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Table of Contents

GROWTH AND COMPETITION IN A MODEL OF HUMAN CAPITAL ACCUMULATION AND RESEARCH

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Abstract:

The aim of this paper is to analyze the relationship between competition and growth in a model of human capital accumulation and research by disentangling the monopolistic mark-up in the intermediate goods sector and the returns to specialization in order to have a better measure of competition. We find that the steady-state output growth rate depends on the parameters describing preferences, human capital accumulation technology and R&D activity. We also show that the relationship between competition and growth is inverse U shaped. This result that seems to be in line these empirical results (Aghion and Griffith, (2005)) is explained by the resource allocation effect.

Keywords: endogenous growth, horizontal differentiation, technological change, imperfect competition, human capital

JEL Classification: D43, J24, L16, 031, 041

1. Introduction

Economists have long been interested in the relationship between competition and growth, but economic theory seems to be contradicted by the evidence. Indeed, the most important growth models in which there exists an imperfect competition show a decreasing relationship between competition and growth [Romer, (1990), Grossman and Helpman, (1991) and Aghion and Howitt, (1992)]. However, a recent empirical work (Aghion and Griffith, (2005)) which disputes the form of this relationship, finds an inverted-U relationship between competition and growth that is robust to many alternative specifications and remains true in the data for many individual industries. In order to reconcile theory with evidence, Aghion and Griffith (2005) and Bucci (2005a) extend the basic Schumpeterian endogenous growth model. Aghion and Griffith (2005) introduce an escape competition effect in the Aghion and Howitt (1992) model whereas Bucci (2005a) introduces an resource allocation effect in the Romer (1990) model.

On the other hand, recent theoretical works analyze the relationship between R&D investment and human capital accumulation and its impact on growth [(Ziesemer, (1991); Eicher, (1996); Redding, (1996); Arnold, (1998); Blackburn *et al.* (2000); Sjögren, (1998) and Llyod-Ellis and Roberts (2002))]. However, all these studies don't focus on the effect of competition on growth. More recently, Bucci (2003) focuses explicitly on the relationship between competition and growth.

The purpose of this paper is to extend these works. Indeed, contrary to all these models, first, by following Benassy (1998) and Bianco (2006), we introduce a distinction between the returns to specialization and the market power parameter which allows us to have a better measure of the competition. Indeed, in our model the market power parameter is not strongly related to the returns to specialization but it is completely independent. Secondly, unlike Bucci (2003), we introduce two different assumptions concerning the knowledge accumulation. In a first time, the degree of R&D difficulty in the sense that higher values of skilled labor force require more skilled labor allocated in the research sector to achieve the same level of the growth rate of knowledge, is assumed. In the second time, by introducing an externality of knowledge, we introduce the possibility to have two sources of growth, human capital and innovation, unlike Bucci (2003) who assumes only one source of growth, human capital.

Our paper is structured as follows. Section 2 presents our model. Section 3 analyses the market equilibrium. Section 4 discusses the relationship between competition and growth in a general case. Finally, section 5 concludes.

2. The model

The model developed is based on Bucci (2003)[1] model in which we disentangle the returns to specialization from the market power. The economy is structured by three sectors: final good sector, intermediate goods sector and R&D sector.

2.1. The final good sector

In this sector atomistic producers engage in perfect competition. The final good sector produces a composite good Y by using all the j_{th} type of intermediate goods x_j and skilled labor H_Y[2]. Production is given by:

$$Y = AH_Y^{1-\alpha} n^{\gamma-1+\alpha} \int_0^n x_j^\alpha dj \,, \tag{1}$$

Where: α and $\gamma \in \,]0,1[$ and A are technological parameters.

This production function allows us to disentangle the degree of market power of monopolistic competitors in the intermediate sector ($\frac{1}{\alpha} - 1$) and the degree of returns from specialization γ[3]. In this sense, this model is a generalization of the Bucci (2003) and the Arnold (1998) models[4]. Under perfect competition in the final output market and the factor inputs markets, the representative firm chooses intermediate goods and skilled labor in order to maximize its profit taking prices as given and subject to its technological constraint. The first order conditions are the followings:

$$\frac{\partial \pi_Y}{\partial x_j} = \alpha AH_Y^{1-\alpha} n^{\gamma-1+\alpha} x_j^{\alpha-1} - p_j = 0 \,, \tag{2}$$

$$\frac{\partial \pi_Y}{\partial x_j} = (1-\alpha) AH_Y^{-\alpha} n^{\gamma-1+\alpha} x_j^{\alpha-1} - w_Y = 0 \,, \tag{3}$$

where W_Y is the wage rate in the final good sector and p_j is the price of the j_{th} intermediate good. Equation (2) is the inverse demand function for the firm that produces the j_{th} intermediate good whereas equation (3) characterizes the demand function of skilled labor.

2.2 The intermediate goods sector

In the intermediate goods sector, producers engage in monopolistic competition. Each firm produces one horizontally differentiated intermediate good and has to buy a patented design before producing it. Following Grossman and Helpman (1991), Bucci (2003), Bucci (2005b) and Bucci (2005c), we assume that each local intermediate monopolist has access to the same technology employing only skilled labor h_j:

$$x_j = B \cdot h_j \,. \tag{4}$$

Using the first order condition, we obtain the price of the j_{th} intermediate good:

$$p_j = \frac{w_j}{B\alpha} \,, \tag{5}$$

where w_j is wage rate in the intermediate goods.

At the symmetric equilibrium, all the firms produce the same quantity of the intermediate good, face the same wage rate and by consequence fix the same price for their production. The price is equal to a constant mark up $\frac{1}{\alpha}$ over the marginal cost $\frac{w}{B}$.

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[1] We use the notations of Bucci (2003) in order to have a direct comparison with his model.

[2] Time subscripts are omitted whenever there is no risk of ambiguity.

[3] Benassy (1996) made a simple modification of the Dixit and Stiglitz (1977) model which clearly disentangles taste for variety and market power. At the same time, Benassy (1998) and de Groot and Nahuis (1998) show that the introduction of this modification in an endogenous growth model with expanding product variety *à la* Grossman and Helpman (1991) affects the welfare analysis.

[4] Indeed, we obtain the Bucci (2003) model by introducing the following constraint $\gamma = 1 - \alpha$ in our model. In the same way, we obtain the Arnold (1998) model by introducing the following constraints $\gamma = \frac{1}{\alpha} - 1$ and $A = 1$ in our model.

Defining by $H_j = \int_0^n h_j d_j$, the total amount of labor employed in the intermediate goods sector, we can rewrite the equation (4):

$$x_j = \frac{BH_j}{n}.$$

(6)

Finally, the profit function of the firm[5] which produces the j_{th} intermediate good is:

$$\pi_j = A\alpha(1-\alpha)B^\alpha n^{\gamma-1} H_j^\alpha H_\gamma^{1-\alpha}.$$

(7)

2.3 The R&D sector

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

$$\dot{n} = \frac{nCH_n}{H},$$

(8)

Where C is a productivity parameter.

Unlike Bucci (2003), we explicitly assume that positive spillover effect is attached to the available stock of disembodied knowledge (approximated by the existing number of designs, n) in discovering a new product variety. Another important difference is the existence of a dilution effect[6] in our model. Indeed, the equation (8) captures in a very simple way the idea that R&D difficulty grows with the labor force[7]. According to this effect, the invention of a new intermediate requires a share of R&D skilled labor in the skilled labor force $H_n = \dfrac{H}{C_n}$, which changes over time because of both innovation and skilled labor growth. While innovation generates a positive inter-temporal externality, the skilled labor growth tends to reduce innovation via a fall in the R&D productivity.

Because of the perfect competition in the R&D sector, we can obtain the real wage by using the zero profit condition:

$$w_n H_n = \dot{n} V_n,$$

(9)

where w_n represents the real wage earned by R&D skilled labor and j_{th} is the real value of such a blueprint which is equal to:

$$V_n = \int_t^\infty \pi_j e^{-r(\tau-t)} d\tau, \quad \tau > t,$$

(10)

since the research sector is competitive, the price of the j_{th} design at time t will be equal to the discounted value of the flow of instantaneous profits that is possible to make in the intermediate goods sector by the j_{th} firm from t onwards.

Given V_n, the free entry condition leads to:

$$w_n = \frac{nV_n}{H}.$$

(11)

2.3 The consumer behavior

The demand side is characterized by the representative household who holds asset in the form of ownership claims on firm and chooses plans for consumption (c), asset holdings (α) and human capital (h)[8]. Following Lucas (1988), we assume that the household is endowed with one unit of time and optimally allocates a fraction u of this time endowment to productive activities (final good, intermediate goods and research production) and the remaining fraction ($1 - u$) to non productive

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[5] In order to have a negative relationship between competition and profit, we assume that $0 < \gamma < 1$.

[6] Dinopoulos and Segestrom (1999) have introduced this kind of effect in an endogenous growth model. In our model, unlike Dinopoulos and Segestrom (1999), this effect is also linked to the human capital accumulation.

[7] For more details about this issue, see Dinopoulos and Thompson (1999), Dinopoulos and Sener (2006) and Jones (2005).

[8] Like Bucci (2003), Bucci (2005b) and Bucci (2005c), for the sake of simplicity, we assume that there is no population growth.

activities (education). Following Romer (1990), we assume that the utility function of this consumer is[9]:

$$U = \int_0^\infty e^{-\rho t} \, log(c) \, dt \,, \tag{12}$$

where c is private consumption, ρ is the rate of pure time preference. The flow budget constraint for the household is:

$$\dot{a} = wuh = ra - c \,, \tag{13}$$

where w is the wage rate per unit of skilled labor services. The human capital supply function is given by:

$$\dot{h} = \partial(1-u)h \,, \tag{14}$$

where $\delta > 0$ is a parameter reflecting the productivity of the education technology.

From the maximization program of the consumer[10], the first order conditions are:

$$\lambda_1 = \frac{1}{c} e^{-\rho t} \,, \tag{15}$$

$$-\dot{\lambda}_1 = \lambda_1 r \,, \tag{16}$$

$$-\dot{\lambda}_2 = \lambda_1 wu + \lambda_2 \delta(1-u) \,, \tag{17}$$

$$\lambda_1 = \lambda_2 \frac{\delta}{w} \,, \tag{18}$$

Equation (15) gives the discounted marginal utility of consumption which satisfies the dynamic optimality condition in equation (16). Equation (18) gives the static optimality condition for the allocation of time. The marginal cost of an additional unit of skills devoted to working evolves optimally as in equation (17). Conditions (15) through (18) must satisfy the constraints (13) and (14), together with the transversality conditions:

$$lim_{t\to\infty} \lambda_1 a_t = 0 \,, \tag{19}$$

$$lim_{t\to\infty} \lambda_2 h_t = 0 \,, \tag{20}$$

3. The equilibrium and the steady state

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

3.1 The equilibrium

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

$$u^* = S_Y + S_j + S_n \,, \tag{21}$$

$$w_Y = w_j \,, \tag{22}$$

$$w_j = w_n \,. \tag{23}$$

Equation (21) is a resource constraint, saying that at any point in the time the sum of the skilled labor demands coming from each activity must be equal to the total available supply. Equation (22) and equation (23) state that the wage earned by one unit of skilled labor is to be the same irrespective of the sector where that unit of skilled labor is actually employed.

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

$$Y = C \cdot \tag{24}$$

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

[10] The control variables of this problem are c and u whereas a and h are the state variables. λ_1 and λ_2 denote the shadow price of the household's asset holdings and human capital stock.

Equation (24) is a resource constraint on the final good sector.

We can describe the capital market equilibrium in our economy. Because the total value of the household's assets must be equal to the total value of firms, the following condition must be checked:

$$a = nV_n,$$ (25)

where V_n is given by the equation (10) and satisfies the following asset pricing equation:

$$\dot{V}_n = rV_n - \pi_j.$$ (26)

3.2 The steady state

At the steady state, all variables as Y, c, n, a, H^{11}, H_Y, H_j, H_n grow at a positive constant rate.

Proposition : *If u is constant then all the other variables grow at strictly positive rate :*

$$g_h = g_H = g_{H_Y} = g_{H_j} = g_{H_n},$$ (27)

$$g_Y = g_c = g_a = \gamma g_n + g_h,$$ (28)

$$g_n = Cs_H.$$ (29)

Proof. *From the equilibrium on the skilled labor market, given by the equation (21), it easy to show that $g_H = g_{H_Y} = g_{H_j} = g_{H_n}$ if u is constant. Because of the assumption on the size of the representative household and the population growth rate, it is obviously that $g_h = g_H$. Combining these two conditions, we get $g_h = g_H = g_{H_Y} = g_{H_j} = g_{H_n}$. From the definition of the firm research process, given by the equation (8), we obtain that $g_n = Cs_n$. From the equilibrium on the product market, given by the equation (24), it is easy to find that $g_Y = g_c$. The equations (7, 10, 25, 26) implies that $g_a = \gamma g_n + g_h$. By substituting equation (6) into equation (1), then by log-differentiating the equation (1), we obtain $g_Y = \gamma g_n + g_h$. By combining the previous equations, we find the equation (28).*

Using the previous equations, we can demonstrate the following steady state equilibrium values for the relevant variables of the model[12] :

$$r = \delta - \frac{\gamma(\delta + (\alpha - 1)(C + \delta)\alpha)\rho}{\delta},$$ (30)

$$H_j = \frac{H\alpha(C+\delta)\alpha\rho}{C\delta},$$ (31)

$$H_Y = \frac{H(C+\delta)(1-\alpha)\rho}{C\delta},$$ (32)

$$H_n = \frac{H\{(1-\alpha)(C+\delta)\alpha+\delta\}\rho}{C\delta},$$ (33)

$$u^* = \frac{\rho}{\delta},$$ (34)

$$g_h = g_H = \delta - \rho,$$ (35)

$$g_n = \frac{((1-\alpha)(C+\delta)\alpha+\delta)\rho}{\delta},$$ (36)

$$g_Y = g_c = \delta - \rho - \frac{\gamma(\delta + \alpha(\alpha-1)(C+\delta))\rho}{\delta}.$$ (37)

According to the equation (30), the real interest rate (r) is constant. Equations (31), (32) and (33) give the amount of skilled labor in each sector at the equilibrium. Equation (34) represents the optimal and constant fraction of the household's time endowment that it will decide to devote to work (u^*) at the equilibrium. Equation (35) states that the growth rate of human capital depends on technological and preference parameters (δ and ρ)[13]. Unlike the Lucas (1988), Blackburn *et al.* (2000) and Bucci (2003) papers, the equation (36) shows that the growth rate of the innovative activity depends not only on preference and technological parameters but also on competition. Unlike the Lucas (1988), Blackburn *et al.* (2000)[14] and Bucci (2003)[15] papers, the equation (37) shows that the

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[11] Given the assumptions on the size of the representative household and the population growth rate, $h \equiv H$ which implies that we can use g_H instead of g_h.

[12] See Bianco (2008) for the demonstration of these results.

[13] The condition $\delta > \rho$ also assures that $0 < u^* < 1$.

[14] In these models, output growth depends only on human capital accumulation (g_h).

growth rate depends not only on the competition (α) and human capital accumulation (g_h) but also on the degree of returns from specialization (γ) and a productivity parameter (C). As in the recent Lucas (1988), Blackburn *et al.* (2000) and Bucci (2003) papers, the market power enjoyed in the monopolistic sector does not play any role on the consumers' decision about how much time to invest in education and training (such a decision being solely driven by the parameters describing preferences and human capital technology).

3.3 The relationship between product market competition and growth

In this section, we study the long run relationship between competition and growth in the model presented above. Following most authors (Bucci (2003); Aghion *et al.* (2005); Aghion and Griffith (2005); Aghion and Howitt (2005); Bucci (2005a); Bucci (2005b); Bucci (2005c); Bianco (2006) and Bianco (2007)), we use the so-called Lerner Index to gauge the intensity of market power within a market. Such an index is defined by the ratio of price (P) minus marginal cost (Cm) over price. Using the definition of a mark up ($Mark\ up = \dfrac{P}{Cm}$) and Lerner Index ($Lerner\ Index = \dfrac{P-Cm}{P}$), we can use (5) to define a proxy of competition as follows:

$$(1 - Lerner\ Index) = \alpha . \tag{38}$$

We show that in this model which consists in having the monopolistic mark-up in the intermediate goods sector and the returns to specialization treated separately, the relationship between competition and growth is inverse U shaped. This theoretical result is in line with empirical results [Aghion *et al.* (2005)].

Proposition: *The relationship between competition and growth is inverse U shaped.*

Proof. *The proof is obtained by differentiating (37) with respect to α :*

$$\frac{\partial g_Y}{\partial \alpha} = -\frac{(2\alpha - 1)\gamma(C+\delta)\rho}{\delta} . \tag{39}$$

As C, δ, $\rho > 0$ and $0 < \gamma < 1$ \$, then we the sign of the derivative is given by the opposite sign of $2\alpha - 1$. Finally, we obtain that $\frac{\partial g_Y}{\partial \alpha} > 0$ if and only if $0 \le \alpha < \dfrac{1}{2}$ and $\frac{\partial g_Y}{\partial \alpha} < 0$ if and only if $\dfrac{1}{2} < \alpha \le 1$.

To enlighten Proposition 2, remark that any increase in competition has a non linear effect on the skilled labor allocated to the research sector (H_n). This means that the resource allocation effect seems to predict an inverted-U relationship between product market competition and growth. Moreover, the human capital accumulation which is the second source of growth in our model has a positive and linear effect on growth. Finally, due to the composition of these two effects, the relationship between product market competition and growth is inverse U shaped.

4. Conclusion

In this paper, we presented a generalization of the Bucci (2003) model in which we disentangle the monopolistic mark-up in the intermediate goods sector and the returns to specialization in order to have a better measure of competition. Indeed, in our model the market power parameter is not strongly related to the returns to specialization but it is completely independent. Moreover, we introduce the degree of R&D difficulty in the sense that higher values of skilled labor force require more skilled labor allocated in the research sector to achieve the same level of the growth rate of knowledge. We also introduce another important different. Indeed, unlike Bucci (2003), we explicitly assume that positive spillover effect is attached to the available stock of disembodied knowledge in discovering a new product variety.

The results of the model can be summarized as follows. First of all, unlike Bucci (2003), the steady-state output growth rate depends on the parameters describing preferences, human capital

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[15] In this model, output growth depends not only on human capital accumulation (g_h) but also on competition (α).

accumulation technology and R&D activity. Secondly, unlike Bucci (2003), we find that the relationship between competition and growth is inverse U shaped. This result that seems to be in line these empirical results (Aghion *et al.* (2005)) is explained by the resource allocation effect.

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A STUDY OF QUALITY IN THE PROCESS OF SOFTWARE PRODUCT DEVELOPMENT ACCORDING TO MAINTAINABILITY AND REUSABILITY

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Abstract

Our research indicates the modality by which algorithm modifications imply intervention in modules where expressions are evaluated or selections of elements are performed, the conclusion being the fact that in order to design robust software, a clear definition of the modules is necessary. Thus, the weak module which can be easily modified must be defined and placed so as not to affect other modules through modifications applied to them.

The reusability issue is even more important as the main software producing companies have developed class libraries which reduce programming efforts. It is thus possible to start the realisation of software with personnel no larger than 15 people, but with high qualification and logistical resources. The problem of reusability occurs especially in the interference area. In designing interfaces, graphic elements are dominant, as well as those of information search-find. All this implies the definition of text placement and designing parts of the text which determine actions or operation selection.

The problem of reusability occurs when in new software products conversions, compressions, sorting and optimisations as operations with extremely low proportion in the computing volume must be introduced, but which represent significant consume from the point of view of the programming effort.

