have to know how many industries in the economy are neck – and - neck and how many are

unlevelled: in fact, the overall effect of competition on innovation for the entire economy must be represented as a weighted average of the effects registered for each single industry, on the basis of the technological features of each sector.

Moreover, the fractions of industries belonging to one of the two states are not predetermined but may change over time. In fact, competition can also affect the composition of the economic structure for different industries. In particular, since a stronger competition favours technological innovation comparatively more in the neck-and-neck industries than in the unlevelled industries, then a rise of product market competition may induce the change of many sectors from neck-and-neck industries to unlevelled ones. Then, at the end, the fraction of industries with neck-and-neck firms is decreasing while the proportion of unlevelled industries is increasing: as a consequence, the new composition of industries in the economy implies, for the effect of competition on innovation at an aggregate level, that the Schumpeterian effect will be more relevant than the escape-competition effect. For this reason, especially for high levels of competition, the composition effect reinforces the Schumpeterian effect, in determining a negative relation between competition and innovation.

7. Distance to Frontier, Selection and Growth

At the current state of research, the last important contribution on the topic has been offered in the literature on world technology frontier and economic growth, which has analyzed, both theoretically and empirically, how product market competition and in particular entry deregulation can produce different effects on long-run growth, depending on the position of the country relative to the technological frontier. In particular, a seminal paper in this field is the article by Acemoglu, Aghion and Zilibotti (2006), which proposes a distinction between an investment policy, based on the accumulation of capital and on the imitation of the existing technologies, and an innovation policy, based on the progress at the world technological frontier and on the selection of high-skill entrepreneurs. The main argument of the model is that a growth-maximizing strategy requires the adoption of an investment-based policy for the economies far from the technological frontier and of an innovation-based policy for the countries close to the frontier. In fact, as long as a country presents a low level of technology, it can exploit imitation in order to promote technological improvement; but, as soon as it attains the technological frontier, it cannot take advantage of imitation but it has to support innovation, by investing in research and development, in order to elaborate new ideas and invent new products or improve the quality of the existing ones. In this perspective, the paper also analyzes the issues of political economy related to the transition from one to another growth policy, in order to study how to induce an optimal convergence path towards the world technology frontier.

The model considers an economy with overlapping generations of risk-neutral agents, where each generation consists of two types of individuals: capitalists, endowed with property rights on firms, and workers, gifted with skills. The workers can be employed in production activities, and in this case they have the same productivity, or can act as entrepreneurs, but in this situation they show different skills: more precisely, they are high-skill with a probability λ, and low-skill with a probability $1-\lambda$.

The economy is composed of a final sector and an intermediate one. In the final sector a unique final good is produced, using labour and a continuum one of intermediate goods, according to the following production function:

$$y_t = \frac{1}{\alpha} N_t^{1-\alpha} \left(\int_0^1 \left(A_t(v) \right)^{1-\alpha} x_t(v)^{\alpha} \, dv \right) \tag{49}$$

where N_t is the number of workers employed in production activities, $A_t(v)$ is the productivity in the intermediate sector v and $x_t(v)$ is the amount of intermediate good v used in the production of final good.

In each intermediate sector v, final product is used as input for the production of intermediate goods. Only one firm can exploit the most advanced technology $A_t(v)$ and then it can transform one unit of final product in one unit of intermediate good. The other firms can imitate this technology but they face higher production costs, so they need χ units of final good in order to produce one unit of intermediate good. The parameter χ captures the degree of product market regulation of the economy: the higher is the regulation of entry, the higher the costs for the follower firms. Then the leading firm

sets a price equal to the marginal cost for the follower firms, that is χ. From the solution of the profit maximization problem for a firm producer of final goods, given that $p_t(v)=\chi$, we can derive the equilibrium demand for the intermediate product and then we can write the equilibrium profit for a leading firm in the intermediate sector v:

$$\pi_t(v) = [p_t(v) - 1]x_t = \delta A_t(v) N_t \tag{50}$$

where δ is a measure of the extent of monopoly power by the leading firm and it is equal to:

$$\delta = (\chi - 1)\chi^{-(1/1-\alpha)} \tag{51}$$

Assuming that $\chi \leq 1/\alpha$, δ is increasing in χ, i.e. a higher price implies a higher monopoly power and a lower degree of competition in the market.

Each leading firm has to be managed by an entrepreneur, whose skills are not known at the beginning but are revealed after he works for the first period. Entrepreneurs are involved in two different tasks: adoption of the existing technologies, which doesn't require any particular skill; innovation, which needs high level of skills. After experiencing the entrepreneur's level of skills, the capitalist can decide whether to keep the same manager or whether to hire another entrepreneur. Then, if the entrepreneur has demonstrated high skills, he is retained in order to run large projects. But if the existing manager has displayed low skills, the firm can be interested in taking a young entrepreneur in the second period: in this case, the capitalist could benefit from the eventually higher abilities of the new manager, but he also has to renounce to the investment of the retained earnings of the previous manager. The continuation decision with low-skill entrepreneurs R_t is taken according to the following criteria:

$R_t=0$ if $E_t V_t^*(e = Y) \geq V_t^*(e = O, z = L)$ (52)

$R_t=1$ if $E_t V_t^*(e = Y) < V_t^*(e = O, z = L)$ (53)

That is, the manager is fired if the expected value of the firm run by a young manager is equal or greater than the value of a firm run by an old entrepreneur with low skills (52); otherwise the manager is maintained (53).

Another issue concerning the principal-agent relationship between the capitalist and the entrepreneur is a typical moral hazard problem, due to the imperfect monitoring of the manager's activity by the capitalist. In fact, it is assumed that the entrepreneur is able to divert a fraction μ of the returns for his own use without ever being prosecuted. Then, in order to solve this problem of asymmetric information for the capitalist and to fulfil the incentive compatibility constraint for the entrepreneur, profits must be always shared between the capitalist and the entrepreneur, in such a way that the former takes a share $1-\mu$ and the latter obtains a share μ.