JEL Classification: L86

1. Introduction

In the IT domain, there are fundamental difficulties regarding product measurement, especially in the case of software products. On a closer look to the concept of quality, especially project quality, we discover that human originality and creativity are closely connected to it. These aspects of quality are hard to measure, especially since computer programmers see their work as a work of art rather than a commercial product.

According to software quality, the necessity to supply a solution appropriate to the user's needs is often considered to be *design quality,* while conformity to specifications is *production quality*. The classical cycle of a software product development resolves this ambiguity addressing the design and production in different phases of the process. The quantitative side is dominant, being the reason why class definition to table defining and data computing is extremely important.

Quality is an integral part of achieving an IT product. While some aspects of quality can be improved after implementation (for example supplementary hardware can be added to improve performance), others, such as software reliability and maintainability are based on including direct quality into the product, so that if the improvement of its quality is desired, it can be achieved only by re-design and re-development, to a higher price than if the improvement had been done during its initial development.

Starting from the definition of quality as it is formulated by the ISO 9000:2000 standard [Ince, (1996)], a quality IT product that which fits the purpose and which satisfies the client's demands, both expressed and implicit.

The requests expressed for an IT product are those established in the users' specifications, which must include a complete list of specifications, necessary to satisfy the client's needs. These specifications may include, but are not limited to, availability, reliability, usability, efficiency, maintainability and constraints in using the IT products and they have to be clearly defined by characteristics which can be observed and evaluated by the user.

Users' specifications for an IT product can be done by: specification regarding the product, specification regarding selected technical configuration and specification of design objectives for a product's application in the case of specific usage. Satisfying implicit requirements is more difficult, especially since they must be specified.

In the case of developing an It product, as a result of a contract or internal understanding, according to theory, all specifications should be mentioned. The ISO 9001 standard assigns it to the responsibility of the producer to make sure that the specifications are clearly defined and appropriately documented.

Within this context, implicit specifications are specifications so obvious that nobody considers they should be included in the specification. These specifications may be those referring to areas outside the competence of those defining specification (which is often related to delivering the IT product), determined by the nature of the product or service, by the client's manner of organising or the environment in which it operates.

We consider that defining IT products quality is much more difficult, compared to other products judging by the quantification difficulties of the qualitative attributes.

The main and derivative characteristics of software product quality according to the quality model defined by the ISO / IEC 9126 are described in the following table.

Table 1. Main and derivative characteristics of software product quality

No.	Characteristics	Derivate characteristics and meaning value
1	Functionability	▪ *Adequacy*: the presence and adequacy of the functions set according to specifications. ▪ *Accuracy*: the attributes of the software product related to obtaining correct or agreed results (for example the necessary precision degree of the values). ▪ *Interoperability*: the possibility of interaction between the software product and other specified products. ▪ *Conformity*: conformity with standards, conventions, regulation and other similar prescriptions connected to the application domain. ▪ *Security*: the software product's possibility to prevent unauthorised access, accidental or deliberate, to programs or data.
2	Reliability	▪ *Maturity*: the software product's degree of maturity, respectively the failure frequency on account of the software product errors. ▪ *Fault tolerance*: the software product's capacity to maintain a certain specified level of performance in the case of error. ▪ *Recoverability*: the possibility of re-establishing the level of performance and data recovery in case of error, the time and effort necessary for it.
3	Usability	▪ *Understanding facility*: the quick understanding, the user's effort to recognise the logic concept and its applicability. ▪ *Operability*: easy operating, respectively adapting the interaction style and the user interface type. ▪ *Learning facility*: the quick learning of the product's applicability.
4	Efficiency	▪ *Durability*: the efficiency as time response on processing operations, transfer rates in various conditions and configurations. ▪ *Resource behaviour*: the memory consumption in various conditions.
5	Maintainability	▪ *Analysability*: the rapidity and precision of identifying an error in execution between the software product messages and its causes. ▪ *Changeability*: the necessary effort for changing, repairing the error or for changing the environment. ▪ *Stability*: it refers to the risk of unexpected defect of modifications. ▪ *Testability*: it refers to the effort necessary for validating the modified software.
6	Portability	▪ *Adaptability*: the adaptability to other specific environments without using other facilities than those specific to the software product. ▪ *Easy installing*: the possibility of easily installing the software product in a specified environment. ▪ *Conformity*: the degree of the software product's adherence to standards and reglementations related to portability. ▪ *Interchangeability*: the possibility and the effort of using it instead of another specified software, in that software's environment.

2. Software maintainability

Maintainability is a process specific to software products destined to function for a long time period that is more than three years. In time, due to the evolution of technologic processes, legislation modifications and structural modifications of collectivities, adopting software products so as to answer the users' real demands is necessary.

Modifications of algorithms imply intervention in modules where expressions are evaluated or elements selections are performed. In order to elaborate maintainable software it is necessary to define modules clearly enough. Thus, modules possibly subjected to changes must be defined and placed so as not to affect other modules through modifications operated on them.

Modifications of input data imply increasing the data volume subjected to processing, introducing new variables to describe collectivity's elements or changing the representation model. In all these cases, modifications within the modules are necessary to maintain performance at a transaction level and to work on the new data. The program is maintainable if it accepts data modifications through similar processes. That is, when adding fields, processing modules are also added, when adding articles, modules of realisation rapid access are also added. When eliminating fields, processing modules are also eliminated or modules are deactivated.

Modifications at hardware level imply rethinking the product so as to accept hardware modifications. The depth of these modifications is in most cases so great that it is preferable to acquire a new product. Since there is an abundance of free circulating software, the problem of maintainability has a different connotation. The existence of extremely cheap products found on disks or CDs makes the users change their position towards acquiring maintainable software, eliminating it from the beginning. What is more, the user is after the products' structural dynamics for which it develops IT software applications and develops conditions to pass in very short periods of time from one product to another, each developed according to a new concept, with other hardware structures.

The problem of maintainability is shifted in this case towards the data that is a large variability of storage volume which may be processed by any software product.

Maintenance at result level is seen as the necessity of obtaining results in the exact shape and quality demanded by the user. Software producers have the obligation to take into consideration structures of results necessary to the users. Software products will be thus designed so as, by specific operations, to offer users the possibility to change result structures. In order to ensure maintainability, a series of measures will be taken into consideration, the most important of them being:

▪ defining reserves / back-up on support for each article, to allocate new fields while the development of the information data base to describe processes or elements of a colectivity;

▪ building modified expressions which, through values of coefficients to allow including or excluding some factors; for example, if the initial program evaluates the expression:

$$expr = a + b + c + d; \tag{1.1}$$

and if this expression is susceptible to be modified by decreasing or by eliminating some terms, the following form is implemented:

$$\exp r = \sum_{i=1}^{4} \alpha_i \cdot x_i \tag{1.2}$$

where: x_1 – is set in correspondence to a; x_2 – is set in correspondence to b; x_3 – is set in correspondence to c; x_4 – is set in correspondence to d.

For:

$\alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = 1$ results e = a + b + c + d.

$\alpha_1 = 1, \alpha_2 = -1, \alpha_3 = 1, \alpha_4 = -1$ results e = a - b + c - d.

$\alpha_1 = 1, \alpha_2 = 0, \alpha_3 = 0, \alpha_4 = -1$ results e = a - d. $\tag{1.3.}$

Introducing elements which ensure variability in performing selections; thus the function:

$$f(x) = \begin{cases} g_1(x), & if \ x \in [a_1, b_1] \\ g_2(x), & if \ x \in [a_2, b_2] \\ \cdots\cdots\cdots\cdots\cdots\cdots\cdots \\ g_n(x), & if \ x \in [a_n, b_n] \end{cases} \tag{1.4}$$

implies the use of a massive one-dimensional with cu *n+1* components, $a_1, a_2, \ldots, a_{n+1}$ is implemented by defining the number of intervals *n*, by allotting memory for the *n+1* components of the massive one-dimensional *a[]* and by defining analytical expressions of the n functions $g_i(x)$, *i = 1, 2, ...,n*; all as input data; the maintainable program is endowed with an interpreter which uses analytic

expressions of the functions $g_i(x)$ and evaluates them.

Maintainability compared to hardware evolution is possible in design phase by including elements which would accept the following modifications.

As a rule, the new computer generations accept products created for previous generations. The disadvantages stem from the impossibility to use the facilities available on the new computers.

For example, a product developed for a computer in which floating precision calculus were emulated by using procedures will not use the co-processor's facilities.

Moreover, developing in the multimedia field implies increasing the software products' capacity to operate with images and sounds. Attaching components which allow input/output multimedia operations compatible is a strong point in maintainability manifestation area.

Maintainability is measured using the metric I_{ment}:

$$I_{ment} = \frac{T_{modif}}{T_{dezv}}$$

(1.5)

where: *Tmodif* – the time needed for operating modifications in the software product to maintain it in current use; *Tdezv* – the time needed for the development of the product (analysis, design, encripting testing, and implementation).

Practice shows that if $0,6 > I_{ment} > 0,4$ the decision to replace the product in the near future is necessary since the future maintenance demands will imply very high costs.

If constantly $I_{ment} > 1$ this means that the product was not designed to fulfil new demands. In present circumstances, evaluating maintenance on a source text does not prove to be eloquent due to various ways of ensuring maintenance, including by building translators which have the role to modify source texts, bringing them to new demands imposed by the user.

Software products developed according to component-based techniques have real maintenance processes, with a minimum realization effort.

3. Software reusability

Object-oriented programming is the direct result of the need to design re-usable software. Embedding, an essential characteristic of the objects refers to isolating in a single entity of the operands and operators (methods). When the object is defined, all the elements are taken into consideration so as to ensure a complete processing. The operands and operators cover a sufficiently large area and through guaranteeing the correctness of the calculus and generality they are processed as such.

If a programs library implies the proceedings existence (methods) the operands being left to users both for defining and initialising, the objects exclude the users' contribution especially in producing errors in defining operands and their initialising. Defining and using objects is possible only when in programming languages specific mechanisms to dynamic allocation and differentiated treatment of operands and operators are implemented by adding properties regarding access, reference and domains.

Legacy is the most obvious way of re-using software at the level of applications development. Legacy creates the possibility that what exists to be able to add new properties by building derivate classes.

Polymorphism ensures working independence of the programmers without further supplementary restrictions on the way of defining functions different as structure which create the same processing procedure (writing, calculus, sorting, and drawing). Reusing software is possible if in module design processing correctness and generality is ensured.

Reusing ensures work consumption reduction and leads to shorting the time necessary for creating a software product. First of all, those who develop software must know exactly what exists, what module is available, the using way and how much they are processed or are available.

Conditions for software reusability are:
▪ The components to fully develop the required processing function;
▪ The qualitative level of the reusable component must be superior or at least equal to that of the product to be realised;

▪ Concordance between data structures which the product under construction operates on and the data structures of the reused component both regarding its input and output;

▪ The availability of the component by taking it from another software product of the firm or by purchasing it at convenient price;

▪ Homogeneity from the point of view of hardware and software demands compared to the developing product demanding reusing.

Software reusing becomes operational when the available components fulfil all conditions and convince the programmer about their usefulness in his activity.

The problem with reusing is the more important the more basic software producing firms have developed class libraries which reduce the programming effort by 60 to 80% by taking over. It is thus possible to start high complexity software even in software producing firm with staff no larger than 15 people, but with enough equipment and high level qualification. The problem of reusing mainly occurs in the area of interfaces interferences.

In achieving interferences, graphic and search-find information elements are predominant. All these imply defining text placing and constituting parts of the text which determine actions or operation selection. The quantitative side is dominant, reason why it is important to define classes oriented towards developing interferences. Moreover, interferences are developed to define tables and process the data in the tables. The problem of reusing occurs mainly when in the new software products conversions, compressions, sorting, optimisations must be included as operations with extremely low percentage within processing volume, but from the point of view of the programming effort significant consumptions are involved.

The reusability degree RD is seen in the relation:

$$RD = \frac{LR}{LT}$$

(1.6)

where: LR – length as number of instructions or Kbytes of the reused components included in the considered software product; LT – total length as number of instructions or Kbytes of the software product in which the components have been reused.

For example, in the case of a program which implements operations on the matrix necessary to comparing levels of characteristics of a definite number of users of software applications series of 15 procedures summing up LR = 362 source code lines, were reused from a matrix functions and procedures library.

Since the source code of the program contains LT = 1150 de instructions, the re-usage degree is:

$$GR = \frac{362}{1150} = 0,31$$

When a program is analysed, it is necessary to identify: LT – the total length of the program; LR – the length of the components effectively reused; LR_{max} – the maximum length of the components that might have been reused.

In this case, the degree of work waste included in the software product is calculated, DS, in the relation:

$$DS = \frac{LR_{max} - LR}{LT}$$

(1.7)

As a rule, when a program is evaluated, the indicator DS is evaluated to bring its cost at the real level. Wasting work is a result of not knowing about the existence of software components, an aspect which is not charged on the user, but on the software producer.

4. Conclusions

Structural matrixes for object oriented design require a different approach from matrixes used for procedural architectures or data oriented since the programs are differently structured. In the present situation, the programs are structured around objects, which embed states, properties and possible actions for a certain object. Functional design is based on procedures, functions and models and on their decomposition in procedures or smaller and simpler modules. To conclude with, measuring structural complexity for the two types of codes is different. In order to exemplify the differentiation, we can use the example of the number of code lines for procedural programs – a useful

element in studying complexity, but it is quite easy to realise that this parameter for object oriented programming does not have too much significance. Therefore, matrixes are required to show the complexity of the object oriented code and quantifying the implementation effort, in this case measuring is oriented towards classes, modularity, embedding, legacy and abstractisation.

The set of matrixes appropriate to this purpose is made up of six matrixes which measure the dimension of a class of objects and its complexity, using legacy, coupling classes, class cohesion and communication between object classes as described below.

▪ Model density in a class – this matrix studies the number and complexity of the methods in the object class. Complexity at class level are based on McCabe method, cyclomatic complexity and the number of code lines in the class studied, adding up complexities for all the methods in the class. This software matrix is an indicator of effort necessary for implementing and testing the class, higher values suggesting that the class is too big dimensionally, and therefore must be fractioned.

▪ The depth of the legacy tree – is the matrix analysing how many levels of legacy make up a class hierarchy. If the value of the matrix is high, it indicates a high project complexity, but a better re-usability of it.

▪ The number of instantiers – measures the number of immediate successors of the class. If this number is high, the weakening of the parent class abstractisation is observed, and then a more laborious testing is necessary, together with a better re-usability. An eventual re-designing might be considered.

▪ Coupling objects classes. It is a measurement of the way in which other classes are based on a certain call and vice versa. It is actually a measurement of the classes which are coupled. Two classes are considered coupled when the declared methods in a class use methods or variables instantiated by other classes. The high level of this matrix implies a higher complexity, reduces maintainability and reduces re-usability.

▪ Class response – represents the dimension of a set of methods which can be potentially launched in execution to answer a message received by the object containing them. It is calculated by adding up the number of response methods to the number of local methods subordinated to those previously counted and which supplies in turn response to the immediate superior level. Complexity increases proportionally to increasing responses for a class and implies a necessary supplement for testing.

▪ Lack of method cohesion. This matrix counts how many different methods in a class referentiate an instantial given variable. Design complexity and difficulty increase with the matrix increase.

For all the matrixes presented above, increasing value levels is correlated to the following effects: low productivity, higher effort in reusing classes, difficulties in class design and class implementation, high number of maintenance operations, a higher number of classes with malfunction/defect. Problems reported by users.

Reference levels through which each class comes to fulfil at least two of the established criteria and consequently they must be identified and investigated for an eventual redesign are: response for a class > 100, coupling between objects > 5, response for a class - 5 times higher than the number of methods in the class, density of methods in a class > 100 and number of methods > 40.

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ESTIMATING CORE INFLATION IN NORWAY

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Abstract:
Central banks are continually considering the problem of how to identify which price changes should be considered permanent and which entirely temporary. Indeed, due to the delayed effect that monetary policy uses to put its choices into action, a wrong valuation of the type of inflation can prove extremely costly for the economy and does not produce the desired results. Since price indexes (as CPI) deliver a distorted picture of underlying inflation, it is necessary to devise a more appropriate target for monetary policy. The need to find a good measure for the latter variable becomes more marked when the central bank adopts price stability as the overriding aim of monetary policy.
In this paper we apply the Quah and Vahey (1995) methodology to Norway, oil producing OECD country, and derive measures of core inflation by imposing restrictions from economic theory within the context of a multivariate econometric analysis. To estimate long-term movements of inflation, we present two models that enable the distinction between core and non-core inflation and also between domestic and imported inflation. We conclude that in all the models presented core inflation is a 'prime mover' of inflation.

Keywords: Core inflation, Monetary Policy, Norway

JEL Classification: C51, E52, D58

1. Introduction

During the 1990s the central banks of many countries adopted the inflation targeting regime, directing their monetary policy choices towards the primary goal of low and stable inflation [see, e.g., Bernanke and Mishkin, (1997); Svensson, (1997); Haldane (1995); Neumann and Jurgen, (2002)]. The policy of inflation targeting has stimulated heated debate on the efficiency of monetary policy as a means of controlling price movements. Theoretically, inflation targeting resolves the problems of time inconsistency connected with the management of money [Svensson, (1997); Walsh, (2003)] and eliminates the typical trade-off between credibility (fixed rules) and flexibility (discretional policy) in the discussion about the best monetary policy [Kydland, Prescott, (1997); Barro, Gordon, (1983), Walsh, (1995)].

If the central bank wants to keep inflation under control it must have a precise measure of the inflationary pressure in the economy on which to base its choices.

In practice, making price stability the priority of monetary policy can be aimed in a different way. Price stability can be obtained in terms of a price index (HICP) or through the consumer price index (CPI), since the value of money is generally associated with the purchasing power of consumer money. This second reference applies in almost all countries that have adopted an inflation targeting regime but is flawed and raises serious problems for monetary policy. The CPI index is not intended to measure price trends but changes in the cost of living.

To prevent the difficulties linked to the use of an inappropriate measure of inflation (like the CPI), many central banks that have taken on inflation targeting, including Norway, have adopted a number of indicators as a reference point for their monetary policy choices.

Of these, core inflation, a net measure of inflation of noise price signals, takes on particular importance. Literature on this subject has proposed a different measure for underlying inflation. One is based on statistical methods for finding a measure of core inflation from the data on price indexes and inflation rates. The most elementary of these approaches (and probably the most widely used) is that of excluding some categories of consumer price index from the overall inflation rate. For instance, in the euro area a common measure of core inflation is the *Harmonised Index of Consumer Prices* (HICP), excluding some volatile categories of prices (the so called 'ex food and energy index'). Several attempts have been made to improve this methodology [Blinder, (1997); Dow, (1994); Macklem, (2001)].

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[17] For a detailed description of the Italian system of unemployment benefit and a review of the workers' categories entitled to receive the *Cassa Integrazione Guadagni*, see [Ferrera, (2006)].

A second approach is a modelling one, which focuses on the definition of core inflation. This approach was initially provided by Bryan and Cecchetti (1994) and implemented in Cecchetti (1996) and Bryan, Cecchetti and Wiggins (1997). It is applied to disaggregated CPI data using cross section and time series methodologies. In the literature of the modelling approach, four methods of defining core inflation emerged [Roger, (1995, 1997)]: the percentile method, the exclusion method, the trimmed means method, and the standard deviation trimmed method.

Although some of these methods could produce useful information about the inflation process, they could also misrepresent the core inflation. Since they do not provide a precise definition of core inflation, these methods are unacceptable for the formal criteria used to judge the accuracy of the measured rate of inflation.

Unlike this, the methodology used in this paper is the only one based on economic theory and this helps to reduce the mismatching of the theoretical concept of inflation and the actual inflation measurement.

This methodology enables the core inflation components to be identified through a structural approach as put forward in the article by Quah and Vahey (1995).

Following Quah and Vahey (1995) we define core (or underlying) inflation as the component of inflation that does not influence real output in the long-run and reflects the state of demand in the economy. This definition seems to reflect Milton Friedman's view that inflation is always and everywhere a monetary phenomenon.

Our identification method is based on the work of Blanchard and Quah (1989), Quah and Vahey (1995) and Bjornland (2001), even if it differs in two aspects. First of all the identification process put forward by Quah and Vahey (1995) suggests that non-core disturbances do not significantly contribute to inflationary movements or rather that the core shocks must be the leading force on price changes. This is a purely theoretical hypothesis and should not be taken too literally since it is known that some shocks have an effect on both output and inflation.

Secondly the use of a long term Phillips curve is based on the assumption that output and inflation are stationary. However, if inflation is not stationary then the use of a long term Phillips curve may not be necessary.

For monetary purposes it is relevant to distinguish persistent long-term price movements (core inflation) from short-term shifts in prices (no core inflation). The persistent price movements are induced by monetary factors (demand side) and do not reflect short-term shocks. Such an inflation measure must represent steady underlying economic fundamentals. Temporary shocks are driven by supply side factors and are outside the control of the central bank. So, the effectiveness of monetary policy, in terms of inflation control, depends on whether the inflation measure reflects long-term price movements or includes short-term structural shocks as well. On this point Bryan and Cecchetti (1994) argue that in some circumstances (during periods of poor weather, for example), food prices may rise owing to decreased supply, thereby producing transitory increases in the aggregate index. Because these changes do not constitute underlying monetary inflation, the monetary authorities should avoid basing their decisions on them. Thus, core inflation is the component of price changes which is expected to persist over the medium-run horizon of several years.

Quah and Vahey (1995) adopt a common view of core inflation that there is a well defined concept of monetary inflation that ought to be of interest for monetary policy makers. This kind of inflation cannot be captured by the development of a price index.

The purpose of applying the Quah and Vahey (1995) approach to Norway is to show how this technique provides a robust direction for inflationary control. We find that core inflation becomes the prime inflation mover and, from a policy point of view, the best inflation forecaster. Moreover, this application highlights the potential of the Quah and Vahey technique to forecast inflation in small oil exporting countries, highly exposed to the volatility of oil price fluctuations coming from external channels. In these countries the business cycle may be highly influenced by global macroeconomic shocks and cycles. In fact, cycles in real oil prices, real oil revenues or oil investment are correlated to the global business cycle, strongly impacting on small oil-exporting economies (such as Norway) in the short-term (see Bjornland, H.C., (1998)). This result may be confirmed by past episodes of supply driven oil price increases (e.g., OPEC shocks), which depressed worldwide demand. In the current global cycle the demand side drives increases: oil price increases may sharpen economic fluctuations. In the particular case of this paper, the Norwegian Central Bank has fully achieved the aim of low

inflation and high growth, by keeping inflation impressively low without the need of any monetary intervention [OECD, (2007)]. The use of economic schemes and careful econometric estimates (as the Quah and Vahey approach described in this paper) made the job easier for Norwegian central bank making understandable the causes of inflation, forecasting more easily inflation dynamics as well distinguishing between internal and imported inflation [Bjornland, H.C., (2001)].

Furthermore, the widespread use of these techniques of estimates in many countries [see Vega, Wynne, (2001); Landau, (2000); Bagliano, Golinelli, and Morana, (2002)], has revealed that the Quah and Vahey technique of estimating inflation is very effective in controlling and forecasting inflation.

The paper is organised as follows. In section 2 we provide the theoretical background of SVAR approach and a short summary of the econometric technique followed in the assessment. In section 3 we present the empirical analysis and model specification to estimate core inflation for the Norwegian economy. Having identified the core inflation in a simple model with two variables we continue by separating the domestic and the imported inflation, introducing the foreign inflation as new variable and explaining the effect of imported inflation on monetary decisions. In section 4 we provide some limitations to the analysis and we indicate some interesting topics for future research. The conclusions are to be found in paragraph 5.

2. Core inflation in the Structural VAR approach: Methodology and theoretical framework

The Quah and Vahey methodology of measuring core inflation is based on an explicit long-term economic hypothesis. This long run identification scheme is implemented for the first time by Shapiro and Watson (1998) and Blanchard and Quah (1989). To disentangle core inflation, Quah and Vahey (1995) assume that inflation is affected by two types of shocks, identified by their effects on output and assumed to be uncorrelated at all leads and lags. The core inflation shock is output neutral (the long run impact is restricted to zero); the no core shock could influence output in the long run. Then, core inflation is the underlying movement in measured inflation associated only with the first kind of disturbance [Quah and Vahey, (1995)].

The theoretical presumption for the Quah and Vahey approach is the economic notion of the vertical long run Phillips curve. This assumption is not without problems and generates some issues on its economic interpretation.

At first it would seem that the acceptance of a vertical Phillips Curve in the long term means that monetary policy is neutral in its effect on real economy. In this interpretation, the inflation is purely a monetary phenomenon. This proposition is not so obvious, however: it would diminish the role of monetary policy, relegating the monetary authority to a simple guardian of purchasing power without effects on real economy.

Secondly the Quah and Vahey methodology does not state the speed of adjustment of the economy to core inflationary shocks. In particular, the SVAR approach does not restrict how quickly core inflationary shocks became output neutral, leaving indefinite the adjustment process of inflation toward long run (core) components. Such an adjustment may be explained with agents being subject to expectations errors (for information problems). In this sense the Quah and Vahey long period, provided by long term identification restrictions, is the time horizon of a correction adjustment process for expectations. At the end of this time the economic system is in a steady state and the (rational) expectations of agents are realized. This interpretation is in line with the theoretical predictions of an AD-AS model for supply and demand shocks.

For instance, imagine that the economic system (in the simplest framework) can be represented by the following equations (variables expressed in log):

$$y_t = y_{t-1} + \Delta m - \pi_t + \varepsilon_t^D \qquad AD$$
$$y_t = y^\circ + \lambda(\pi_t - \pi_t^e) + \varepsilon_t^S \qquad AS \qquad (1)$$

where y_t and π_t are, respectively, the level of current output and the inflation rate; Δm synthesizes the monetary tools; y° is the steady state output level and π_t^e the forward looking expectation on inflation rate. In the short term the difference between y_t and y° is due to $\pi_t - \pi_t^e$ (the λ parameter expresses the speed of expectation adjustment). This term identifies the unexpected

inflation costs. In fact, once wage contracts have been fixed, increases in unexpected inflation (π_t) above π_t^e are benign for the real variables (y_t) (see AS schedule). Inflation is generated by supply and demand effects together (for a given Δm).

In the long term, when the expectations are realized and ε_t^S disappear, $\pi_t = \pi_t^e$ and the system (1) can be rewritten as:

$$\begin{aligned} \pi_t &= \Delta m + \varepsilon_t^D \qquad AD \\ y_t &= y^\circ \qquad\qquad AS \end{aligned} \tag{2}$$

In system (2) the supply schedule is vertical ($y_t = y^\circ$) and the only source of inflation are monetary shocks (demand side shocks) due to Δm. Implicitly, imposing long term restrictions to identify core inflation, the economic views of Quah and Vahey reflects the steady state status of the economy (see (2) equations).

From an econometric point of view, this is equivalent to estimate system (1) and imposing $\lambda = 0$ as a long run restriction.

More precisely we estimated a SVAR model in the growth rate of real output and inflation (CPI index) as in Quah and Vahey (1995). Their measure is based on long-term restrictions on this bivariate VAR model. We suppose that there are only two types of exogenous shocks that are distinguished by their long run impact on the level of real output. We have a supply shock that has permanent effects on output and aggregate prices, and the demand shock that has non long-term effects on output (but permanent effects on prices). The one type of shocks is allowed to influence the level of real output in the long term, the other type of shocks on the real output is brought to zero thought long-term restrictions.

With this system Quah and Vahey (1995) define the former type of shock as no core inflationary and the latter core inflationary shocks.

Taking first difference (to guarantee stationary state) the structural VAR representation can be written as follows:

$$B(L)x_t = \varepsilon_t \tag{3}$$

where x_t is the vector of endogenous variables: (as usual, y_t indicates the log of output and π_t the log of price level):

$$x_t = \begin{pmatrix} \Delta y_t \\ \Delta \pi_t \end{pmatrix} \tag{4}$$

and ε_t is the vector of shocks:

$$\varepsilon_t = \begin{pmatrix} \varepsilon^D \\ \varepsilon^S \end{pmatrix} \tag{5}$$

where ε^D and ε^S are, respectively, core and non-core shocks. These structural shocks are orthogonal, and white noise errors. They are normalized so their covariance matrix is:

$$E(\varepsilon_t \varepsilon_t^T) = \begin{pmatrix} \text{var}(\varepsilon_t^D) & \text{cov}(\varepsilon_t^D; \varepsilon_t^S) \\ \text{cov}(\varepsilon_t^D; \varepsilon_t^S) & \text{var}(\varepsilon_t^S) \end{pmatrix} = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} = I \tag{6}$$

where I is the identity matrix.

The matrix $B(L)$ provides us with the coefficient of the covariance stationary process with L lags. We assume $B(L)$ is a full rank matrix.

From the structural vector moving average (VMA) representation of x_t we can obtain:

$$\Delta y_t = \sum_{k=0}^{\infty} c_{11,k} \varepsilon_{t-k}^{D} - \sum_{k=0}^{\infty} c_{12,k} \varepsilon_{t-k}^{S}$$
$$\Delta \pi_t = \sum_{k=0}^{\infty} c_{21,k} \varepsilon_{t-k}^{D} - \sum_{k=0}^{\infty} c_{22,k} \varepsilon_{t-k}^{S} \tag{7}$$

or

$$x_t = C(L)\varepsilon_t \tag{8}$$

where $C(L) = B(L)^{-1}$ is a polynomial in the lag operator whose individual coefficients are denoted by $c_{ij,t}$.

We want to identify the coefficient matrices $C(L)$ from the structural VMA representation and to estimate the structural shocks ε_t.

To find the $C(L)$ coefficient we must estimate the reduced form of the VAR system with the reduced-form innovations e_t:

$$x_t = Ax_{t-1} + e_t \tag{9}$$

If A is invertible, the reduced form Wold representation of x_t can be obtained:

$$\begin{pmatrix} \Delta y_t \\ \Delta \pi_t \end{pmatrix} = \begin{pmatrix} C_{11} & C_{12} \\ C_{21} & C_{22} \end{pmatrix} \tag{10}$$

or

$$x_t = D(L)e_t \tag{11}$$

where $D(L)$ is a polynomial in the lag operator.

If $D(1)$ is the matrix of long run effect of reduced form shocks then, after some algebra, we have:

$$D(1) = (I - A)^{-1} \tag{12}$$

Thereafter, we can assume that the reduced form innovations are linear combinations of the structural shocks:

$$\begin{pmatrix} \varepsilon_t^{D} \\ \varepsilon_t^{S} \end{pmatrix} = \begin{pmatrix} c_{11} & c_{12} \\ c_{21} & c_{22} \end{pmatrix} \tag{13}$$

or

$$e_t = C(0)\varepsilon_t \tag{14}$$

Given the relationship between the structural and reduced form shocks we must find the coefficient of $C(0)$. The estimation of $C(0)$ is obtained through some restrictions illustrated in the appendix C.

3. Identify internal and exported inflation

In this section we present two models applied to Norwegian data. In the first, we use Quah and Vahey (1995) methodology to identify core inflation in Norway, using quarterly changes in CPI and GDP variables and then distinguishing between domestic and imported shock.

Then, we present a model that captures the effects of global macroeconomic shocks with three variables: quarterly changes in CPI, GDP and CPI_F (foreign inflation) to decompose core inflation in domestic and imported core inflation, having identified and applied the methods of assessment of core inflation with just two variables as in the article by Quah and Vahey (1995) (inflation rate is measured by quarterly changes in Consumer Price Index CPI and output by quarterly changes in real Gross Domestic Product GDP). The introduction of foreign inflation is significant for a small oil exporting country such as Norway. The importance of CPI_F is clearly linked to the effects of globalisation, in which Norway is largely involved, supplying oil and others commodities at high prices and increasingly importing low-cost consumer products.

Quarterly changes in CPI and GDP of Norway from 1990q1 to 2006q2 are used to calculate a SVAR measure of core inflation.

To start with data is cleaned for seasonality and outliers (we did auxiliary regressions with constant and dummies) and then we performed some diagnostic tests (unit root test, lag length, residual normality, autocorrelation, co-integration, and invertibility) before estimating a Structural Vector Autoregression (SVAR) with constant and trend (see Appendix A).

Unit root tests confirm that for GDP and CPI we can reject the hypothesis of a unit root in favour of the stationary alternative (c.f. appendix A.1).

At a second stage, we determine the lag order of the model performing several selection criteria as Akaike information criterion (AIC) and sequential modified LR test statistic (LR). All tests indicate that in order to estimate the SVAR model one should use four lags, constant and seasonal dummies. Using four lags we could reject the hypothesis of autocorrelation and heteroskedasticity.

At the end, in the SVAR model specified above, we test co-integration relation between CPI and GDP (by Johansen co-integration test). By testing for co-integration we confirm that none of the variables in the SVAR model are co-integrated (see table A.3). Therefore, as explained above, we can identify the SVAR by long term restrictions imposed on $C(L)$ matrix.

Figure 1 shows the rates of variation in CPI and GDP from the sample period and from this it is possible to visualize the three phases that characterized the Norwegian economy.

In the first phase, from 1990 to 1995, the economy is stagnant and inflation is rather high. Indeed at the beginning of the nineties Norway imported high inflation because of an extreme negative supply shock (the Golf war). This situation created the expectation of further price increases, with negative effects on the on the growth of the real economy.
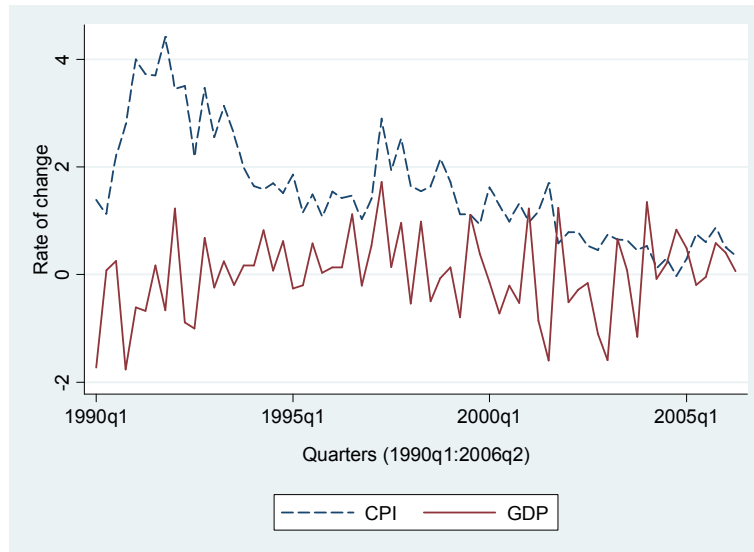
Figure 1. Norway; CPI and GDP quarterly changes from 1990q1 to 2006q2

From 1995 to 2000, with the war over, the expectations of inflation levelled off and the economy showed important signs of recovery, thanks also to the effective stabilization policies of the Norwegian government (e.g. Bjornland, 1996).

By 2002, as well as government stabilizing policies, the Norwegian central bank intervened several times with the objective of limiting inflation without compromising the an economic recovery. The effect of these interventions, which has been especially evident in recent years, is a sustained rate of GDP growth and low inflation.

In this particular case the difficulty in identifying the short term non monetary factors influencing inflation is rather evident. In the theoretical plan to the identifying mechanism analysed in the preceding paragraph, inflation can be generated by two sources: the demand side boosts and the productivity shocks. The first source produces inflation without GDP movements (we look at it by imposing long-term restrictions); the second source is linked to output movements (supply side shocks). So, the policy maker might be misled by two effects leading to mistaken monetary policy.

This creates the need for a reliable and careful measure for inflation on which to base ones own decisions.

If a negative (but temporary) shock impacts on productivity producing an increase in inflation, the central bank might be forced to restrict its monetary policy and thereby worsen the economic depression. These policy effects can reverberate through the economy for a long period and give out a worse inflation signal than agent's expectations. To avoid this, a measure that can identify core inflation would allow for more effective administration in the economy as a whole since temporary shocks on prices ought not to activate a reaction by the central banks.

In view of this, to best evaluate the effects derived from imported inflation, we introduce a second model in which we work with three variables: CPI, GDP and CPI_F (foreign inflation) in quarterly changes to decompose core inflation in domestic (CPI) and imported inflation (CPI_F). In this model we adopt the same methodology described above; we generalize the first model inserting CPI_F as an endogenous variable.

Once again in this case we have performed some diagnostic tests (unit root test, lag length, residual normality, autocorrelation, co-integration, and invertibility) before estimating a Structural Vector Autoregression with constant and trend (see Appendix B).

In fact, unit root tests confirm that for CPI_F we can reject the hypothesis of a unit root in favour of the stationary alternative (c.f. appendix B.1).

Then, we determine the lag order of the model by performing the same selection criteria used for the first model: Akaike information criterion (AIC) and sequential modified LR test statistic (LR). While the LR test of parameter reduction reported four lags, the AIC indicated two lags (see appendix

B.2). We have decided to rely on LR criteria estimating the SVAR model with four lags, constant and seasonal dummies.

Finally, in the SVAR model specified above, we test the co-integration relation between CPI, CPI_F and GDP (by a Johansen co-integration test). None of the variables in the SVAR model are co-integrated (see appendix B.3).

Presented below are firstly the impulse responses and then the variance decompositions from both models. The impulse response analysis gives the accumulated responses of inflation and real output to each shock, with a standard deviation band around the point estimates, reflecting uncertainty of estimated coefficients.

3.1 Impulse response analysis

The impulse response functions for Norway from the model with just two variables are depicted in Figure 2 (panel A-D). It shows the dynamic reactions of the GDP and the CPI to an unanticipated one-unit supply and demand shock over a period of thirty quarters, with one standard deviation band around the point estimates, reflecting the uncertainty of estimated coefficients. The standard errors reported are calculated using the Monte Carlo simulation based on normal random drawings from the distribution of the reduced form VAR. The standard errors that correspond to the distributions in the $C(L)$ matrix are the calculated using the estimate of $C(0)$.

Figure 2. Impulse responses with one standard error band (model with CPI and GDP)

The vertical axis refers to the log of the variable and reports the contribution of the structural supply and demand shocks, while the horizontal axis indicates the time horizon in quarters.

In panel A we note that a positive non core disturbance (e.g. productivity) has a strong impact on output stabilising its effect after 10 quarters. When the shock comes from the supply side the GDP is permanently affected.

But output is also impacted by core shocks. In panel B a positive core disturbance has a low impact on output (it goes to zero after 12 quarters) because of the long term restrictions, confirming the output (long term) neutrality assumption. Our dynamics match the predictions of AS-AD model in the long term (see equation 2) very well. A positive shock induces a permanent increase in the GDP, stabilizing after 12 quarters while a positive demand shock temporarily increases output.

This behaviour provides some evidence of a negative sloped short-term Phillips curve.

Norwegian output reaches a peak after ten quarters but output effect vanishes after some time, responding to the realization of agent expectations (see equation 3) . From an econometric point of view this is the equivalent of enforcing the long term restrictions that quash the effect of the output after just ten quarters.