Another decision of the capitalist, which is strictly related to the managerial organization of the firm, regards the size of the projects and then the financing of their execution. The size of the project $s_t(v)$ can assume different values, being equal to $s_t(v)=\sigma<1$ for small projects and to $s_t(v)=1$ for large projects. The projects can be financed in two different ways: either by borrowing from financial intermediaries collecting funds from the consumers, or by investing the retained earnings of the old entrepreneur. Then, if the capitalist chooses to replace the entrepreneur, he has to entirely finance the cost of the project, notwithstanding that in the future he won't be able to get all the profits from his investment, simply because he receives just a share $1-\mu$ of the profits. This implies that, in the case corresponding to $R_t=1$ (termination of the contract with an old low-skill entrepreneur), even if a large project is profitable, the capitalist could not be willing to make such investment and then he could decide to implement a small project: hence, underinvestment can occur in equilibrium. Clearly, the underinvestment problem, due to an appropriability effect, can always affect the decisions of the capitalist: but it assumes more relevance when firms choose young entrepreneurs without previous wealth. For this reason, the capitalist interested in implementing a large project could be induced to

keep the same entrepreneur just in order to obtain the investment of his retained earnings for the project. In this way, the retained earnings can mitigate the underinvestment problem but can also be exploited by old entrepreneurs as a means for shielding themselves from the competition with young managers. So, the investment of retained earnings in part solves the credit issue for large projects, but also reduces selection for managers.

The productivity of each intermediate good v can be expressed as:

$$A_t(v) = s_t(v)\left[\eta \overline{A}_{t-1} + \gamma_t(v) A_{t-1}\right] \tag{54}$$

where $s_t(v)$ indicates the size of the project, η is a constant, $\overline{A}_{t-1}$ is the world technology frontier at time *t-1*, $\gamma_t(v)$ is the skill level of the entrepreneur and A_{t-1} is the average level of technology in the economy at time t-1. In order to implement the project, the entrepreneur can imitate the existing technology from the world frontier $\overline{A}_{t-1}$ or can innovate on the basis of the technology stock A_{t-1} in the economy and using his skill $\gamma_t(v)$. In this way, such equation shows the two alternative ways to promote productivity growth in the intermediate sector *v*.

It is possible to aggregate the values of productivity in each intermediate sector *v* in order to compute the average level of technology in the economy A_t, that is:

$$A_t \equiv \int_0^1 A_t(v) dv \tag{55}$$

Substituting (54) in (55) and dividing A_t by A_{t-1}, the growth rate of aggregate technology is:

$$\frac{A_t}{A_{t-1}} \equiv \frac{\int_0^1 A_t(v) dv}{A_{t-1}} = \int_0^1 s_t(v) \left[\eta \frac{\overline{A}_{t-1}}{A_{t-1}} + \gamma_t(v) \right] dv \tag{56}$$

This equation clearly shows the role of the distance from the technological frontier in determining the choice between investment and innovation. When the economy is far from the frontier, because $\overline{A}_{t-1} >> A_{t-1}$, the major source of productivity growth is due to imitation of well-established technologies. On the contrary, when the country is near to the frontier, since the ratio $\overline{A}_{t-1} / A_{t-1}$ is close to 1, innovation is more important for productivity growth and then it is necessary for the firm to choose high-skill entrepreneurs able to run such innovation process.

Let define the proximity to frontier a_t, that is the inverse of the distance to frontier, as the ratio between the average technology level A_t in a given economy and the world technology frontier $\overline{A}_t$. The world technology frontier $\overline{A}_t$ moves according to the following law of motion:

$$\overline{A}_t = \overline{A}_0 (1+g)^t \tag{57}$$

where g is the aggregate growth rate of technology at the frontier.

The transition from an investment-based policy to an innovation-based policy in an economy is associated to a given value of the proximity to frontier. This threshold can be determined by some institutional settings, such as the degree of product market competition, and then inversely the extent of market power δ of the leading firms in the intermediate sectors. But it is also affected by the measure of appropriability μ of the profits generated by the leading firm. For these reasons such transition value is indicated as $a_r(\mu, \delta)$ and it corresponds to the level of proximity to frontier, such that below this threshold low-skill old entrepreneurs are still retained but above it they are replaced by young entrepreneurs.

Depending on the position of the actual threshold $a_r(\mu, \delta)$ and on the implementation of different institutional settings, the model can present four possible equilibrium. Firstly, the paper presents a growth-maximizing equilibrium, in the case that the actual threshold $a_r(\mu, \delta)$ corresponds to the optimal value for transition $\hat{a}$, as it is determined by the intersection between the two growth path for

R=1 and *R=0*; in such situation (Figure 2), the economy benefits from the highest possible growth rate, because it pursues a strategy of *R=1* for $a_{t-1}<\hat{a}$ and of *R=0* for $a_{t-1}>\hat{a}$.

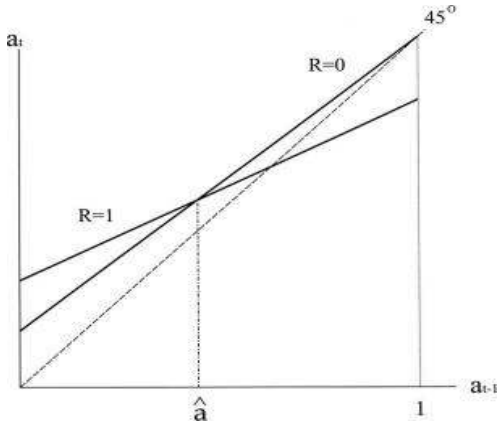

Figure 2. Growth-maximizing equilibrium $\hat{a}=a_r(\mu, \delta)$
Source: Acemoglu, Aghion and Zilibotti (2006)

Secondly, the model shows an underinvestment equilibrium, when $a_r(\mu, \delta)<\hat{a}$: in this situation, small projects are run, because capitalists and entrepreneurs are not willing to invest more due to an appropriability effect (that is, nobody of them is able to get all the profits generated by his investments). In this underinvestment equilibrium, public intervention could be implemented either directly through investment subsidies, or indirectly through a transitory increase of product market regulation, which would imply augmented profits for the existing leading firms: clearly, these interventions should be temporary, in order to avoid distortions in product market and just to induce higher rate of growth only for the considered interval.

Thirdly, a sclerotic equilibrium can arise if $\hat{a}<a_r(\mu, \delta)$ (figure 3): such case is a consequence of a prolonged implementation of an investment strategy, eventually due to a high degree of regulation.

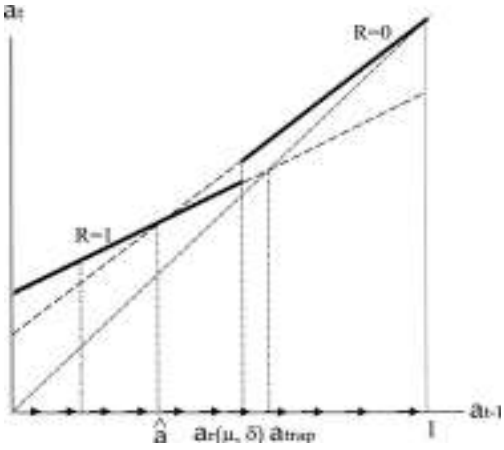

Figure 3. Sclerotic equilibrium $\hat{a}< a_r(\mu, \delta)$
Source: Acemoglu, Aghion and Zilibotti (2006)

Here the retained earnings of the entrepreneurs, as well as the market power of the incumbent firms, delay the transition to a more efficient organizational form, but the economy finally reaches the world technology frontier.