In panel C and D we show the impulse response functions of the CPI depicting the different impact of supply and demand shocks.

The impulse response functions of CPI depict the different impact of supply and demand shocks on prices. While a negative supply shock induces a permanent reduction in the CPI, a positive demand shock induces a permanent increase of the CPI. In line with the stationary property of Norwegian inflation we have assumed, both shocks affect inflation only temporally. A CPI non core shock reduces inflation slightly at the beginning; then, after 12 quarters, it stabilises its effect (Panel C). However, at the same time the accumulated response of CPI to core shock has a permanent effect on inflation. The impulse response takes 12 quarters to settle down to its long term level.
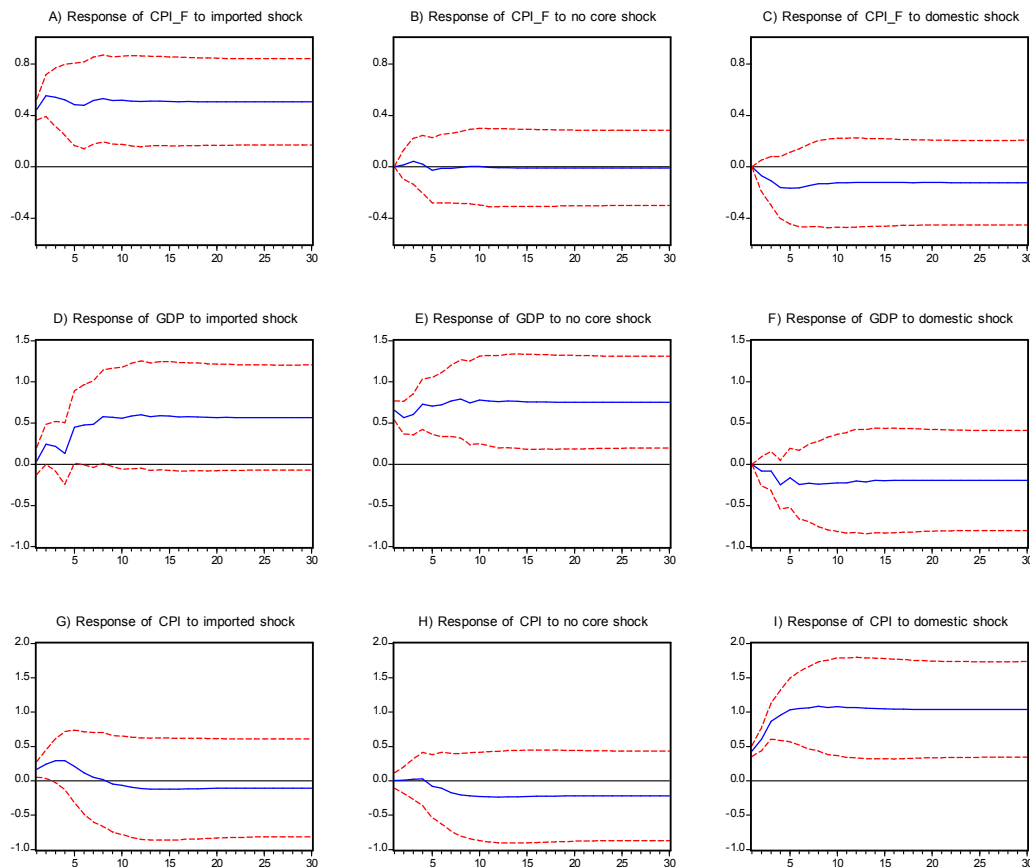
Figure 3. Impulse responses with one standard error band (model with CPI, CPI_F and GDP)

In figure 3 (panel A-I) there are the impulse functions in response to the second model. We can observe that a positive non core shocks have a strong effect on foreign prices in the long term. Domestic core shocks do not affect international prices in the long term (by restriction). In panel D we note that imported core shocks do not affect output in the long term; in panel F domestic core shocks do not affect output in the long term. As in the first model no core shocks have a low effect on the output in the long term; in addition imported core shocks have little effect on domestic prices.

3.2 Variance decomposition
The variance decomposition explains the contribution of some structural shocks to the variance of the n-step forecast errors of the variables. For each point in time the relative importance of the different structural shocks of the development of the variables can be assessed.

The variance decomposition for output and inflation over sixty quarters are reported in table 1.

In the model using only GDP and CPI , the variance decomposition of GDP reveals that the variation in output in Norway is attributable mainly to supply shocks. The long impact of the supply shocks on output approaches almost 100 percent, a result which is imposed by the identification procedure.

The variance decomposition of the CPI indicates that in Norway demand shocks exert the major contribution to the variability in the CPI on all levels. In the short-term, demand shocks account for about 92% increase of variance in CPI. This share converges to almost 100 percent in the longer term. It should be noted that this result in not due to any kind of imposed restriction. These results of the variance decomposition of the CPI are consistent with the concept of core inflation being demand driven. A demand driven measure captures the price trend, if the demand factors account for the predominant part of the variation in the price index in the medium to long-term.

Then we check if the measured CPI matches the estimated core inflation well.
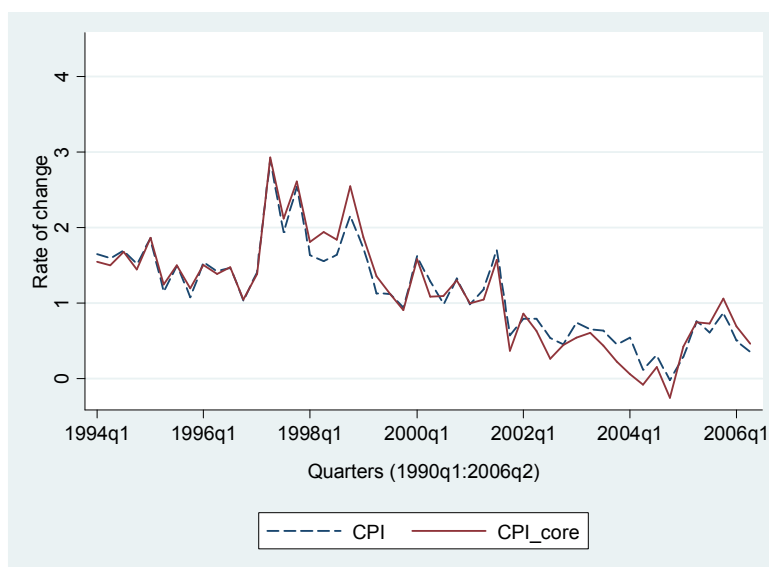
Figure 4. Norway; Core and measured CPI inflation

From figure 4 we can note that the core component of inflation appears to perform well in its role of first component of inflation. In particular, peaks and troughs of core match the headline well. In this sense it constitutes its prime mover of movements.

In general inflation was stronger than the measured one, this is probably because positive non core shocks pushed the supply side of the economy raising inflation (e.g. productivity shocks). This seems evident from 1998 to 2000. From 2002 to 2005 the inflationary process was weaker than indicated by CPI, non core disturbances (loss of productivity, competitiveness) generating an opposite impact on GDP. In the first six-months of 2006 the situation is inverted: core inflation runs (not randomly) very near to CPI measured in such a natural way; positive non core shocks drive the supply side of economy raising inflation (making productivity shocks likely).

The variance decomposition in the second model is fairly in line with expectations but again we observe a strange result. Imported shocks explain 24% of output variance after 12 periods against the long term restrictions (that do not have any effect in decomposition). The same results are found for CPI in the first model. In this model we are able to disentangle the domestic core inflation from the imported core inflation. The domestic core inflation looks quite similar to the core inflation. To show the differences we have to sum the other component of core inflation that is the imported core inflation. From 1999 to 2001 imported core shocks worked to reduce total core inflation. International prices fell at a much higher rate than in Norway. From 2002 to the end of 2004 total core was above domestic core, hence Norway imported inflation. Again in 2004 total core inflation lay below the CPI (as in the first model) suggesting that negative no core shocks reduced GDP. In the sixth-month of

2006 the situation was stable but international prices appeared to decrease at a higher rate than Norwegian prices.
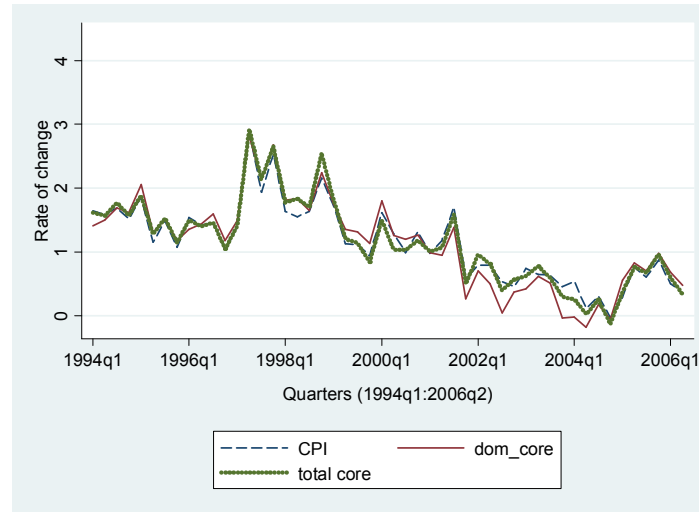

Figure 5. Norway; Core domestic, total core and measured CPI inflation

Table 1. Variance decomposition
(model with GDP and CPI)

GDP			CPI		
Period	No core	Core	Period	No core	Core
1	100.000	0.000	1	0.01	99.99
2	99.924	0.076	2	0.02	99.98
3	99.922	0.078	3	0.02	99.98
10	91.140	8.860	10	8.33	91.67
20	91.045	8.955	20	8.41	91.59
30	91.045	8.955	30	8.41	91.59
40	91.045	8.955	40	8.41	91.59
60	91.045	8.955	60	8.41	91.59

Table 2. Variance decomposition
(model with GDP, CPI and CPI_F)

GDP				CPI			
Period	Imported core	No core	Domestic Core	Period	Imported core	No core	Domestic Core
1	0.384	99.616	0.000	1	12.725	0.006	87.270
2	8.741	89.848	1.411	2	13.244	0.013	86.743
3	8.825	89.769	1.406	3	11.149	0.074	88.776
10	24.187	68.457	7.356	10	16.202	4.721	79.077
20	24.378	68.175	7.447	20	16.473	4.742	78.786
30	24.380	68.173	7.448	30	16.474	4.742	78.784
40	24.380	68.173	7.448	40	16.474	4.742	78.784
50	24.380	68.173	7.448	50	16.474	4.742	78.784
60	24.380	68.173	7.448	60	16.474	4.742	78.784

CPI_F			
Period	Imported core	No core	Domestic Core
1	100.000	0.000	0.000
2	97.704	0.131	2.165
3	96.650	0.458	2.892
10	94.050	1.709	4.241
20	94.018	1.738	4.244
30	94.018	1.738	4.244
40	94.018	1.738	4.244
50	94.018	1.738	4.244
60	94.018	1.738	4.244

4. Limitations and future research

In our analysis quarterly changes in CPI and GDP of Norway from 1990q1 to 2006q2 are used to calculate a SVAR measure of core inflation. Really, this is a limitation because it is a short sample to impose long term restrictions but data before 1990q1 and after 2006q2 is presently unavailable (as final release). An uploading of data could be interesting to deepen recent dynamic of inflation but for the purpose of the paper this uploading does hardly affect the results (impulse response analysis, variance decomposition) and, most of all, does not change the core of the application, i.e. an implementation of Quah and Vahey (1995) approach to Norway, to show how this technique provides a useful tool for inflationary control.

In future, core inflation research should focus on some topics connected with peculiar features of Norway.

In fact, being a small oil exporting country, Norway is highly exposed to the volatility of oil price fluctuations coming from external channels. The Norwegian business cycle may be highly influenced by global macroeconomic shocks and cycles. Cycles in real oil prices, real oil revenue cycles or oil investment are correlated to the global business cycle, strongly impacting on small oil-exporting economies in the short term [see Bjornland, H.C., (1998)].

By adopting inflation targeting the Norwegian central bank is obliged to defend the purchasing power of its own currency from the adverse effects of imported inflation (especially dangerous in Norway) with the aim of keeping price levels stable and in line with the chosen inflation objective and implicit in the monetary regime that has been adopted.

New uncertainty about the workings of the economy, and with globalisation becomes a more complex phenomenon, and the exogenous shocks affecting it, has presented the Norwegian Bank a new set of challenges.

Norwegian Bank must maintain high credibility in order to manage inflation stabilizing oil price expectations at that time. Certain external shocks could undermine its reputation and cause Norwegian Bank to level off and to deflect from its monetary pronouncements. This risk is sensible and foreseeable because of the higher Chinese and Indian inflation once the productivity growth there slows down. It will be critical to any further growth in credibility that while global conditions are difficult: the shocks of globalisation can put a solid economy in a difficult position by posing challenges even to such a highly successful monetary policy.

4. Conclusions

In this paper the structural VAR methodology developed by Quah and Vahey (1995) is applied to decompose Norwegian inflation in non-core shocks.

This decomposition has effects that are extremely relevant for economic policy since it is through this that a central bank can implement the most effective economic policy measures.

Indeed, due to the effects of monetary policy, mistaking the nature of price changes (temporary or permanent) can be extremely damaging to the economy. For example, difficulties in identifying the start of the inflationary process can lead to a sustained growth in inflation and require an extended period of restrictive policies. On the other hand an excessively strong reaction to a temporary price increase can lead to a swift crisis in economic activity.

When the system being implemented is that of inflation targeting the ability to find an accurate measure of the inflationary pressure becomes essential in order to reach price stability. The CPI is not an appropriate index for measuring inflation since it is strongly affected by the temporary effects (shocks exogenous or modifications of the fiscal rates).

For this reason, many central banks (including the Norwegian central bank) calculate a 'correct' inflation index by cleaning the CPI of the effects of 'noise' that are outside their control. Although many of these methods can provide useful information about underlying inflation they do not stand up to a formal criteria by which it is possible to judge the inflation rate measure or in general appraise the results.

In addition to this the process of defining and measuring the underlying inflation implicit in these methods involve an element of subjective opinion: it is difficult to identify a means of measuring underlying inflation that is at the same time useful to monetary policy and created according to scientific criteria.

Unlike these methods, in this paper we use Quah and Vahey (1995) methodology to identify core inflation in Norway, using quarterly changes in CPI and GDP variables and then distinguishing between domestic and imported shock.

We first discuss the notion of core inflation from a theoretical point of view, explaining why, in practice, the concept of core inflation in the formulation of policy aimed mostly at controlling inflation (e.g., inflation targeting), plays a crucial role in monetary prescriptions.

In this context the core inflation is the persistent (or underlying) component of measured inflation that has no medium to long term effect on output.

The results show that the core inflation is a prime mover movement of inflation, while the non-core shocks mainly contribute to the movements of output. Especially in Norway the movements that are caused by imported inflation (oil price shocks for example) are determined through the explanation of inflationary causes that are realized over long periods of time.

The empirical analysis also highlights the fact that in Norway the CPI inflation over or underestimates the core inflation in many periods while the shocks on productivity are responsible for the underestimation of inflation relative to core inflation from the beginning of the 1990s.

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Appendix A: First Model

Notes: All variables in this article are expressed in quarterly change in the log of original variables.

Table A1. Unit root tests

GDP	Confidence	t-Statistic	Prob.
Augmented Dickey-Fuller test		-9.3197	0.0000
Test critical values:	1% level	-4.1055	
	5% level	-3.4805	
	10% level	-3.1680	
CPI	Confidence	t-Statistic	Prob.
Augmented Dickey-Fuller test		-4.0186	0.0128
Test critical values:	1% level	-4.1079	
	5% level	-3.4816	
	10% level	-3.1687	

Table A2. Lag order tests

Lags	LogL	LR	AIC
0	98.02	NA	3.95
1	97.82	20.37	3.73
2	98.26	3.91	3.79
3	98.16	7.83	3.77
4	85.98	10.64 ☞	3.70 ☞

Notes: * indicates lag order selected by the criterion; LR is the sequential modified LR test statistic (each test at 5% level); AIC is Akaike information criterion

Table A3. Co-integration tests

Series: GDP CPI			
Lags interval (in first differences): 1 to 4			
Unrestricted Co-int. Rank Test (Trace)			
Hypothesized		Trace	
No. of CE(s)	Eigenvalue	Statistic	CriticalValue(5%)
None	0.16	17.05	25.87
At most 1	0.10	6.11	12.52
Trace test indicates no co-integration at the 0.05 level			
Unrestricted Co-int. Rank Test			
Hypothesized		Max-Eigen	
No. of CE(s)	Eigenvalue	Statistic	CriticalValue(5%)
None	0.16	10.94	19.39
At most 1	0.10	6.11	12.52
Max-eigenvalue test indicates no co-integration at the 0.05 level			

Appendix B: Second Model

Table B1. Unit root tests

CPI_F	Confidence	t-Statistic	Prob.
Augmented Dickey-Fuller test		-6.3259	0.0000
Test critical values:	1% level	-4.1055	
	5% level	-3.4805	
	10% level	-3.1680	

Table B2. Lag order tests

Lags	LogL	LR	AIC
0	⫝151.01	NA	5.07
1	⫝132.27	34.45	4.75 ☞
2	128.37	6.81	4.92
3	⫝122.91	8.98	5.03
4	⫝111.91	17.03 ☞	4.96

Notes: * indicates lag order selected by the criterion; LR is the sequential modified LR test statistic (each test at 5% level); AIC is Akaike information criterion.

Table B3. Co-integration tests

Series: CPI_F GDP CPI			
Lags interval (in first differences): 1 to 4			
Unrestricted Co-int. Rank Test (Trace)			
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	CriticalValue (5%)
None	0.25	34.62	42.92
At most 1	0.17	17.16	25.87
At most 2	0.09	5.44	12.52
Trace test indicates no co-integration at the 0.05 level			
Unrestricted Co-int. Rank Test			
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	CriticalValue (5%)
None	0.25	17.47	25.82
At most 1	0.17	11.71	19.39
At most 2	0.09	5.44	12.52
Max-eigenvalue test indicates no co-integration at the 0.05 level			

Appendix C: Restrictions and identification of shocks

In the first model described in paragraph 3 the $C(0)$ matrix contains four elements. The problem is, as always happens in identification issues, is that we find ourselves in a situation where we have more unknowns than equations. So, we have needed some restrictions, one for each coefficient. From the estimation of the reduced form VAR we can build the following matrix:

$$\Omega = C(0)C(0)^T \tag{15}$$

that represents the (known) variance-covariance matrix of the reduced form residuals.
The first restriction comes from the variance of the first VAR residuals:

$$Var(e^D) = c_{11}^2(0) + c_{12}^2(0) \tag{16}$$

Similarly we obtain the second restriction for the second residual:

$$Var(e^S) = c_{21}^2(0) + c_{22}^2(0) \tag{17}$$

The third restriction comes from the covariance of estimated residuals:

$$\text{cov}(e^D, e^S) = c_{11}(0)c_{21}(0) + c_{12}(0)c_{22}(0) \tag{18}$$

The fourth restriction is backed by economic grounds. We must pose explicit long-term restrictions on the behaviour of the system. To find it, we consider equation (7). Because $D(1)$ matrix represents the long-term effect of the reduced form shocks, we can obtain the long-term matrix of the structural shocks denoted by $C(1)$:

$$\begin{pmatrix} C_{11}(1) & C_{12}(1) \\ C_{21}(1) & C_{22}(1) \end{pmatrix} = \begin{pmatrix} D_{11}(1) & D_{12}(1) \\ D_{21}(1) & D_{22}(1) \end{pmatrix} \begin{pmatrix} c_{11}(0) & c_{12}(0) \\ c_{21}(0) & c_{22}(0) \end{pmatrix} \tag{19}$$

or

$$C(1) = D(1)C(0) \tag{20}$$

If $C(1)$ is lower triangular, we can derive the necessary restriction.