Finally, a non-convergence trap equilibrium occurs when $\hat{a}<a_{trap}< a_r(\mu, \delta)$ (figure 4): in this situation, the protection in favour of incumbent firms is so strong that the economy will never

transition to an innovation-based equilibrium and will never attain the world technology frontier. In a political economy perspective, appropriate institutions are needed, in order to avoid the capture of politicians by special interest groups, interested in low market competition and high profits for the incumbent firms.

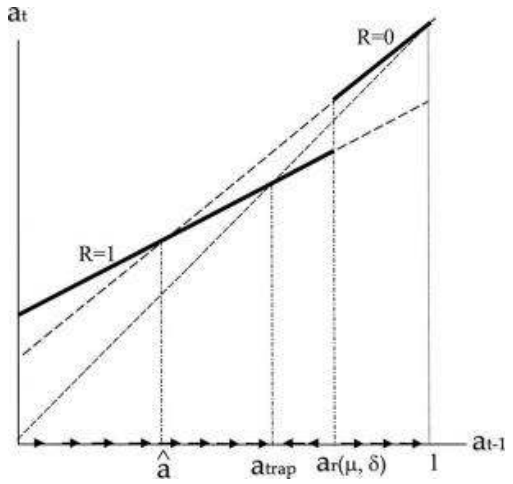

Figure 4. Non-convergence trap equilibrium $\hat{a} < a_{trap} < a_r(\mu, \delta)$
Source: Acemoglu, Aghion and Zilibotti (2006)

The existence of much possible equilibrium for economic growth shows that the results of this model can suggest a new theory of leapfrogging, able to explain the different performances of some economies in terms of technological progress. While the step-by-step assumption suggests that an initially backward economy must before adopt the leading-edge technology and only after can achieve a technological leadership, the leapfrogging paradigm admits that a previously backward economy is able, thanks to innovation, to suddenly get over the existing frontier and to develop directly a higher level of technology.

Just to give an idea, let consider the case that two countries with the initial level of technology pursue two different growth paths: country A follows an investment-based strategy, also supported by some measures of anticompetitive policy, while country B adopts an innovation-based approach and keeps it for all the time. In the initial period, A can experience higher growth rates than B, thanks to the adoption of the existing technologies. But in the second period, B can exploit the innovations generated thanks to the R&D activity and then obtain a higher technological progress and achieve a more sustained growth, while A experiences lower growth rates and finally reaches a non-convergence trap.

The description of the transition path towards the world technology frontier and the indication of some policy interventions aimed at promoting higher growth rates also introduce some political economy observations regarding the implementation of these actions by the governments. In particular, the paper discusses the implications of those policies designed to increase the level of investments and to encourage the adoption of technology for the countries far from the frontier. Even if investment subsidies are the most direct instruments to face underinvestment issues, they are difficult to implement in relatively backward economies and then an alternative solution is given by regulatory policies in favour of the incumbent firms, such to increase their profits and to stimulate their investments in technology adoption. But, given that these policies may have negative effects in the long-run, potentially favouring non-convergence traps, it is important to ensure that they are really limited to a transitory period and that the pressures of interest groups don't influence the timing of their implementation. The issue arises because the anticompetitive policies which increase the barriers to entry for some protected industries also augment the economic power of such incumbents. Then these groups of old capitalists could exploit it in order to exert some pressures aimed at obtaining a longer duration or a permanent implementation of such anticompetitive measures, then contradicting

the temporary purposes of the initial intervention. So the political economy problem discussed in the last part of the paper is how to avoid that enriched interest groups, through lobbying and bribery, may capture politicians in order to obtain the adoption of anticompetitive policies.

Assuming that capitalists are willing to pay the revenues obtained in the first period in order to increase their monopoly power, they will be successful in bribing politicians if the amount of money paid to them is equal or higher than the pay-off that the politicians would obtain by behaving honestly. Supposing that this pay-off is an increasing function of the average technology level in the previous time, and then is given by $h\,A_{t-1}$, the condition which expresses this case is:

$$\delta_{t-1}(1-\mu)\sigma N\left(\eta+\lambda\gamma a_{t-1}\right)\geq ha_{t-1} \tag{58}$$

where the LHS indicates the earnings of the firm in the period t-1, while the RHS denotes the pay-off of the honest politician. So, at the end, the success of this pressure depends on the amount of money that the capitalist is able to offer to the politicians, and then on the total earnings that he can get during the first period. And this amount is larger when δ_{t-1} is higher, that is when the market power of the incumbent firms is stronger, given that this also implies the realization of richer profits.

In this framework, politicians have to choose the degree of product market regulation χ_t within an interval $\chi_t\in\left[\underline{\chi},\overline{\chi}\right]$, and consequently they determine the extent of market power of the incumbents δ_t within an interval $\delta_t\in\left[\underline{\delta},\overline{\delta}\right]$. When $\delta_t=\overline{\delta}$ (lowest degree of competition), the condition (58) for successful bribing is satisfied as an equality for a value of the proximity to frontier corresponding to a_L: this means that capitalists will manage to bribe politicians as long as $a_{t-1}\leq a_L$. At the same time, when $\delta_t=\underline{\delta}$ (highest degree of competition), a_H is the value of the distance to frontier for which condition (58) is satisfied as an equality: this means that capitalists will successfully corrupt politicians as long as $a_{t-1}\leq a_H$. As already observed, the old capitalists can exert a stronger pressure on politicians for lower levels of product market competition: this implies that $a_L>a_H$, since in such case they can obtain the desired policy outcome also for higher values of the proximity to frontier.