It comes from the restriction of one of the original shocks not having any long run impact on one of the VAR variables:

This restriction is:

$$C_{12}(1) = 0 \tag{21}$$

or

$$D_{11}(1)c_{12}(0) + D_{12}(1)c_{22}(0) = 0 \tag{22}$$

Now we are able to estimate $C(0)$ and together with $D(1)$ to estimate the structural shocks.

In fact, these restrictions make $C(1)$ lower triangular and we can use this property to recover $C(0)$.

Putting long term expression (9) (see paragraph 2) and (15) together we have:

$$C(1)C(1)^T = D(1)\Omega D(1)^T \tag{23}$$

Using the Choleski decomposition of (supra), $C(0)$ can be identified by the following equation:

$$C(0) = D(1)^{-1} N \tag{24}$$

where N is the lower triangular Choleski decomposition.

HOW DARK IS THE NIGHT: THE CONSUMERS' MOOD COPING WITH THE CRISIS. EVIDENCES FROM ISAE CONSUMER SURVEY

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Abstract:

Since 2008 the global economy, following also the financial crisis, is facing a severe decline in economic activity and the economic estimates concerning the first quarter 2009 are even worse. The Italian Consumers Confidence Indicators (CCI), however, after a sharp fall beginning in 2007, is unexpectedly showing some signals of recovery since the end of summer 2008. It seems that the effects of the financial crisis have not influenced Italian consumers yet, as it is documented worldwide.

It is worth sorting out this puzzle. The paper tries to explain these trends starting from the role played by the single elements on which the composite indicator of confidence climate is determined. Then the recent price evolution and its influence on the Italian Consumer Confidence dynamics are investigated. Since end of summer 2008, the sharp inflation slowdown together with nominal wages increase, may have contributed to keep confidence from falling. A further tool for explaining recent CCI dynamics could also be represented by a micro-data analysis of opinions of population sub-groups, because some of these could have been more exposed than others to the crisis. Therefore the paper explores reactions of different consumers segments (e.g. by income, professional status, household composition).

Keywords: Consumers Confidence, Consumption, Survey data.

Jel Classification: C21; D12

1. Introduction

The aim of this paper is using information stemming from the ISAE consumer survey [Fullone and Martelli, (2008)] in order to inquire how consumers are facing the current recession. The paper is composed by two main parts. Firstly (Sections 2 - 9) a mainly descriptive presentation of the ISAE Consumer Survey results is introduced, focusing on the very recent months and on the most interesting series, i.e. concerning opinions about prices, saving and unemployment and, above all, the Consumer Confidence Indicator. CCI is analyzed as a whole and by different breakdowns, either focusing on subsets of Confidence (as Personal, Economic, Current or Future ones) and by sectoral breakdowns (e.g. by occupations, income quantiles, geographical areas) to better focus consumer attitudes. Then (Section 10), using a micro-econometric methodology, we will try to distinguish the behaviors of different groups of the population as regards confidence during these key quarters. Through an ordered probit model it is possible to highlight the features characterizing the mood of various categories (age, gender, professional status, etc.) and their relative shifts during the observed period. Conclusions follow, containing a tentative answer to the question: what consumers confidence trend tell us?

2. The Consumer Confidence

It is worth noticing that Tendency Surveys [European Commission, (2006, 2007)] offer very timely information even though of qualitative kind. It is then possible to analyze the "present" situation and this occurrence gives sure advantages in understanding the economic frame.

A further essential economic interest of Consumer confidence lies in the fact that it has often been used as a proxy variable of households' consumption, also with leading capacities [see e.g. Klein and Ladiray, (2002)]. A wide literature has been dedicated to Consumer confidence and its relationship with consumption since the leading work of Katona (1951, 1975) and, for Italy, by Parigi and Schlitzer (1994) and Locarno and Parigi (1995). A recent and thorough review of literature referring to the role of confidence and its relationship with consumption is presented in Malgarini and Margani (2007). The authors point out that confidence contributes to explain households' consumptions besides the economic macro-variable correlated with them. They further assess that

Confidence is also affected by political or exceptional events, mainly, however, when straight linked to situations directly influencing consumers.

In the past it has been observed that during the sharp 1992-1993 recession the Italian Consumer Confidence Indicator fall amounted about 20%. A similar drop was also recorded during the 2002-2004 period, even though consumption didn't fall and the recent ISAE revision of cycle chronology [ISAE, (2009)] defined the period May 2003 - August 2007 as a recovery phase of the economy (the 2002-2004 drop could be mainly imputed to the changeover tensions that let uncertainty increase).

The focus of the present paper is on the most recent time span since January 2007 up to now (June 2009), for which other kinds of information are scarce or even missing. Since August 2007 the Italian economy has entered a contraction period, worsening over the time. Accordingly, and to some extent anticipating the downturn, Consumer Confidence fall between January 2007 and July 2008 about 13%. Just after mid 2008, the world credit crisis let the world economy enter the most severe recession since Second World War. Unexpectedly, however, in Italy CCI recovered a major part of the previous 2007-mid 2008 drop in the last year (+ 10%), since July 2008 up to now (June 2009), when the crisis is perhaps easing but its end is not yet certainly foreseeable, after the GDP decrease of 2, 4% in the 2009 Q1 with respect to the previous quarter and of 5, 9% with respect to 2008 Q1 [ISTAT, (2009)].

This recent and continuous positive trend stands for the key question the paper tries to answer, concerning the determinants of the recent trend of the Italian CCI.

3. Recent evolution of Consumer Confidence

In this section, while presenting consumer series starting in 2000 in order to better define the frame, the attention is mainly focused on the period since beginning 2007 up to now, with major attention to the last months, since July 2008 up to June 2009.

Italian Consumer confidence, after the 2002-2004 slowdown probably due to the changeover difficulties, shows a correlated shape both with cycle index and ISTAT household consumption (Figures 1 and 2). Already from the graphical inspection, CCI leading features are evidenced in the 2007 upper turning point that consumer assessed beginning of the year. Since mid 2008 Confidence seems to show, besides, an increased variability, a possible stabilization or even the start of a recovery.
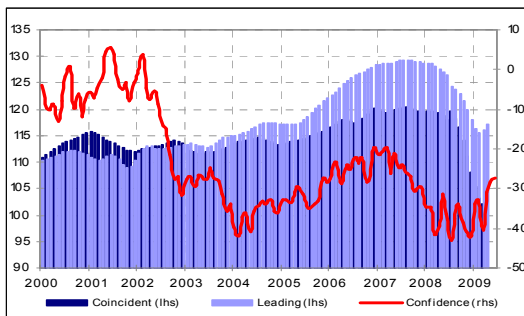
Figure 1. Cycle and Confidence
Source: ISAE
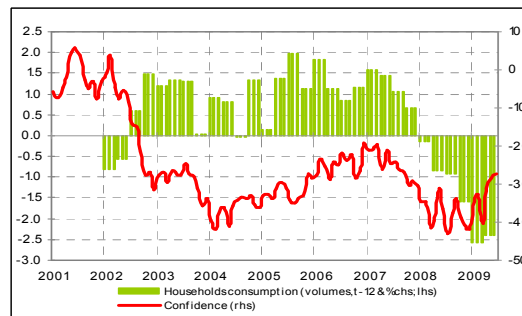
Figure 2. Consumer and Confidence
Source: ISAE; elaborations on ISTAT data

It has to be noticed that in Italy, as in most European countries, the financial crisis did not exert the heavy effects on individuals' vulnerability it could cause on the United States, where pension and health care systems are mainly managed by private funds. Besides, no bank went bankrupt in Italy. Moreover, crisis cut inflation that has been accelerating since the beginning of 2007 up to mid 2008, and afterwards showed a remarkable drop. Also this occurrence contributed to easier the consumers' worries.

Bound to the industrial crisis, however, labor market worsening is likely to have contributed to lower Consumer Confidence. As known, a main drawback of the Italian welfare system concerns the lack of an universal unemployment benefit[17]. However, it has to be considered that an instrument as the Cassa Integrazione Guadagni – which grants an income to some kinds of workers who are temporary suspended for economic reasons - allows maintaining the relationship between the

employee and the firm. This can contribute to avoid a drop in employees' sentiment when firms go trough difficult economic periods.

4. Confidence and Saving

To improve our understanding of confidence performance, in this paper a slightly different version of the usual ISAE consumer sentiment indicator is presented. It is computed[18] as simple average of the series (excluding bases and constant) and is aimed to better highlight the swings of the series in the recent tumultuous months. The same reasons led us not to seasonally adjust the data. Further more the saving opportunity is excluded from the confidence computation. This latter series in fact stems from an ambiguous question. Namely the wording is: "Do you consider the present time a good moment for saving?"[19]. Positive answers could be given indeed for conflicting purposes (e.g. for finance investment or for life-cycle or precautionary objectives).

From Figure 3 it is evident that since the beginning of 2007 confidence (grey broken line) and saving opportunity (black line) show opposite trends. The precautionary aspect of the opportunity to save is probably prevailing and often this occurrence is bounded with consumer uncertainty against the future [Guiso *et al.,* (1992)] and [Carroll and Kimball, (2006)] and could be one of the factors restraining consumption [ISAE, (2009)]. When we considering a Confidence Indicator calculated excluding present saving opportunity (red line) this evidence becomes even more remarkable[20]. Therefore, in the following sections, these latter versions of the indicators will be applied[21].
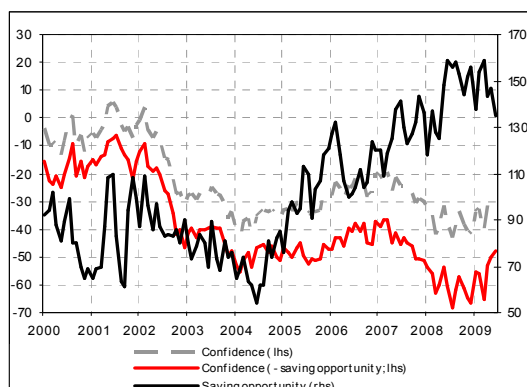
Figure 3. Consumer Confidence and Saving; raw data
Source: ISAE
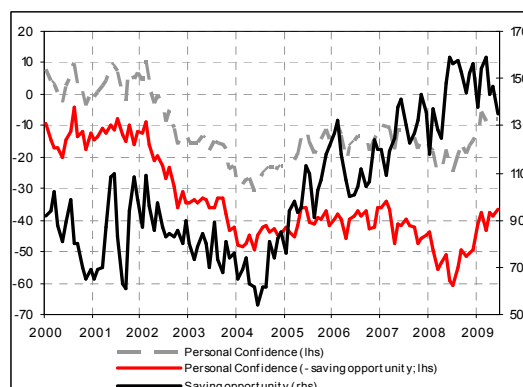
Figure 4. Personal Confidence and Saving; raw data
Source: ISAE

The precautionary aspect of saving opportunity is also confirmed looking at the confidence index breakdowns (Figures 4-6). The positive correlation between saving opportunity and confidence (Table 1) observed up to 2004, weakens in 2005-2006 and turns negative since 2007. This effect is relatively stronger for Personal and Current Indicators, but in the last period also for Economic and Future Confidence.

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[18] See Methodological Notes in Appendix for the formulas applied for calculating the ISAE Consumer Confidence indicator and its breakdowns.

[19] The EC wording more properly is: "In view of the general economic situation do you think that is now a very good/fairly good/not a good/a very bad moment to save". Also this version, even different from the Italian one, could give raise to ambiguity in interpretation.

[20] A similar behavior, even though weaker in intensity, was also recorded during the 1993-1996 recession.

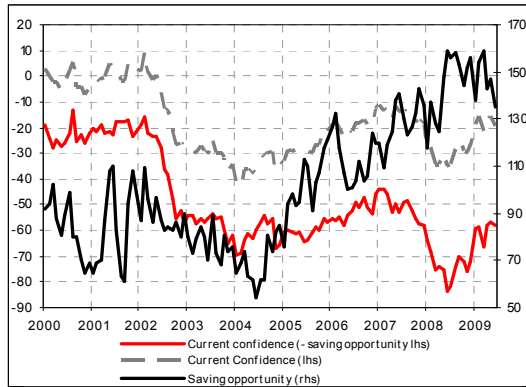[21] Future and Economic Confidence have only one version as saving opportunity isn't a component of them.

Figure 5. Current Confidence and Saving; raw data
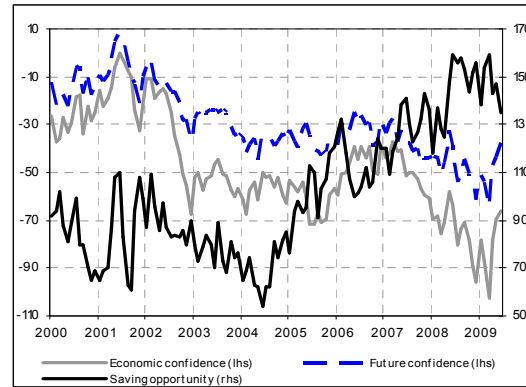
Source: ISAE

Figure 6. Economic and Future Confidence and Saving; raw data

Source: ISAE

Consumers somehow considered that the domestic crisis started in 2007 affected their personal situation much more than the world financial one that broke out with its impressive effects September 2008. This latter, is more influencing the economic and future perceptions. It looks like consumers feel to some extent personally more "protected", less "uncertain" about their own situation and current assessment.

Deep pessimism shaped, on the contrary, the Economic and Future Confidence since the beginning of 2007 up to March 2009. Since April 2009 on, however, they record a sharp positive upswing. Possible explanations could be attributed to the first public announcements on the possible overcoming of the most negative phase.

Table 1. Confidence and Saving Opportunity

R2	Total confidence		Personal		Current		Economic		Future
Date	Total	excl. saving opp.	Total	excl. saving opp.	Total	excl. saving opp.	Total	Total	Total
2000-2004	0.5239	0.4428	0.6027	0.4714	0.5478	0.4172	0.3842	0.4520
2005-2006	0.4818	0.1768	0.7837	0.2878	0.7161	0.3302	0.0703	-0.0200
Jan07-Jul08	-0.3345	-0.4967	-0.3191	-0.6981	-0.3779	-0.5824	-0.3128	-0.1496
Aug08-Jun09	-0.6725	-0.7502	-0.3804	-0.5473	-0.4172	-0.6010	-0.5706	-0.6693

Source: ISAE

A further tool for evaluating the saving perceptions is offered by the financial stress indicator outlined by Malgarini [ISAE, (2008)]. This indicator is simply calculated from the question on household financial situation included in the consumer survey, as the percentages of answers indicating that consumers have to use their own savings or get into debt. According to this indicator (Figure 7), consumers reported increasing financial stress since beginning 2007, anticipating the August turning point; this behaviour, however, sharply turned upside down mid 2008, together with the domestic inflation slowdown (see below) and despite the international financial crisis.
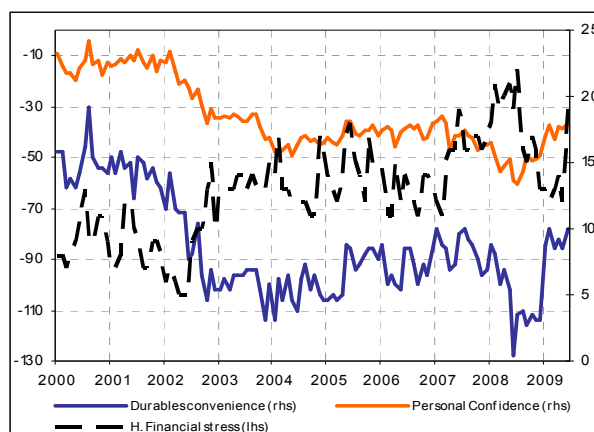
Figure 7. Durables and Financial stress

5. Inflation

After the troubled changeover years, since the beginning of 2007 Consumer qualitative perceptions satisfactorily fit the consumer price evolution (Figure 8 and 9). Consumers were clearly aware of the 2007 price dynamic acceleration and of the subsequent mid 2008 slowdown which, coming with the renewal of many collective labor agreement during 2008, is well reflected on their optimism, particularly on the Personal Confidence.
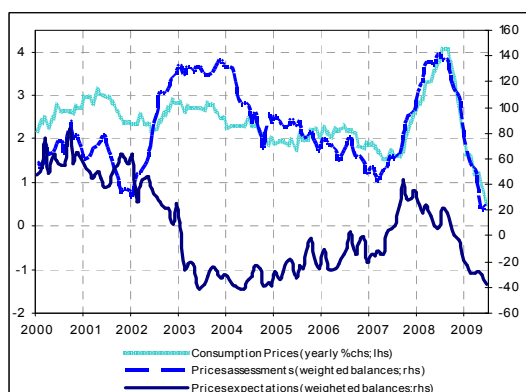

Figure 8. Prices and Inflation
Source: ISAE and ISTAT
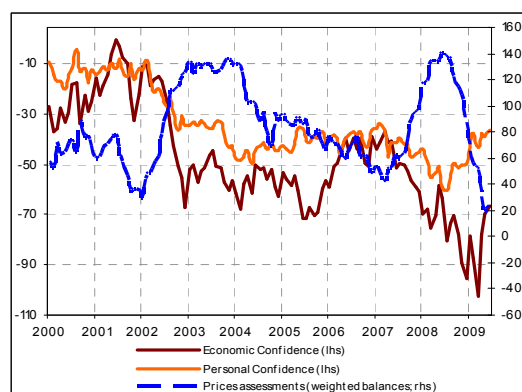
Figure 9. Confidence and Inflation
Source: ISAE and ISTAT

In fact, the judgment on prices evolution seems to influence a lot Italians mood, offering a reason for the current Confidence improvement. This is confirmed by Golinelli and Parigi (2005), which - in their model for the estimation of CCI - find a structural break in coincidence with the changeover, disappearing if perceived perception on prices evolution is included in the estimate. Gabriele, Pollastri and Raitano (2009), have estimated the Personal Climate till 2008, find that the price dynamic is significant and have a negative coefficient.