On the basis of these premises, we can distinguish three possible cases for the outcomes of the political lobbying by old capitalists. If $a_0<a_H$, that is when the starting point of the economy is very far from the world technological frontier, the capitalists can easily induce politicians to implement an anticompetitive policy: this strategy will ensure growth until the economy reaches a non-convergence trap, then such situation displays a political economy trap. If $a_0>a_L$, when the economy is close to technological frontier, the capitalists don't have enough funds to bribe politicians: then, as implied by the technological structure of the economy, a procompetitive policy is implemented in order to enhance innovation. Finally, when $a_0\in\left(a_H,a_L\right)$, the outcome depends on the initial level of competition: in fact, if $\delta_{t-1}=\overline{\delta}$, the capitalists of the incumbent firms, benefiting from strict product market regulation, obtain high monopoly profits and then can successfully bribe politicians; while, if $\delta_{t-1}=\underline{\delta}$, the low profits due to the highly competitive environment don't permit the old capitalists to exert a significant pressure on politicians and then a competitive policy leading the economy to the technology frontier is implemented.

The extension of the growth model to such political economy considerations allows us to identify a multiplicity of steady state political equilibrium: one consists in the implementation of a competitive policy and ensures that the economy will achieve the world technology frontier; the other, based on an investment policy, displays a political economy trap and excludes convergence to the frontier.

8. Conclusions and Perspectives for Further Research

The review of the previous models of endogenous growth is useful for drawing some conclusions about further and possible developments of research on the relation between product market competition and economic growth.

In fact, the discussed models present different results about the sign and the magnitude of the relation: while the basic Romerian model of endogenous growth predicts a positive relationship between competition and growth, the basic Schumpeterian model indicates a negative relation between

those variables. The subsequent variants of the first and of the second model add some important extensions, more consistent with the observation of real world, but in general they don't offer a clear and definitive solution for the theoretical analysis of the topic. Anyway, a comparison between the different approaches shows an analytical superiority of the models based on vertical innovation over the models of horizontal innovation. In general, the models with expanding product varieties don't suggest an exhaustive solution to the problem, both for an excessive importance of the exogenous parameters in the determination of the final results, and for the existence of scale effects depending on the amount of labour force. On the contrary, the models with increasing product quality present a more rigorous explanation of the innovation process as endogenously determined by the decisions of firms interested in obtaining the appropriate reward for innovation. This is the reason why the models with vertical innovation are probably more appropriate to form a future basis for further perspectives of research on the issue.

In any case, independently from the previous observation, the presentation of the models makes evidence of two main problems which arise in the theoretical analysis of the relationship between competition and growth.

The first issue regards the difficulty of introducing a market structure consideration in a macroeconomic model of endogenous growth: in fact it is necessary to identify an appropriate indicator of competition which allows us to derive some clear conclusions about the type of relation observable at aggregate level. Even if the majority of these models uses the Lerner Index as a measure of market power in a market characterized by the dominance of a monopolistic firm, some analysis take into account the substitutability between differentiated products in a market with monopolistic competition, while other works employ the profit level of duopolistic firms in neck-and-neck industries as an indicator of the degree of collusion in oligopoly markets. The variety of possible indicators is also the proof of the numerous market situations to be considered and then also the demonstration that a unique measure of competition is not enough for satisfying the complexity of the possible market structures in the real world.

The second problem concerns the empirical verifiability of the results obtained in these models: in fact the applied literature on competition and growth often propose conclusions which are opposite to the results derived in some theoretical models, especially in the case of the basic Schumpeterian model of endogenous growth. But, even when the results of the empirical analysis are analogous to those ones of the theoretical studies, as it occurs for the models based on horizontal innovation or for the second-generation models of vertical innovation, the applied outcomes show some aspects of complexity, which are not fully captured by the analytical models. For example, while empirical studies are conducted by distinguishing the specific features of the various industries, for example through panel data analysis with industry effects, analytical models tend to adopt univocal conclusions for the aggregate economy, although the effects of competition on growth can be different in sign and magnitude depending on the particular needs of each industry.

So, in order to develop this idea about the distinction between industries, a reasonable approach could be to study the relation between competition and growth by differentiating the effects for various types of industries. But, in order to develop this research line, we need to identify the elements that distinguish industries from the viewpoint of the innovation decisions. In this perspective, the new models of endogenous growth, both the one on the inverted U relationship between competition and innovation, and the one on the impact of the distance to frontier on growth, provide some reasonable solutions in order to explain the effect of competition on productivity growth: in fact, they distinguish the effects depending on the initial level of competition as well as on the proximity of the economy to the world technological frontier.

In particular, a useful approach is proposed in the paper by Aghion, Bloom, Blundell, Griffith and Howitt (2005), where the distinction between neck-and-neck industries and unlevelled industries is used in order to derive different conclusions about the relation between competition and growth. This classification is based on the technological structure of an industry and then on a comparison regarding the technology level reached by each firm in the industry: so the willingness to invest in research depends on the position of each firm and on the distribution of the other firms in an innovation scale. Moreover this article suggest an interesting way to aggregate these separate results through the solution of a Markov process aimed at determining the fixed fractions of the two types of industry in the steady state and then at computing an average innovation rate.

The other possible distinction is suggested in the article by Acemoglu, Aghion and Zilibotti (2006), where the distance to the world technology frontier is determinant for choosing the optimal growth policy for a country. In fact, while a country far from the world technology frontier should adopt a strategy based on an investment policy, on the contrary a country close to technology frontier ought to implement a selection-based growth policy, through the elimination of all the entry barriers. As clarified by the authors, this reasoning about technology frontier, originally considered for a cross-country comparison, can be extended to a cross-industry comparison, then suggesting that the organization of production should be different in industries which are closer to technology frontier.

Both the solutions proposed in the cited papers use the technological structure of an industry, defined either as the distribution of the technology levels across firms or as the distance of the industry from the technology frontier, as the distinctive criterion for explaining the different effects of competition on growth. In both cases the technology level is relevant for determining the production costs, given that the firm which has access to the leading-edge technology can produce the output more efficiently, with lower production costs, and then it has a higher profit than the other firms.

Finally, an important progress can be noticed in the recent literature regarding the notion of competition, since new attention has been paid to the idea of potential competition, which could be enhanced through the abolition of the previous barriers to entry. This choice acquires a lot of importance for its policy implications, in particular in the European case. In fact, the practice of competition authorities until now has focused more on competition among incumbent firms, rather than on entry in the market. This literature now suggests that the threat of entry by new firms can play a very important role in inducing incentives for innovation among the incumbent firms. So, the conclusions of these models can provide some guidelines in order to design the appropriate growth policies that should be promoted in Europe in order to promote technological progress and to tackle the issue of the productivity slowdown observed in the last two decades.

9. Acknowledgements

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BUSINESS INTELLIGENCE AS A SUPPORT OF E-COMMERCE SYSTEMS IN CONNECTION WITH DECISION MAKING AND CROSS-BORDER ONLINE SHOPPING

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Abstract:
Recent business development in connection with the present state of world economy evokes the managers to make alterations in their decision making. Companies´ managements can make right decisions only with the aid of current and precision information. In addition, managers have to get all information in time. Decision-making processes should be realized quickly and under the strong thumb of a competitive environment. Some years ago, for the support of top level of management, information systems development was oriented to decision support systems (DSS). On the present, decision support systems development is transformed to development of business intelligence (BI) systems. Business intelligence technologies provide historical, current, and predictive views of business operations. In business intelligence, described views are represented by reporting, ad-hoc reporting, OLAP analysis etc. With the aid of business intelligence systems development, managers have more possibilities to choose types and structures of information. This article deals with business intelligence systems development in connection with the e-commerce systems, cross-border online shopping and business companies´ management needs.

Keywords: e-commerce system, online shopping, customer requirements, management needs, business intelligence, reporting.

JEL Classification: C87, C88, F43, F47, L21, M15, M16, M21, O31, O33, Q55.

1. Introduction

Electronic Commerce or e-commerce is the trade of products and services by means of the Internet or other computer networks. E-commerce is expected to influence a wide range of supply chain systems and thus lead to unidentified environmental impacts. E-commerce provides customers with a platform to search product information through global markets with a wider range of choices, which makes comparison and evaluation easier and more efficient. Although number of Europeans and world shopping on-line grow up, there are a high percentage of unsuccessfully business transactions in foreign internet shops. Business environment and its development in connection with a present state of world economy urge managers to look for new methods and procedures lowering financial charges especially in the sphere of ancillary processes. Many companies have to redefine some internal and external processes and IS/IT architecture and in many cases companies have to use support of internal functions with help of external resources (outsourcing). Managers can make right decision only if they get precision information in a required form in right time. To this goal, recent development of information systems is oriented to business intelligence. Business intelligence is rapidly becoming a major source to achieve competitive advantage and often aims to support better business decision-making, among others, in the sphere of e-commerce (online shopping).

2. E-commerce statistics and the Supposed Development

There were and there are many forecasts concerning of e-commerce, especially online shopping. Jaap Favier in 2006 forecasted that in the coming five years, the number of Europeans online shopping will grow from 100 million to 174 million. Their average yearly net retail spending will grow from around €1,000 to €1,500, as UK Net consumers outspend even their US counterparts online. Overall, this will cause European e-commerce to surge to €263 billion in 2011, with travel, clothes, groceries, and consumer electronics all above the €10 billion per year mark. (Favier 2006) The other forecast says that in concordance to a recent report from eMarketer, e-commerce in Europe will reach 323 billion Euros ($407 billion) by 2011. That is an average 25% growth rate each year from 2007 to 2011. Italy, Spain and the Netherlands will growth to be a large force for European e-commerce hubs between 2007 and 2011. However Eastern European countries - Russia, Poland and the Czech

Republic - won't impact online shopping hubs until well into the 2010 decade according to eMarketer researchers. (Knight 2007)

All the forecasts are differentiated in terms of numbers, but the same in terms of e-commerce purchase's continuous increasing. The statistics and expectations presented herein above can be documented by data presented by Czech Statistic Authority and other Statistic Offices in different countries recently.

Already 150 million consumers shop online, although only 30 million shop online cross-border. Cross-border e-commerce systems development depends on globalization of the world economy. The globalization of the world economy is characterized by a huge amplification of the interconnections collaborations and interdependencies between the national states generated from the tendency of the economical objectives and interests to exceed the national borders. (Radescu 2008) A big sense for the cross-border online shopping development has also sequential financial integration. (Mirdala 2008) Report on cross-border e-commerce show problems with the business transactions in foreign internet shops.

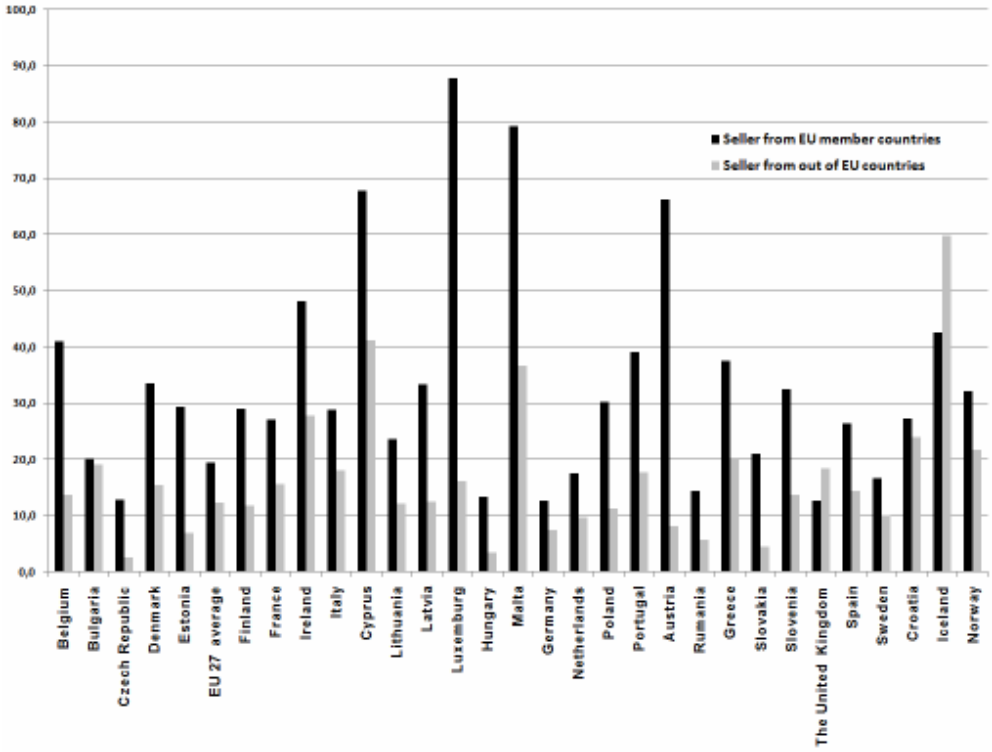

Figure 1. Cross-border online shopping in EU member countries.
Source: Czech statistical office, 2009 and EUROSTAT, 2009.