6. Geographical breakdown

Disaggregating confidence indicators by geographical areas, from a preliminary graphical inspection, significant different patterns in the dynamics of North and South do not emerge. Instead, differences are better investigated with the micro data analysis presented in Section 10. After the 2007-mid 2008 slowdown, all areas show a positive shape during the recent months (Figure 10). North-west regions are characterized by an above-the-average persistent optimism, while the persistent pessimism featuring Centre-South of Italy seems to decrease in comparison with the rest of the country the last year.
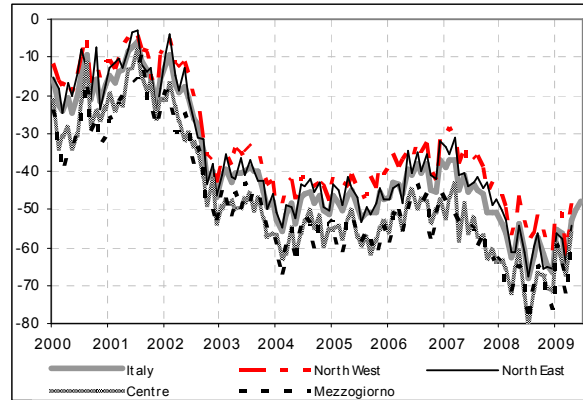
Figure 10. Consumer Confidence by Areas

Looking also at Confidence components in the different areas, the mid 2008 recovery, mainly due to Personal and Current assessments, is everywhere widespread (Figures 11-14).
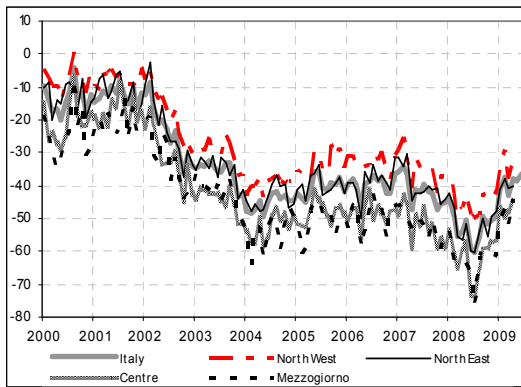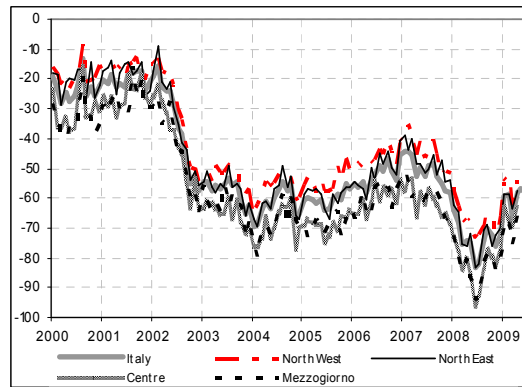

Figure 11. Personal Confidence
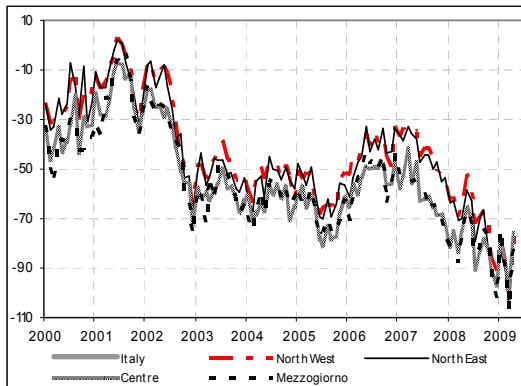

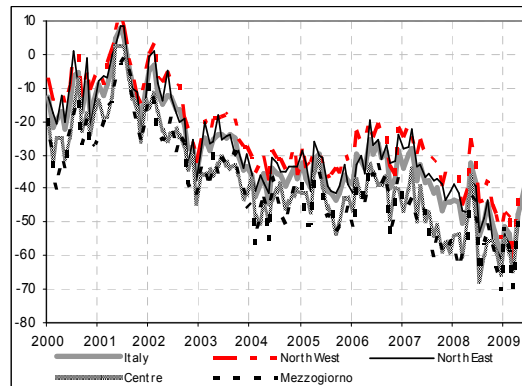**Figure 12.** Current Confidence

Figure 13. Economic Confidence

Figure 14. Future Confidence

7. Professional statuses breakdown

Looking at the breakdown by professional statuses, working consumers are steady more optimistic than the average (Figure 15). Among them, self-employes show a continuous higher profile also in the most recent months. Unemployed, even though more pessimist, don't show any confidence collapse (as it could be feared) since mid 2008. Looking at the confidence indexes breakdowns (Figures 16-19), major differences between professions concerning Personal, Current,
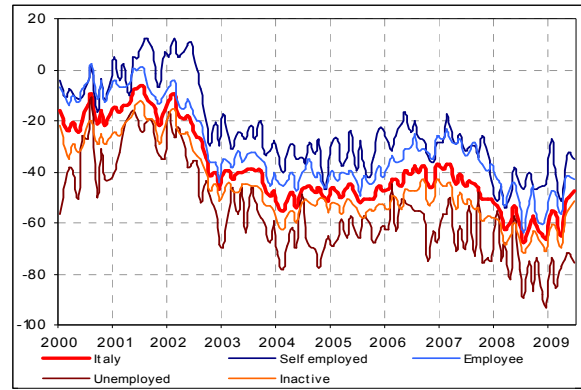
Figure 15. Confidence Climate by Professional Status
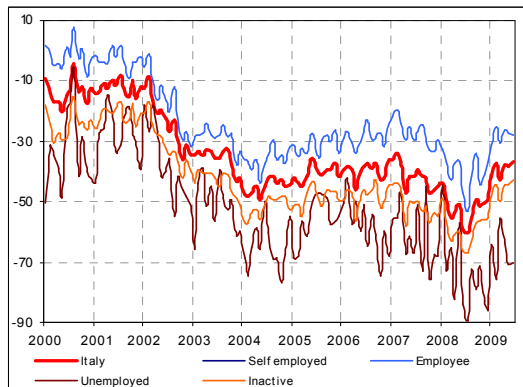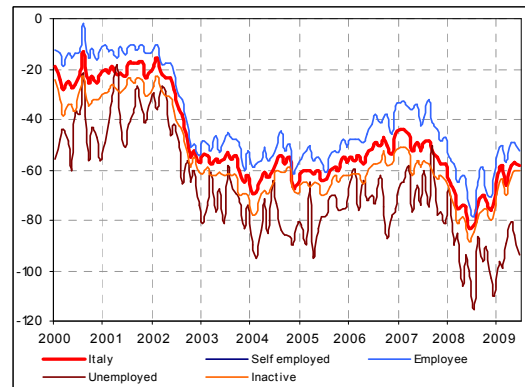

Figure 16. Personal Confidence by Prof. Status

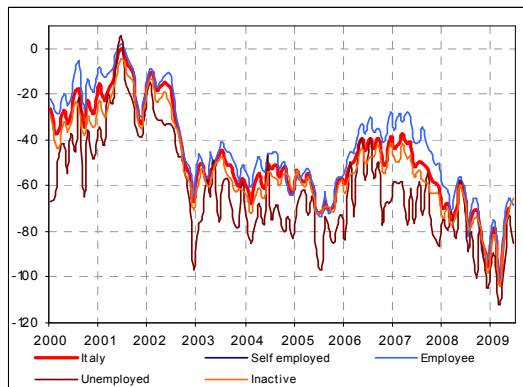**Figure 17**. Current Confidence by Prof. Status

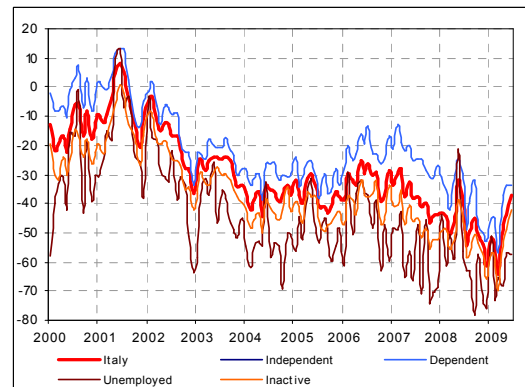**Figure 18.** Economic Confidence by Prof. Status

Figure 19. Future Confidence by Prof. Status

and also Future indicators emerge, while for the index concerning Economic Confidence opinions are more homogeneous. Personal and Current indicators also confirm the increasing trend since mid 2008 for all occupational breakdowns. The evaluations on Economic and Future situation remain more cautious.

8. Unemployment

Due to the recessive phase, the expectations of unemployment increase reached in the first quarter of 2009 their historical maximum. Nevertheless, since April they show a sharp downturn (Figure 20). This improvement in labor market expectations could be seen as a positive signal stemming from consumers. They start to have less negative forecasts for the near future. This positive mood affects the very recent economic confidence.

Evident inverse correlation between Personal Confidence and unemployment expectations since mid 2008 is, on the contrary, not easy to explain (Figure 21). The most recent available official figures

on unemployment refer to 2009 Q1, when the situation was still beginning to worsen while a strong deterioration is likely to become manifest only in the current months. ISAE Consumers perceive a labor market weakening since mid 2008 up to 2009 Q I; this occurrence, however, does not affect their personal situation (which is improving) may be as the unemployment increase is assumed as a limited phenomenon that should not concern the majority of respondents. This occurrence could be confirmed by the 2009 Q II Survey data, when to a remarkable recover in the labor market expectations corresponds a steady Personal Confidence outcome.
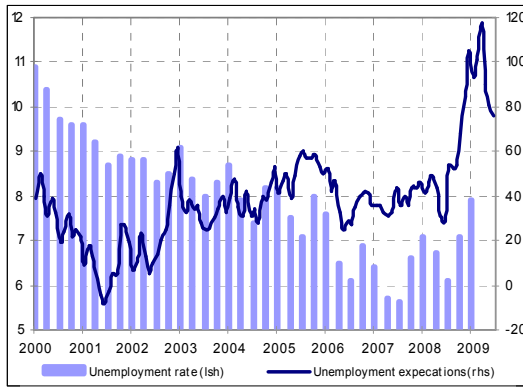
Figure 20. Unemployment and expectations
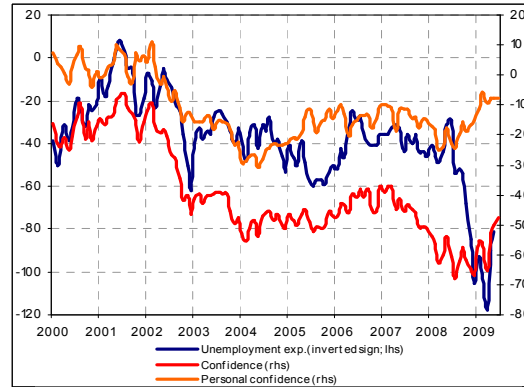**Source**: ISTAT Labour Force Survey; ISAE

Figure 21. Unemployment and Confidence
Source: ISAE

9. Income

Analysing confidence by income quartiles (Figure 22 and Table 2), it comes out that the most wealthy one (Q4) has been showing a remarkable loss in confidence, mainly since mid-2007 up to July 2008. This kind of consumer, likely owning larger stock of financial assets, were the most hit by the crisis even before the July 2008 subprime drop, as the financial markets started to worsen already in 2007. The most recent months, however, even they are characterised by a high volatility (uncertainty), they also show the higher (even though still limited) recover in confidence.

The third quartile (Q3) also shows a drop in the January 2007 - July 2008 period, but of lower intensity. It is interesting to point out the non-respondent to the question of household income behavior (Q_NR). In recent times this elusive group of consumers is unfortunately amounting to about 25% of the respondents, nearly vanishing the possibility of any precise estimation (for this reason information about income quartiles are not used in the micro-econometric analysis carried out in Section 10). However, treating non-respondents as a fifth quartile, some information do emerge. They show a very similar profile as the third quartile, just with more uncertainty in the last year. Maybe this group is composed by consumers with less stable (even not deprived) situation, who are not so able to cope with the present difficulties. Q2, showing a good recovery since last July, is likely to be the category, which better benefited from the strong inflation drop. The poorest quartile (Q1) shows relatively limited swings, downwards until July 2008, and upwards in the subsequent recovery. It is worth noticing however that the drop for these consumers already started in 2006.

Table 2. Income % changes

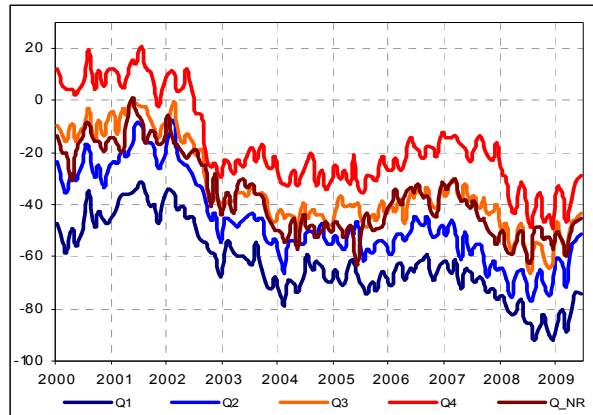| % Changes	Jan2007-July2008	July2008 - Jun2009
Q1	-39%	14%
Q2	-49%	33%
Q3	-82%	35%
Q4	-234%	41%
Q_NR	-85%	28%

Figure 22. Confidence by Income quartiles

The graphical inspection seems to suggest that the confidence is recovering since mid 2008 for all the quartiles with different intensity. The improvement is however stronger for the wealthy ones (mainly Q4), maybe also due to the (relatively) lower volatility shown by financial markets. To a less extent the recovery features also Q3 and Q2. According to Leproux and Malgarini (2007), it is the confidence of the poorer segments of population that should more affect the consumption expenditure, suggesting in our case some doubts on possible favourables trends in the near future.

Personal Confidence even if at different levels, showed substantial stability in 2006-2007 for the two upper quartiles (Q3 and Q4) while the remaining ones already began to deteriorate (Figure 23). Current confidence, instead, recorded downward trends for all the quartiles but the richest one (Q4) since beginning 2007 (Figure 24).
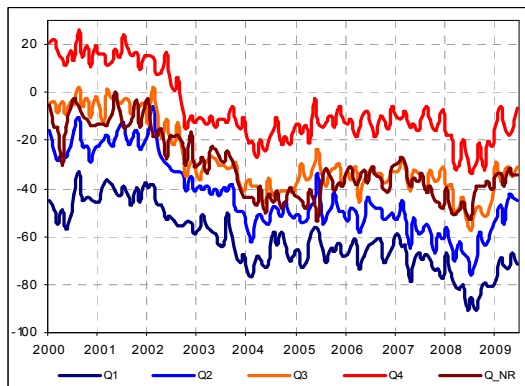

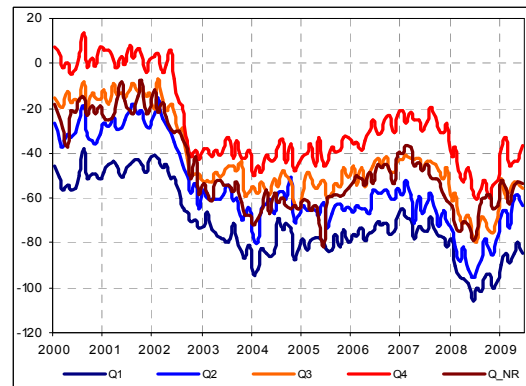**Figure 23**. Personal Confidence by Income Quartiles

Figure 24. Current Confidence by Income Quartiles

In the second half of 2008, similar profiles are shown by Personal and Current Confidence, where sharp increases, are recorded for all. Economic confidence (Figure 25) shows a negative and very volatile profile for all the quartiles. Maybe the most recent upswing could be seen as the starting point of a better mood. Looking at future confidence (Figure 26) convergence emerges in all the quartiles but the first one which show an increasing pessimism.
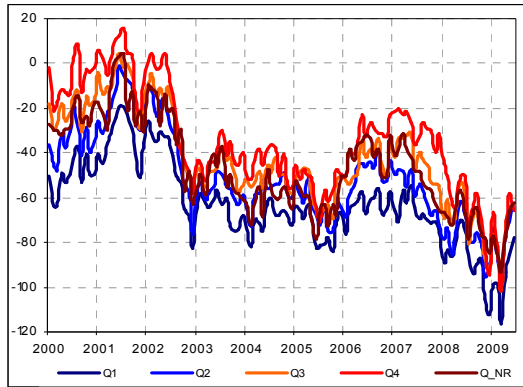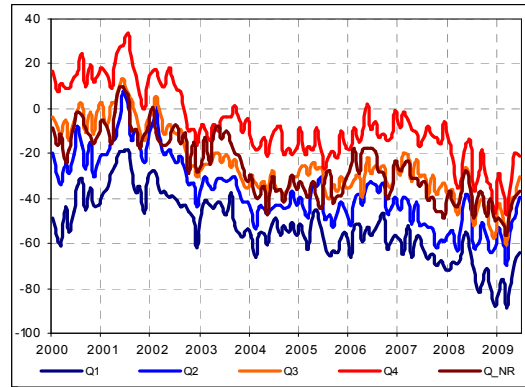
Figure 25. Economic Confidence by Income Quartiles   **Figure 26.** Future Confidence by Income Quartiles

10. Micro data analysis

The analysis is carried out through an ordered probit model[22], because the dependent variables used in the regressions are qualitatively ordered ones (their increase means a better sentiment)[23]. The variables investigated are the different compositions of Confidence Indicator, namely Total, Personal, Current, (both without saving opportunity), Economic and Future. On the right side of the estimated model a large set of explicative variables is included: gender, age, the number of family components and of income recipients inside the household, a dummy signaling if there are children younger than 18 in the household, the educational attainment, the dimension of the town of residence, the geographical area (North-West, North-East and South/Islands, assessed respect to Centre) and the professional status. In particular the professional status is assessed comparing, respect to the modality "white-collar", the following statuses: student, housewife, retired, unemployed, farmer[24], blue-collar and self-employed. Regressions are carried out for each quarter since 2007 to the first quarter of 2009 and, in each quarterly regression, monthly dummies are included too.

In general, major information can be collected with reference to the Personal Confidence, on which the analysis is mainly focused. In this frame, women are significantly less optimistic than men for all the observed period. The higher is the number of income earners in the household, the better is the sentiment, and the bigger is the number of household members, the worse is the mood (these results are evidently due to the level of per capita available resources). Having got a mortgage worsens the sentiment, as well as renting the house.

The younger are the people interviewed, the wider is the optimism. People with higher education attainments perceive less vulnerability (but it has to be remarked that education, rather than signaling a pure better sentiment against the crisis by people with a higher attainment, could merely signal a better feeling by well-off individuals, being, on average, higher educational attainments associated to higher incomes). The estimated coefficients of the variable "dimension of the town of residence" and of the dummy recording if there are children aged under 18 in the household are non significant nearly in all quarters since 2007.

Let's now analyze some variables which show several interesting changes during the observed period that is focusing on the dynamic before and during the crisis. Table 3 and Figures 27 and 28 show the signs of the estimated coefficients for professional categories (see also Figures 15-19) and geographical areas (Figures 10-14), i.e. "+" means that the considered category gives a better judgment than the reference one (+1 in the Figures), "–" (-1 in the Figures) means the opposite, and "0" stands for a not significant result at a precision level of 5%.

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[22] For a detailed treatment of the ordered probit model see Verbeek (2008).

[23] Dependent variables are obtained as a simple sum of variables recording individual sentiments along many dimensions, which are recorded trough five qualitative modalities, ordered by increasing levels of confidence. Consequently the dependent variables used in this section, being obtained as a simple average of values of qualitatively ordered variables, are themselves qualitatively ordered too.

[24] However it has to be noticed that the number of farmers interviewed by ISAE survey is very low ranging about less than 50 interviews per wave.