In terms of member states of European Union, almost 20 % of the all online shoppers buy in foreign e-shops. 13 % online shoppers (from member country of EU) buy goods in e-shops from countries out of EU. (Figure 1) Research results show that 60 % of attempts to buy products in foreign internet shops are failure. Reason is that businessmen for various reasons do not offer the goods into the some countries and in many cases there are some problems with payments systems. The biggest problems with the cross-border online shopping in out of EU countries have people in Bulgaria, Rumania, Latvia, Malta and Belgium. The smallest problems in the sphere of cross-border online shopping have people in Austria and Spain. (EURACTIVE 2009)

One of the barriers to cross-border online trade is language proficiency. 33% of EU consumers say they are willing to purchase goods and services in another language, while 59% of retailers are prepared to carry out transactions in more than one language.

Although there are some problems at present, we can suppose changes which will lead to takeoff a cross-border online shopping development. This predication is supported by:

- next development of information technologies,
- foreing business markets opening off,
- currency unification (the euro adpotting),
- payment systems development,
- co-ordination of business activities at the level of supranational bodies,
- the improving of language proficiency.

Regarding to the current worldwide economic conditions, rapid development in the sphere of internet online shopping in Far East, above all in China and India, can be supposed. This presumption is supported, among others, by the economic development and development of world internet users. Towards the end of the year 2009, there are approximately 1 733 993 742 world internet users, from that 338 000 000 in China. (IMRWORLD 2009) Rightly China´s, India´s and other Asiatic countries´ markets will offer a big business potential in future. Contemporary software producers prepare for this fact and a great number of software contain Chinese and other Asiatic countries´ languages support.

3. E-commerce systems

E-commerce systems are fundamental aids of online shopping. Generally and simply, e-commerce system can be defined as web server linked by company´s information system. Detailed definition of e-commerce system appears from definition of information system. (Figure 2)

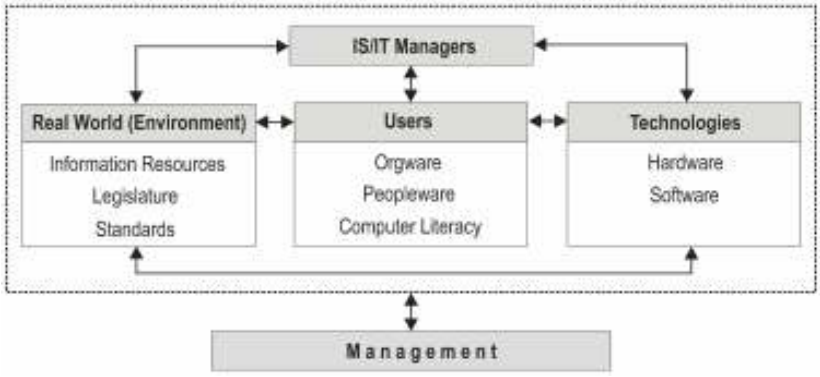

Figure 2. Common components of information systems.

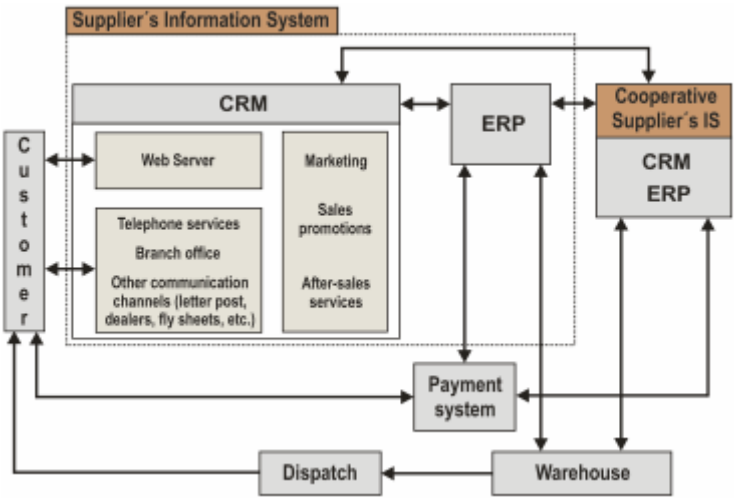

Figure 3. E-commerce system.

E-commerce system is about combining of several parts (Figure 3):

- customers,
- suppliers (sellers, dealers, producers, businessmen),

- web server,
- information system (ERP, CRM, database system),
- payment system,
- dispatch system,
- legislature.

E-commerce systems are developed for support of business activities. Customers have requirements and managers have to find of such ways, methods and resources to satisfy customer requirements and needs. A great emphasis has to be aimed at all management systems. In the sphere of e-commerce there are CRM (Customer Relationship Management), SCM (Supply Chain Management), FRM (Financial Resource Management), HRM (Human Resource Management), MRP (Manufacturing Resource Planning) and CPM (Composite Product Mapping).

ERP is suitable for global operations as it encompasses all the domestic jargons, currency conversions, diverse accounting standards, and multilingual facilities. ERP software attempts to integrate business processes across departments onto a single enterprise-wide information system. The major benefits of ERP are improved coordination across functional departments and increased efficiencies of doing business. The goal of CRM is to collect information gained by doing business in a central repository, analyze it, and make it available to all departments. In many cases, CRM are integrated into ERP, but it is not the rule.

CRM and ERP benefits can be measured and quantified. With usage of ERP, company can gain following benefits:

- improve alignment of strategies and operations,
- improve productivity and insight,
- reduce costs through increased flexibility,
- support changing industry requirements,
- reduce risk,
- improve financial management and corporate governance,
- optimize IT spending,
- gain higher ROI (Return on Investment) faster,
- retain top performers,
- provide immediate access to enterprise information.

A major benefit of CRM can be the development of better relations with the existing and new customers, which can lead to:

- increased sales through better timing due to anticipating needs based on historic trends,
- identifying needs more effectively by understanding specific customer requirements,
- cross-selling of other products by highlighting and suggesting alternatives or enhancements,
- identifying which of your customers are profitable and which are not.

The condition of an entry to global markets is an adjustment of the information system to global information and business system management standards. Management standards are defined for three basic sectors which are customer relationship management, supply management and operating management. These sectors can be further refined into information system management, business processes management, management of logistics and production logistics, management of human resources, legal rules in relation to international law etc. (Vymětal and Suchánek 2009)

Payment systems are often ones of the problem area of e-commerce especially in context of cross-border online shopping. There are numerous different payments systems available for online merchants. These include the traditional credit, debit and charge card but also new technologies such as digital-wallets, e-cash, mobile payment, e-checks, cash on delivery. To support of the cross-border online shopping development, it is necessary to provide the customers safe payment environment and to give support to international bank clearing.