Table 3. Ordered Probit Coefficients of Personal Confidence Breakdowns (Reference categories: White collars and Centre; P>|z| <0.05)

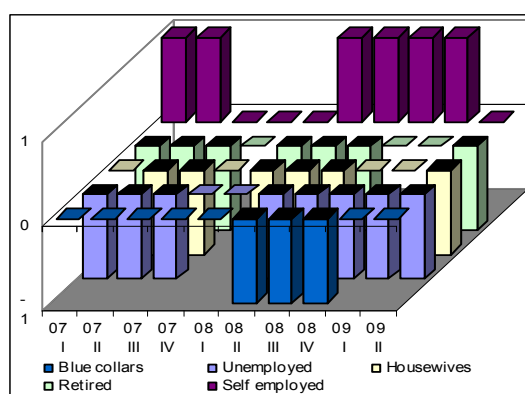| Years/Quarters	2007 I	2007 II	2007 III	2007 IV	2008 I	2008 II	2008 III	2008 IV	2009 I	2009 II
Breakdowns										
Unemployed	-	-	-	0	0	-	-	-	-	-
Students	0	+	+	+	+	0	0	+	0	0
Housewives	0	-	-	0	-	-	-	0	0	-
Retired	-	-	-	0	-	-	-	0	0	-
Self_employed	+	+	0	0	0	+	+	+	+	0
Blue collars	0	0	0	0	0	-	-	-	0	0
North_West	0	0	+	0	0	+	+	+	+	+
North_East	+	0	+	0	+	+	0	+	+	+
South	-	-	0	-	-	-	-	0	-	0

Figure 27. Personal Confidence by Professional Status (Reference category: White Collars)
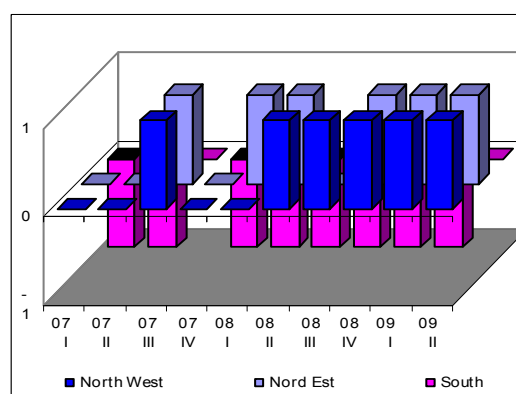

Figure 28. Personal Confidence by Areas (Reference category: Centre)

The unemployed are usually more worried about their personal situation than the white collars (taken as reference category). This is not true only in 2007 Q IV and 2008 QI, after unemployment and the hours of Cassa Integrazione (mostly paid in the manufacturing sector) reached a minimum in 2007 [ISAE, (2009)].

On the contrary, students are generally optimistic. It is more interesting to underline those housewives and retired people, who show great vulnerability in 2007 and till the third quarter of 2008, align afterwards their sentiments to those of white collars. It seems that the price rise of the last couple of years represented a relatively harder problem for them, while the financial crisis, with all its consequences, is not so worrisome. Some negative signals, however, stem out again from the most recent outcomes.

Self-employes judge their personal situation with more serenity than white collars, mostly since 2008 Q II. Maybe they first felt that economy turned down, then, since 2008 Q II on, while the crisis was worsening, self-employed have been showing a greater optimism than white collars, suggesting better capabilities and flexibility to face the recession.

Blue collars became more pessimistic since the second quarter of 2008, perhaps because of the worsening of labour market situation, especially in manufacturing [ISAE, (2009)]. In 2009 Blue collars sentiment is again not significantly different from White collars one and this can be due to a worsening of tertiary sector.

However, is worth pointing out that the results of the 2009 Q II on Personal Confidence warn against unfavourable upcoming trends for all categories.

As for the geographical areas, the increasing optimism of North residents, in particular since 2008, and the pretty constant bad sentiment expressed in the South have to be noticed.

It can be interesting to compare these trends with those concerning the Economic Confidence climate. The Table 4, the Figures no 29 and no 30 show that in this case much more often the categories do not differentiate each other significantly.

Table 4. Ordered Probit Coefficients of Economic Confidence Breakdowns (Reference categories: Employees and Centre; P>|z| <0.05)

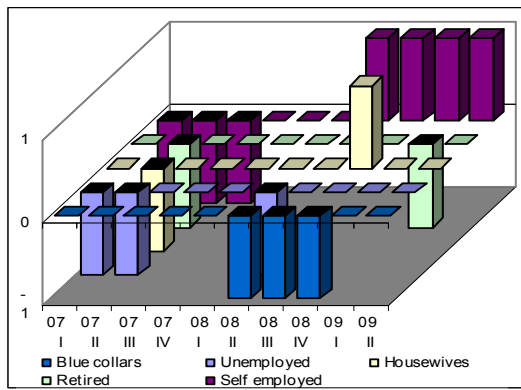| Years/Quarters	2007 I	2007 II	2007 III	2007 IV	2008 I	2008 II	2008 III	2008 IV	2009 I	2009 II
Breakdowns										
Unemployed	-	-	0	0	0	-	0	0	0	0
Students	0	+	+	+	+	0	0	0	+	0
Housewives	0	-	0	0	0	0	0	+	0	0
Retired	0	-	0	0	0	0	0	0	-	0
Self_employed	-	-	-	0	0	0	+	+	+	+
Blue collars	0	0	0	0	0	-	-	-	0	0
North_West	0	0	+	0	0	+	0	+	+	0
North_East	0	0	+	0	+	+	0	+	0	0
South	-	-	-	-	-	-	-	0	+	0

Figure 29. Economic Confidence by Professional Status (Reference category: Employees)
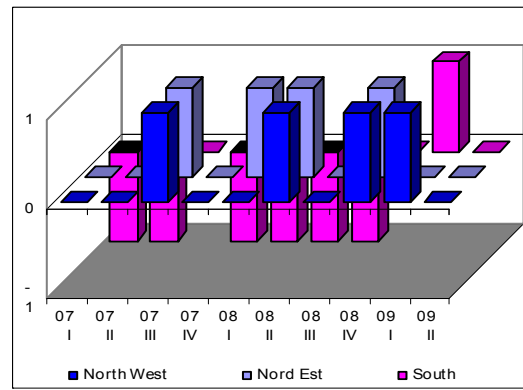

Figure 30. Personal Confidence by Areas (Reference category: Centre)

More specifically, opinions about Economic Confidence by unemployed, housewives and retired are not worse than those of white collars. Self-employed are pessimistic on economic situation at the beginning of the period and they became relatively more optimistic only since the third quarter of 2008, confirming a certain earlier reaction to the economic cycle by this category. No changes are registered for blue collars.

The geographical areas show less polarisation than the previous case and a certain improvement of the South sentiment respective to the Centre in 2009 Q I.

Looking at Current (Figures 31 and 33) and Future (Figures 32 and 34) opinions, we also find some differences. Main divergences among groups stand out on the assessments on Current Confidence, especially with regard to housewives and retired, which tend to align to white collars about the opinion on Future climate since 2008 QIV. The differences by geographical areas are not very relevant.
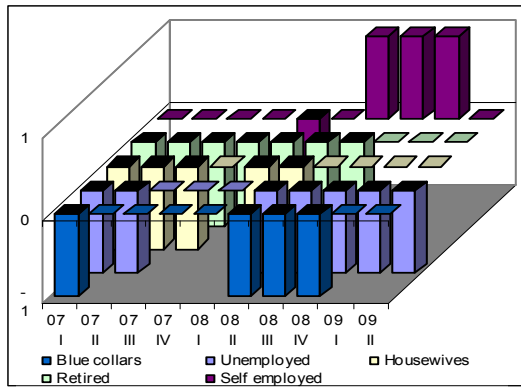
Figure 31. Current Confidence by Professional Status (Reference category: Employees)
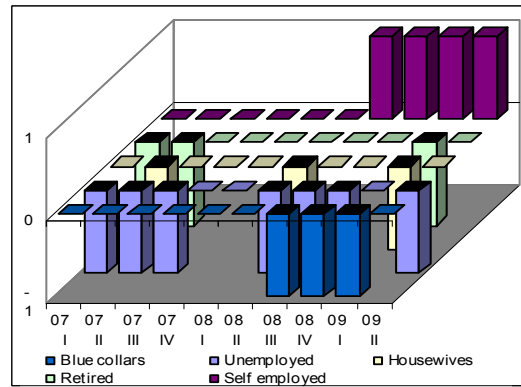

Figure 32. Future Confidence by Professional Status (Reference category: Employees)
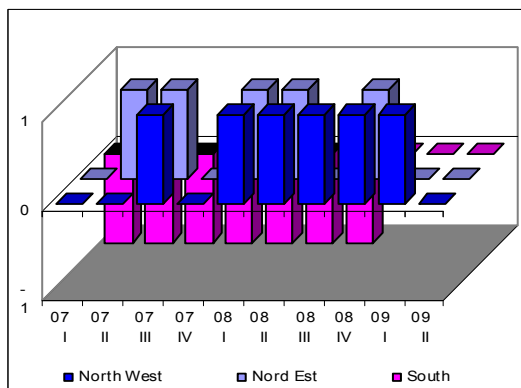

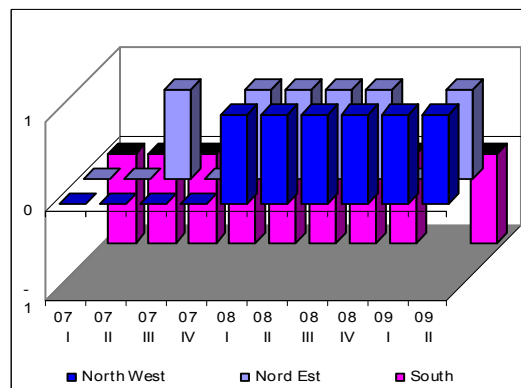**Figure 33.** Current Confidence by Areas Status (Reference category: Centre)

Figure 34. Future Confidence by Areas Status (Reference category: Centre)

11. Concluding remarks

Previous analyses show those consumers' capabilities of perceiving the economic situation is not as bad as it could appear at first sight. In fact, they reveal definite signals of disease since beginning of 2007, anticipating the August turning point.

The mid 2008 Personal Confidence improvement seems mainly depend on the inflation rate drop, in a frame of renewal of several collective working agreements. It is however puzzling that the dramatic rise in unemployment expectation recorded since mid 2008 does not affect the Personal Confidence (Figure 21).

The positive evaluation of their own personal situation doesn't prevent consumers from being worried on economy and future. Furthermore they consider precautionary saving necessary.

Since April 2009, however, Personal Confidence improvement seems to slow down, if not even stop, while Economic Confidence seems definitely recovering. It is worth waiting for next months evolution before trying to explain these occurrences, which could anyway be influenced on one hand (i.e. concerning Personal Confidence) by the labour market difficulties broadening, on the other hand (i.e. concerning Economic Confidence) by the announcements about the possibility that the worst is over.

The confidence improvement of the past quarters –if not contradicted by the following months- could represent a positive sign towards a possible consumption stabilisation.

From the ordered probit analysis, focusing on Personal Confidence and on professional statuses, it emerged that housewives and retired, which probably were the groups the most sensitive to the price dynamic, improved their relative mood in 2008 QIV when inflation went down. Blue collars instead are characterized by deterioration since 2008 QII, probably because of the labour market worsening. Self-employed workers seem to be the more optimistic, apart from the months when the economy touched its maximum turning point and started to worsen: they seem to have correctly anticipated the

cycle swings. Since the same quarter also sentiments of people living in North areas became more positive. Then these usually (relatively) well off groups (self-employed and North living people) show better capabilities of coping with the recession. Finally it has to be pointed out that economic and future sentiment show more homogeneous results.

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Appendix: Methodological Notes

Within the E.U. Harmonised Survey, ISAE carries out since January 1982 its monthly Consumer Survey on a representative sample of 2,000 respondents. Hereafter a list is provided of the main survey's characteristics.

▪ The sample is a stratified two-stage (telephone subscribers / consumers) random sample. The reference universe is represented by the full-aged (18+ years) population, stemming from the Census survey and yearly updated with demographic statistics outcomes. The stratification in 42 strata is performed according to six geographical areas and seven classes of demographic width of municipalities.

▪ The frame is made up of the telephone subscribers list, ordered by region, administrative district, municipality and zip code. Random data selection method is applied within each stratum.

▪ The data collecting method applied is the Computer Aided Telephone Interviewing (CATI). Interviews are carried out in the evening hours of the first then working days of the reference month.

▪ The survey is weighed by using the calibration methodology and the CALMAR software (CALage sur MARges). The calibration variables are: age, regional population, occupation, education and demographic width of municipalities.

▪ This design allows increasing the precision of estimates from the theoretical 2.2 per cent of a simple random sample of size 2000 to 1.38 per cent (2005 average).

▪ Consumer survey comprises (apart from some information on households' structures and incomes) fifteen qualitative harmonised questions characterised by three-to-five reply options (for example, much increased, rather increased, slightly increased, stable, diminished) based on two main topics: notably, opinions on the overall economic situation and opinions on the personal situations. Since 2002 some further question on households' life were added.

▪ For the fifteen above mentioned question, the results are expressed in terms of the relative frequency of each reply option. Balances (differences between favourable and unfavourable answers) provide the indications on the observed phenomena. Balances may be simple (options are aggregated without weighting) or weighted (by attaching double weight to extreme options. The weights adopted are: 2.1, 1.2). Central options (for example, Stable) are not considered in the computation.

▪ The Italian Consumer Confidence Indicator (CCI) is an overall synthetic indicator of the survey. It is elaborated by ISAE on the basis of nine series considered most suitable to evaluate consumers' optimism/pessimism (notably: ex ante and ex post general and households' economic situations; unemployment trend-with inverted sign; present opportunity and future convenience to save; propensity to purchase consumer durables; households' budget). The results of the nine questions, expressed as seasonally adjusted weighted balances, are aggregated through a simple arithmetical mean setting 1980 = 100 as base year.

▪ ISAE also computes four sub-indexes, namely: Economic, Personal, Current and Future situation Confidence indexes. The first is built as arithmetic simple mean of weighted balances of assessments and expectation on general economic situation and on unemployment expectations. The second as average of the remaining six series composing the overall confidence indicator (assessments and expectations on personal situation, household financial situation, opportunity and possibility of saving, convenience of major purchases). The third one is computed as average of questions on assessments (general and personal economic situation, saving opportunities, household financial situation, and convenience of major purchases); the last one as average of expectations (general and personal economic situation, unemployment, and saving possibility). All indicators are based 1980.

▪ All the series and the Confidence indicators are seasonally adjusted with TRAMO-SEATS method (These latter with the direct method).

Since September 2001, for each Member State, the Commission computes, as Confidence Indicator, seasonally adjusted (Dainties method) weighted balances (weights being 1, ½, ½, 1) of four series (expectations on the general and on households' economic situations, on unemployment and savings) and aggregates them with a simple arithmetical mean with no index number. The synthetic indicator for EUR-12 is obtained through the arithmetical mean weighted with single countries' private consumption levels.

GENDER, CORRUPTION AND SUSTAINABLE GROWTH IN TRANSITION COUNTRIES

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Abstract:

Numerous studies have found negative connection between corruption level and economic development. At the same time few of them demonstrate correlation between women representation in politics and corruption level. This paper analyzes correlation between gender and corruption for a specific sample of countries, sharing common cultural and historical legacy – transition countries. Relationship between higher number of women in parliament and decreasing level of corruption is supported by data. Relations with other forms of women social activity were found to be insignificant. Contribution of this paper to the research literature on this topic is twofold. First analysis on gender and corruption in transition economies has previously not been done. Second, this study could also be used for the practical policies on fighting corruption by application of gender quotas.

Keywords: gender; corruption; growth; transition countries

JEL Classification: J16, H11; K42; O10

1. Introduction

After the years of recession most transition countries experience economic recovery. Central and Eastern Europe countries (CEECs) recorded growth already in the early 1990s, though the Commonwealth of Independent States (CIS) remained in the doldrums by the late 1999. Since 2000, however, the CIS countries have also started to recover and even had more than 4 percentage points higher annual growth than the CEECs. From 1999 to 2004, 11 CIS countries had an average annual growth of 7.8 percent, while the four Central European Visegrad countries (Poland, the Czech Republic, Slovakia, and Hungary) recorded an average annual of 3.6 percent. The three Baltic countries came closer to the first group with 7.1 percent growth, and Romania and Bulgaria closer to the Central Europeans with 5.4 percent [Aslund and Jenish, (2006)].

However, this economic recovery, in particular in the CIS, is fragile, as it is rather the result of favourable world price trends than sustainable – i.e. institution-based – growth. Indeed, institution building has been recognised as a crucial additional element required for successful reforms and sustainable growth. Thus, as transition countries are keen on making their growth sustainable, they need to improve their institutional quality. Institution building in transition countries is still slow or even retrogressive, and their quality is lower than European average. Only CEECs have succeeded in institution building and demonstrate higher level of good governance, which to a high extent is the merit of their membership in the EU. On the contrary the institution building in other post-communist countries lags behind and demonstrates a lot of deficits.

Poor level of legal institutions means poor execution of the rule of law and control of corruption. Corruption is seen to be a major problem in almost all of the transition countries. Within the space of the post-communist countries the problem has reached acute levels that hinder the equal distribution of wealth; undermines public confidence in government and discredits the concept of the free market and rule of law. Therefore, the main challenge either for transition countries themselves or for international organizations that are active in the region is fight against corruption. Transition countries are also a good example to analyse the evolution of corruption. In the Soviet times, these countries experienced a uniform level of corruption, but diverge on this governance institution in the course of transition. In addition, transition countries are interesting from the point of the gender research. They are characterized by the high number of educated women, high number of female participation in the work-force, however distrust in mental abilities of women, not only by men but by women themselves, alongside low self-respect of women, wrong perception of feminism and ideas of this movement, apathy in political life and low representation of women in parliament. These countries

are very much under the influence of the traditional view on the female and male roles, which due to economic reality is not is not fully realized in (social) life.

The aim of this paper is to test the alternative measure of fighting against corruption by introducing gender quotas and maintaining women participation in political, economic and social dimensions of public life. This measure seems to be far-promising, as:

▪ there are few studies that demonstrate the negative relationship between women participation in public life and level of corruption;

▪ we expect that the psychological differences between genders – women to be more trust-worthy and public-spirited than men – dominate over corruption promoting experiences of the Soviet times and years of transition;

▪ gender quotas as the measure to fight corruption are more "regime- neutral"[1] and can be therefore implemented either in the open and democratizing or close authoritarian regimes.

This paper will proceed as follows: Section 1 discusses institution building in transition economies; Section 2 reviews studies on negative effect of corruption on economic and social development; in Section3 we turn to discussion of existing works aimed at finding the connection between gender and corruption; Section 4 presents the (geographic) region of our interest, and offers the analysis of studies on gender issues and corruption related to transition countries; in Section 5 we briefly outline the variables and the data that were chosen for this project, and Section 6 is aimed at presenting main econometric results of this paper; Section 7 presents statistical analysis aimed at determination of connection between bribe taking activity and gender, and finally conclusions, and thoughts on the implementation of the current paper are presented.

2. Institution Building in Transition Economies

The post-soviet countries experienced quite heterogeneous economic and political developments throughout the last fifteen years. At the beginning of transition, the post-soviet countries were confronted with the triple task of building a nation state, implementing democracy and moving towards a market economy. The economic reform process based on the Washington Consensus was expected to fulfil the latter task quickly. The transition results, however, were unsatisfying. The reforms implemented during transition decentralized governments. Governments lost their legitimacy already before transition and became even much weaker. Especially in CIS countries, all-encompassing states dismantled and decentralized by these reforms were not able to enforce implementation of other reforms. At the same time, the policy recommendations were foreign and alien to national central and local elites. Elites were only interested in implementation of those reforms, which provided personal benefits. As a result, reforms were implemented only partially. In the early 1990-s, institutional reforms were present in the reform packages recommended to CIS countries. However, they were not at the forefront of the reform programmes and were rather seen as a by-product of other high priority policies. Such high priority policies included achievement of macroeconomic stabilization, trade liberalization and enterprise restructuring [Hare, (2001)]. Even in cases, where the necessity of institutions was recognized and acknowledged, institution building was often flawed because of inappropriate implementation.

At that time, economics and political sciences often under-rated the role and importance of the institutional reforms, taking for granted that as soon as markets were open and market economy was implemented, institutions would be built automatically. Additionally, scientists and politicians lacked sufficient measurement tools that would incorporate a comprehensive understanding of institutions and allow them to support practical implementation. Therefore, it is not surprising that neglecting institution building turned out to be among the crucial points of criticism on the Washington Consensus. The disappointing results of transformation in these countries gave rise to a great number of studies on causality and reasons for mistakes in the design of reform arrangements [Rodrik, (2006), Schweickert and Thiele, (2004)]. In a backline, institutional reforms have been recognised as a crucial additional element required for successful reforms and sustainable growth. In the mid-1990s, on the demand of the Post-Washington Consensus that recognized the importance of institution building

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[1] By "regime-neutral" we mean the measures against corruption that are not directly based on democratic ideology. As "regime-non-neutral" measures against corruption we mean promotion of free media, import of bureaucratic practices through training programmes etc.