Dispatch is supported and controlled by SCM. SCM is the oversight of materials, information, and finances as they move in a process from supplier to manufacturer to wholesaler to retailer to consumer. Supply chain management involves coordinating and integrating these flows both within and among companies. Supply-chain management, at least in the largest multi-national corporations, is a global endeavor. (Murillo 2001)

Like every area of business these days, ecommerce is surrounded by a maze of red tape, rules and regulations. In fact, selling online tends to be worse because of the international dimension. On

the one hand, legislature can help to online shopping and cross-border online shopping, on the other hand can scant e-commerce development.

4. Customer Requirements and Management Needs

In terms of e-commerce, customer requirements can be separated up two groups. The first group of customer requirements result from exploitation of IS/IT as the main technological support of e-business and e-commerce environment. In 2003, ANEC Policy Statement on Design for All called upon the standard- makers to take the following generic consumer requirements into account when designing, selecting, commissioning, modifying and standardizing ICT systems. Requirements for IS/IT were summarized as accessibility/design for all, adaptability, child safety issues, comprehensible standards, consistent user interface, cost transparency, easily adaptable access and content control, ease of use, environmental issues, error tolerance and system stability, explorability, functionality of solution, health and safety issues, information supply for first-time user set-up procedure, interoperability and compatibility, multi-cultural and multi-lingual aspects, provision of system status information, privacy and security of information, quality of service, system reliability and durability, rating and grading systems, reliability of information, terminology. (ANEC 2005)

The second group of customer requirements is closely associated with business transactions. Customers want to find what they want easily and in short time, to get sufficient number of information, to place an order easily, payment system to be secured and failsafe, to get goods in quality of service and in short time, goods to be guaranteed by sellers (producers) and to get benefits in dependence on a number of purchases.

To be reliable in an uncertain and changing environment, firms must be able to quickly respond to changes. To obtain it, managements need actual information. The most important condition of customer satisfaction is feedback. Suppliers and producers have to monitor market environment and all have to be targeted the customers. All customer requirements have to be monitored for ever and company information system with the all company´ processes have to be formed to ensure quality and rapid processing of the all customer feedback information, needs and requirements. Feedback information can be getting by the communication channels which are usually integrated in CRM (Customer Relationship Management). Feedback is the most important condition of getting information. If managers want to satisfy all customer requirements, they should: get precision information, get information in time, get information in required form, get information in visual form, know information what do they want to,

Besides information managers need:

- to develop the ability to apply information technology in complex and sustained situations and to understand the consequences of doing so,
- to learn the foundations on which information technology and applications are built
- and current or contemporary skills.

5. Business Intelligence

Business Intelligence is a term that refers to the sum total, or effect, of gathering and processing data, building rich and relevant information, and feeding it back into daily operations so that managers can make timely, effective decisions and better plans for the future. Generally business intelligence brings to managers a quite number of advantages. The advantages enjoyed by market leaders and made possible by business intelligence include the high responsiveness of the company to the needs of its customers, recognition of customer needs, ability to act on market changes, optimization of operations, cost-effectiveness, quality analysis as the basis for future projections, the best possible utilization of resources etc.

Business intelligence is oriented to management needs and decision making support. Optimal setting of control processes is a prerequisite of the planned and expected aims. A business processes are the collections of activities designed to produce a specific output for a particular customer or market. It implies a strong emphasis on how the work is done within and organization, in contrast to a product's focus on what.

To do right decisions, managers need information. Data that is relevant to a business decision may come from anywhere. The most important sources of data include:

▪ **Master data -** this is data that is collected (usually once and once only) to define the entities in an e-business system (customer file, product file, account codes, pricing codes, etc...). Scores of the time we can meet with term of Master Data Management (MDM). MDM comprises a set of processes and tools that consistently defines and manages the non-transactional data entities of an organization (which may include reference data). (WIKIPEDIA 2009)

▪ **Configuration data -** as the term implies this is data that defines the nature of the system itself. The system is configured to reflect the nature and needs of the business.

▪ **Operations data (OLTP - Online transaction processing) -** also known as activity this data is generated by daily business activities such as sales orders, purchase orders, invoices, accounting entries, and so on. OLTP refers to a class of systems that facilitate and manage transaction-oriented applications, typically for data entry and retrieval transaction processing.

▪ **Information systems (OLAP - Online analytical processing) -** these are sophisticated applications that collect information from various internal and external sources to analyze data and distill meaningful information. OLAP software allows for the real-time analysis of data stored in a database. The OLAP server is normally a separate component that contains specialized algorithms and indexing tools to efficiently process data mining tasks with minimal impact on database performance.

Almost all requisite data for the decision making support in e-commerce comes from CRM and ERP systems. Business intelligence is closely related to data warehousing. Data has to be processed (data selection, data analysis, data clearing etc.) and send in right time and in required form to the competent persons usually act in management system. (Figure 4) Obtained data are basis of decision making support at all levels and kinds of management.

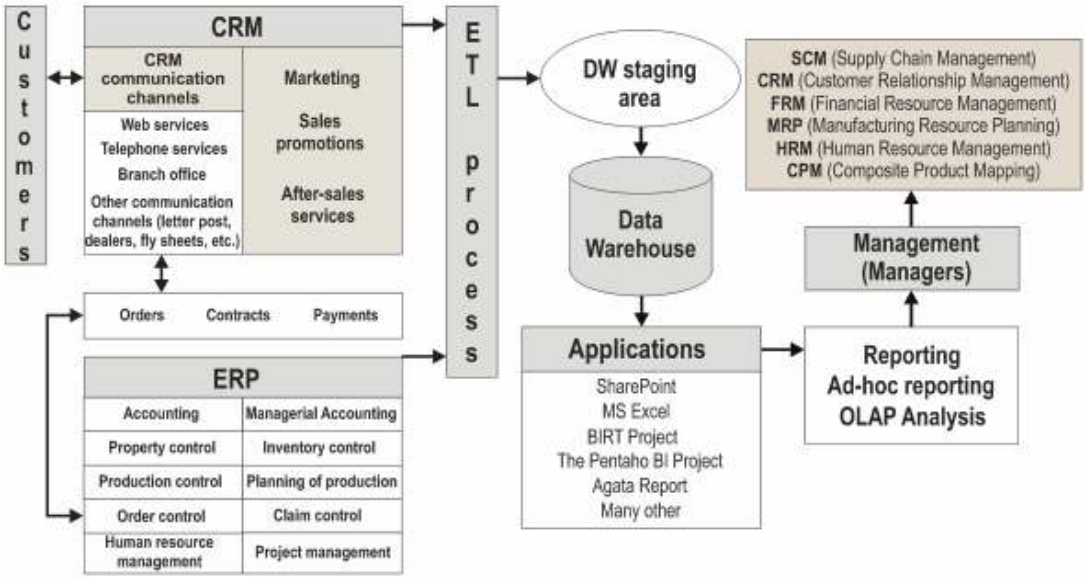

Figure 4. Business intelligence system.

Data processing is support by ETL (Extraction, Transformation and Loading). The ETL process is also very often referred to as Data Integration process and ETL tool as a Data Integration platform. The terms closely related to and managed by ETL processes are: data migration, data management, data cleansing, data synchronization and data consolidation. (ETL-TOOLS.INFO 2009)

The purpose of the Data Warehouse in the overall Data Warehousing Architecture is to integrate corporate data. Data warehousing evolved through 1990s to environments that typically featured batch-oriented "stocking" and "restocking" of the data warehouse, primarily for purposes of after-the-fact reporting and analysis. (Simon and Shaffer 2001) The amount of data in the data warehouse is massive. Data is stored at a very granular level of detail. For example, every sale that has ever occurred in the organization is recorded and related to dimensions of interest. This allows data to be sliced and diced, summed and grouped in unimaginable ways. Recent technological advancements in

data warehousing have been contributing to the emergence of business intelligence useful for managerial decision making. (Taniar 2009)

Applications what can be for example SharePoint, MS Excel, BIRT Project, The Pentaho BI Project, Agata Report and many other (some of applications can be interconnected) are fundamental interface between system and managers. With the aid of shown application users can choose and manipulate a wide variety of visual representations, including map-based data displays to review business intelligence reporting results geographically, multidimensional scatter plots to view data statistically, and bar charts, pie charts, line graphs, profile charts and more.

At present, when the world economic conditions are not affable, companies look for all information which would help them to start economic growth. In this respect e-commerce companies have recently started to capture data on the social interaction between consumers in their websites, with the potential objective of understanding and leveraging social influence in customers' purchase decision making to improve customer relationship management and increase sales. (Young and Srivastava 2007)

Business intelligence systems are able to provide the managers quite a number of statistics dealing with customers and their environment. As important customer statistics can be considered, for example, matching sales revenues with site visitor activity, by week and month, in total and by product line, matching weekly and monthly sales with site visitor activity over time (trend analysis), in total and by product line, matching sales revenues with site visitor activity, by day and hour, in total and by product line (to measure the effectiveness of advertising campaigns), matching sales revenues with site visitor activity from main referrers, by week and month, in total and by product line. Where the referrer is a search engine, also matching the search query with sales revenues. (INTERNET MARKETING ENGINE 2008) These statistics respond the managers to questions:

- Who did buy?
- How much did they buy?
- When did they buy?
- What did they buy?
- From where customer arrived at the site?
- In which region customer are located?
- How they arrived at the site (e.g. by what search engine query)?
- From which page customer entered the site?
- Their path through the site?
- From which page customer left the site?
- On a weekly and monthly basis and the trends, over time.

Advantages and benefits of business intelligence in the sphere of e-commerce can be summarized as:

- Business intelligence gives any firm the specific view of corporate data that is required for progress (quickly access sales, product and organizational data in any database).
- In sales and marketing, business intelligence offers new tools for understanding customers' needs and responding to market opportunities
- By providing financial planners with immediate access to real-time data, Business Intelligence builds new value into all financial operations including budgeting & forecasting.
- Business intelligence supports decision-making with automatic alerts and automatically refreshed data.
- Business intelligence provides performance monitoring for accelerated action and decision making.
- Business intelligence makes companies possible to receive and process data from cross-border business activities (above all from cross-border online shopping).
- Business intelligence can bring to companies competitive advantage.

Besides data from business intelligence systems, companies can use services of the consultation companies. There are many consultation companies providing information and doing analyses. Correct source information are necessary, but usually have to be paid for. There are many sources providing statistical data on the Internet, but these are usually not adequate. Managers can acquire correct information from the many sources. (Molnár 2009) Following sources supply the attested information usable for manager's decision making in the global markets. Foreign stock market information can be

found on (*for example*): http://www.bloomberg.com, http://www.dowjones.com, http://www.nyse.com,, http://www.nasdaq.com, http://www.reuters.com, http://money.cnn.com, http://www.imrworld.org/, http://finance.yahoo.com/, http://www.marketwatch.com/, http://www.indiainfoline.com/. Marketing information can be found on (for example): http://www.formacompany.ie), http://reports.mintel.com/, http://www.eiu.com, http://www.frost.com, http://www.adlittle.com, http://www.datamonitor.com, http://www.euromonitor.com/. Law and legislative information can be found on (for example): http://www.iblc.com/home/, http://www.iblc.com/, http://www.ibls.com/, http://www.enterweb.org/law.htm, http://euro.ecom.cmu.edu/resources/elibrary/ecllinks.shtml.

6. Conclusions

E-commerce is one of the most important facets of the Internet. E-commerce brings benefits to organizations that use this with their business partners, to customers and generally to society. Besides quite a number of benefits, e-commerce fumbles with some problems. One of them is a problem with cross-border online shopping. Reason is that businessmen for various reasons do not offer the goods into the some countries and in many cases there are some problems with payments systems. Although there are some problems at present, we can suppose changes which will lead to takeoff a cross-border online shopping development. Regarding to the current worldwide economic conditions, rapid development in the sphere of internet online shopping in Far East, above all in China and India, can be supposed. Rightly China´s, India´s and other Asiatic countries´ markets will offer a big business potential in future. Hence, it is necessary to understand the development of e-commerce and its future trends. Contemporary software producers prepare for this fact and a great number of software contain Chinese and other Asiatic countries language support. The present state of world economy requires searching for new methods and procedures in support of decision making. Suppliers and producers have to monitor market environment and all have to be targeted the customers. All customer requirements have to be monitored for ever and company information system with the all company´ processes have to be formed to ensure quality and rapid processing of the all customer feedback information, needs and requirements. In this respect, managers have to get right information in right time. Recent development in the sphere of data processing is oriented to business intelligence. Business intelligence systems are able to provide the managers quite a number of statistics dealing with customers and their environment. Generally, Business Intelligence solutions are necessary for any company to keep up with the competition brought on by changing, trends and technologies and the freely available information waiting to be used. Target information help managers in decision making. Besides information from business intelligence systems, there are many consultation companies providing information and doing analyses.

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