[Schweickert and Thiele, (2004)] and the growing need of financial lending organisations, governments and investors, several organisations established governance indicators to judge the ongoing transition process.

Although institutional quality begins to matter, institution building in transition countries is still slow or even retrogressive. The quality of institutions is lower than European average. Figure 1 shows the quality of institutions measured as aggregated value of the World Bank Governance Indicators. Only CEECs have succeeded in institution building and demonstrate a higher level of good governance. Their success is often attributed to their membership in the EU [Pop-Eleches, (2007)]. Accepting ten CEECs as new members, the EU has driven the institutional convergence of these countries towards common European values by fostering institution building by the means of the Copenhagen Criteria, financial and technical assistance in most CEECs [Gawrich and Schweickert, (2004)]. On the contrary, the institution building in other post-communist countries lags behind and demonstrates a lot of deficits.
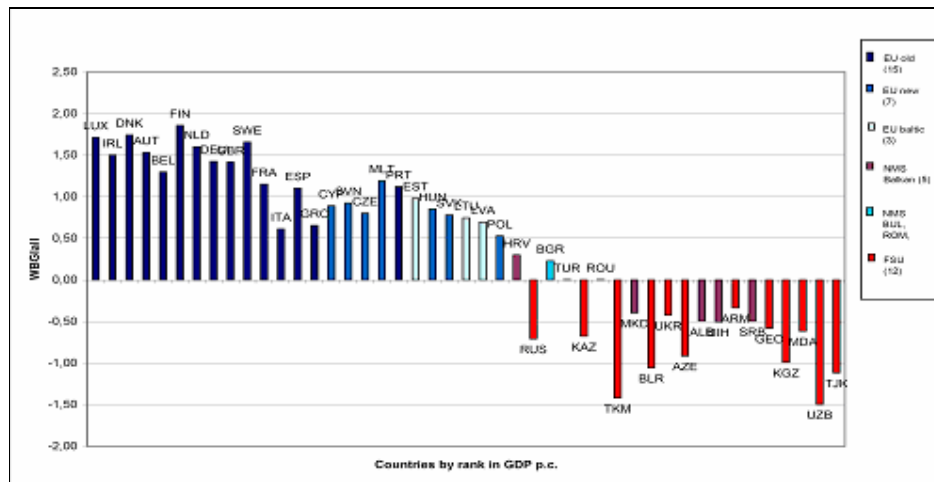

Figure 1. Institutional quality in EU and CIS, 2007

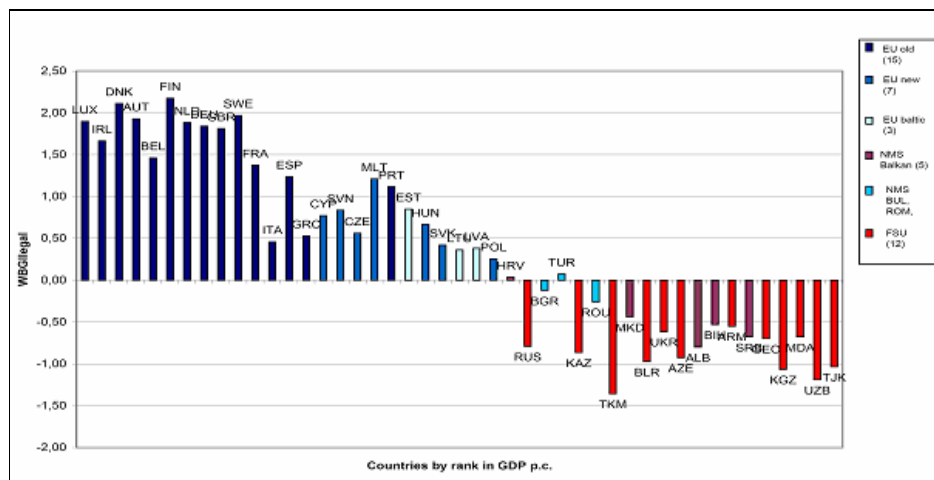**Source**: [WB Governance Indicators, (2008)]

Figure 2. Development of legal institutions in the EU and CIS countries, 2007

Source: [WB, (2006)]

The disaggregated picture of the World Bank Governance Indicators demonstrates the poor quality of legal institutions, i.e. rule of law and control of corruption (Figure 2).[2] The indicator on legal institutions draws a uniform negative picture throughout the region. Taking into account fast transition from socialism to democracy with the following change of formal rules and laws, but lagged implementation of these new rules, such difference in institutional branches seems to be quite plausible. According to the studies of soviet and post-soviet societies, underperformance of indicators on rule of law and control of corruption can be explained by the still existing informal rules and norms, originally coming from "blat"-practices of centrally planned economies. "Blat"-practices that enable all subjects of that command economy to act in the situation of shortages still provides the basis for corruption in the time of transition [Ledeneva (1998), (2003)].The influence of informal rules impedes the implementation of newly established political and economic institutions. Therefore, the level of corruption is the decisive indicator of institutional quality: the higher corruption, the lower is overall institutional quality in a particular country.

3. Corruption and Economic Development

Corruption is hampering economic growth and social development. Numerous studies have revealed negative impact of corruption on economic and social development [Kaufmann (1997, 1998); Aidt, (2003); Murphy *et al.*, (1991); Tanzi, (1998); Goulder *et al.*, (1997); Mauro, (1995, 1997, 1998); Mo, (2001); Pellegrini and Gerlagh, (2004); Johnson, Kaufman, and Zoido-Lobaton, (1998); Rock and Bonnet, (2004); Rodrik, (2006)].

Corruption hinders investment (both domestic and foreign), reduces growth, restricts trade, distorts the size and composition of government expenditure, weakens the financial system, and strengthens the underground economy, increases levels of poverty and income inequality. In order to emphasize how harmful corruption is for developing and transition economies, below we present the most important findings of the previous scientific work.

Gray and Kaufman (1998) claim economic costs of corruption to be enormous. Corruption leads to increased transactions costs and uncertainty in the economy; to inefficient outcomes through misallocation of resources, impediment of the long term investment, and distortion of sectoral priorities; it undercut's state ability to raise revenues, and imposes regressive taxes that fall particularly heavily on "shoulders" of the small enterprises [Gray and Kaufmann, (1998)]. Bribery also increases cost of capital to firms [Kaufman and Wei, (1999)].

Corruption increases public investment but decreases its quality and productivity. Through corruption activities the real development priorities of a country are neglected in favor of those generating the greatest personal gain for the decision-makers [Frish, (1996)]. If such projects are financed through the foreign debt, the debt burden increases dramatically, by the whole cost of the unproductive investment. Private investment (local and foreign) on the contrary decreases as it directly depends on the quality of the business and legal environment of the country. Thus this is the most harmful effect of flourishing corruption to developing countries. In this way ccorruption acts as a sort of tax on foreign direct investment (FDI). Alongside public donors are discouraged. World Bank (2000) demonstrates that in transition countries having high levels of both administrative corruption and state capture, gross domestic investment averages more than 20 percent less than in countries with medium level of corruption.

Through the reduced government revenue, corruption reduces governmental spending on infrastructure, health and education. For example a paper by Mauro (1997) shows that government spending on education, measured as a ratio of GDP, is negatively and significantly correlated with corruption. Weakening of the quality of governmental services has particularly serious consequences for the poor. A strong connection has been demonstrated between corruption and increasing levels of poverty and income inequality [World Bank, (2000)].

Corruption deteriorates investment flows, decreases economic growth rates [Mo, (2001)], and brings about dishonest competition, it has negative effect on productivity of the economy and rates of technological progress in countries [Del Mar Salinas-Jimenez *et al.*, (2008)]. From the abovementioned facts one can conclude that the quality of governance is one of the vital factors for economic growth, and corruption is an offspring of bad governance.

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[2] Institution measured by WBGIs can be analysed along three dimensions: political, economic and legal.

3.1. Corruption and its Costs in Transition Economies

Privatization was one of the main composing parts of the transition process. Privatization has increased political corruption in the former Soviet Union and the former communist countries of Central and Eastern Europe [Kaufman and Siegelbaum, (1996)].

Bribes can represent substantial costs for firms. In 1996-1999 across the countries of CIS, average payments for administrative corruption are estimated by firms to be 3.7 percent of their annual revenues, the share falls to 2.2 percent of revenues in Central and Eastern Europe (CEE) [World Bank, (2002)]. World Bank (2002) also reports that administrative corruption constitutes approximately 17 percent of profits across the transition economies, with 22 percent of average reported profit margin for CIS counties, and 13 percent for CEE.

Kroska and Robeck (2007) in their study on assessment of institutional quality in East and West Germany, and four former communist countries in central Europe – the Czech Republic, Hungary, Poland and the Slovak Republic found that unofficial payments of firms to get government contracts in central Europe exceed 5 percent of the contract value, and are equal to 2.56 percent of sales of the firms paying bribes. The most common unofficial payments mentioned in the article are in connection with inspections, tax administration, customs and the judiciary, as well as regarding public services and business licenses, the highest extent of unofficial payments is in extent to public contracts.

WB (2006) presents results of the survey in transition economies on the issue of how fierce firms perceive the negative effect of corruption on their operation and growth. WB (2006) presents that average percentage of firms that viewed corruption as a problem for the operation and growth for their business in 2002 and 2005 by country: less that 25% of firms were concerned with corruption in Belarus, Uzbekistan, Estonia; around 50% of the firms in Azerbaijan, Czech Republic, Moldova and Macedonia. The highest number of firms seeing corruption as an obstacle for their development (more that 50%) was in Kyrgyzstan and Albania.

Budak and Coel (2004, 2006) results show a negative correlation between the level of country's prosperity, given by the per-capita GDP, and the level of corruption. Authors hypothesize that this might be connected to the fact that in wealthier nations both bribe givers and takers might have lower discount rates to engage in illegal activities.

Due to its disastrous economical and social consequences fighting corruption has become the main question on agenda of countries in transition. Steves and Rousso (2003) paper analyses the anti-corruption activities of 24 of the 27 transition countries in the period 1999-2002. Using the results of a large survey of firms across the region, the paper shows that countries with low levels of administrative corruption were more likely to adopt intensive anti-corruption programmes than countries with high levels of administrative corruption, independent of the level of state capture. Authors find that, to the exception of two countries, all other countries have implemented new anti-corruption legislation which addresses the issue of corruption. However those countries where EU accession is not a near-term prospect, and political power is both more concentrated and less accountable, the process of introducing anticorruption measures has been largely 'top down,' based primarily on presidential decree, and the implementation of the supporting legislation has been delayed by legislative wrangling [Steve and Rousso, (2003)].

Positive effect of the countries' accession to EU on fighting corruption have also found Budak and Coel (2004, 2006), who found that lower levels of corruption are observed in the countries that have more success in the process of accession to the EU, as in the process of accession, corruption control has been an important criterion for selection.

4. Gender and Corruption: Previous Research Findings

The relationship between corruption and gender is still undiscovered issue, as there are only a few studies analysing this issue. Furthermore, the quality of this relationship is not clear. Some studies found that larger representations of women in government reduced corruption while other studies provide the contrary findings.

Dollar *et al.* (2001) demonstrate the existing correlation between women participation in politics and corruption level. They based their study on past behavioural findings of numerous experiments and surveys [Eagly & Crowley, (1986); Eckel & Grossman, (1998); Glover *et al.*, (1997)] and public-spirited attitudes [Goertzel, (1983); Ones & Viswesvaran, (1998)] that women are more inclined to demonstrate altruistic and moral behaviours than men are; and that men are more individually oriented

than women, and are more likely to "sacrifice the common good for personal (material) gain". Hence, Dollar *et al.* (2001) evaluate quantitatively the idea that greater representation of women in parliament leads to a lower level of corruption. They take the country-level data sample for more than 100 countries and regress corruption measured by the International Country Risk Guide's corruption index on number of women in parliaments.[3] Dollar *et al.* (2001) found negative and significant relationship between the proportion of women in country's legislature and the level of corruption.

Similarly, Swamy *et al.* (2001) investigate the relationship between increased representation of women in commerce and politics, and decrease in corruption. They present evidence that countries with greater representation of women in government or/and in the market work have lower level of corruption. They conclude that this evidence supports of the idea that policies aimed at the increase of the women's participation in public life "at least in the short or medium term … will reduce level of corruption". They measure corruption by three indices: "Graft index" constructed by Kaufmann *et al.* (1999), Transparency International's (TI) "Corruption Perception Index" and International Country Risk Guide (ICRG) corruption index. The sample size varies from 94 countries, covered by Graft index, to a 68 countries for the TI's index. For their regression analysis such measures of women's participation in politics and commerce are used: a) proportion of legislators in the national parliament who are female, b) proportion of ministers and high-level government bureaucrats who are women, and c) women's share in the labor force, as a proxy of women's representation in lower levels of government bureaucracy as well as in private sector. From these three measures, authors also compose an overall index of women's participation, as "three women's influence variables … can be interpreted as being a partial measure of the larger concept of women's participation in public life".

Although both studies provide the empirical evidence in the support of these hypotheses, their results are challenged by ideological (i.e. democracy-concentrated) and cultural approaches.

From the ideological point of view, Sung (2003) criticizes the models of Dollar *et al.* (2001) and Swamy *et al.* (2001) that treat female participation in politics as an exogenous factor. He also doubts whether the rely on individual-level findings of female honesty can be used to propose hypotheses about groups (e.g., female citizens are less tolerant of corruption, therefore larger representations of women in government prevent corruption) or whether aggregate data are appropriate to make inferences about the nature of individuals (i.e., gender differentials from cross-national analyses were used to demonstrate that male government officials are more corruption-prone). Alternatively, Sung provides a fairer system explanation. He argues that the observed association between gender and corruption is partially spurious and mainly caused by its context, liberal democracy — a political system that promotes gender equality and better governance. The empirical data of women participation in politics (the proportion of women among sub-ministerial officials and parliamentarians), level of liberal democracy (operationalized by indexes from the Freedom House and the Fraser Institute) and corruption indicator (produced by Transparency International) favour his "fairer system" thesis.

The recent work of Alatas *et al.* (2008) demonstrates that gender differences concerning predisposition to corruption should not be considered as a universal tenet and are more culture-specific. Gender differences in attitude to corruption may be the result of both biological and social differences, i.e., differences in social roles of men and women. An individual's social role and presence in the public domain may play an important role in that individual's exposure to corruption. Hence, if women and men differ in their social roles, one may also expect them to differ in their attitudes towards corruption. Higher levels of exposure to corruption in daily life may promote a tolerance and acceptance of corruption that is reflected in norms of behaviour. In addition, women may be more victimized by (and, hence, less tolerant of) corruption in countries where their presence in the public domain is lower.

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[3] For testing of robustness of results two other indexes are used: German Exporter Corruption Index (GCI), and the World Competitiveness Report's Corruption Index (WCRCI). Their measure of female involvement (PARL) is constructed from the data of the survey "Women in Parliaments: 1945-1995" as an average of proportions of seats in upper and lower Houses of parliament for each country. The regression modelling of country-level panel data included controls for population, civil liberties, population, average schooling, trade openness, ethnic fractionalization, and colonial history, and yielded robust backing to the formulated hypothesis

Atlas *et al.* investigate gender differences in behaviour when confronted with a common bribery problem. Their study departs from the previous literature on gender and corruption by using economic experiments. Based on data collected in Australia (Melbourne), India (Delhi), Indonesia (Jakarta) and Singapore, they show that while women in Australia are less tolerant of corruption than men in Australia, there are no significant gender differences in the propensities to engage in and punish corrupt behaviour in India, Indonesia and Singapore. Hence, their findings suggest that there are larger variations in women's behaviour towards corruption than in men's across the countries.

The critics, coming from ideological and cultural approaches, make the importance of regime and cultural features evident. The incidence of corruption varies among different societies, ranging from rate to widespread to systemic [Gray and Kaufman, (1998)]. Thus, for the analysis of the (linear) relation between gender and corruption a specific sample of countries is chosen, that share common cultural and historical legacy – transition countries; rather than analysing large sample that ignores cultural and ideological background.

The following section demonstrates the peculiarities of corruption and political regime as well as cultural characteristics of gender differences in transition countries.

5. Specifics of Transition Countries
5.1. Corruption and Political Regime
The transition from socialism leads to a great variety of political regimes. CEECs build democratic regimes. On the contrary, the transition in the CIS resulted in a great diversity of non-democratic regimes floating in the "grey zone" between democracy and authoritarianism. The labels for the new regimes – defected democracy, imitated democracy or soft authoritarianism – reflected the idea of a continual transition, although whether this is a movement in the direction of democracy was disputable.[4] Despite different degree of democracy, all transition countries meet the challenge of corruption.

Corruption has historical roots in transition countries. Severe governance and corruption problems were endemic in most areas of the far-flung Russian empire even before the Bolshevik revolution [Wolf and Gürgen, (2000)]. According to the studies of Soviet and post-Soviet societies, underperformance of indicators on rule of law and control of corruption can be explained by the still existing informal rules and norms, originally coming from "blat" -practices (acquaintances and connections) of centrally planned economies. Blat was the name for "economy of favours" [Ledeneva, (1998)], where friends and acquaintances were tied together in an intricate weave of favours and counter-favours in order to facilitate access to commodities or services in short supply. In other words, in conditions of shortages and a state system of privileges "blat" provided access to public resources through personal channels and served the needs of personal consumption. Despite it was provided at the public expense, "blat" was seen in the soviet society as a positive phenomenon. "Blat"-practices that enable all subjects of that command economy to act in the situation of shortages still provides the basis for corruption in the time of transition [Ledeneva, (1998, 2003)].

Furthermore, in the course of post-communist transition, the fusion of the state and the economy that characterized the communist system has been replaced in most of the countries by a new order, but one in which the separation of private and public interests has not been adequately defined. The undefined separation of private and public together with informal networks inherited from the Soviet times, provide the fruitful ground for corruption that soon has reached heights. In addition, privatization that was one of the main composing parts of the transition process has increased political corruption in the CIS and CEECs [Kaufman and Siegelbaum, (1996)].

Although corruption is endemic and historical phenomenon in transition countries, some of them were successful in lowering corruption level due to influence of external factors, as liberalization and membership in international organizations requesting good governance from the accession candidates E.g. CEECs has improved their level of corruption in the course of EU accession. In order to join the EU, all the candidate countries need to fulfil the economic and political conditions known

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[4] Larry Diamond, Thinking about Hybrid Regime. In: Journal of Democracy, 13 (2002) 2, pp. 21-34; Steven Levitsky/ Lucan Way, The Rise of Competitive Authoritarianism. In: Journal of Democracy*, 13 (2002) 2, pp. 51-65; Michael McFaul, The fourth wave of Democracy and Dictatorship: Non-Cooperative Transition in the Post-Communist World. In: World Politics, 54, (2002) 2, pp. 212-224.

as the "Copenhagen criteria," according to which a prospective member must: "be a stable democracy, respecting human rights, the rule of law, and the protection of minorities; have a functioning market economy; adopt the common rules, standards and policies that make up the body of EU law" [Gawrich and Schweickert, (2004)]. Thus, the fight against corruption has become a key element of the policy agendas of governments and international development agencies in many East-Central European countries. The other transition countries were less liberalized, do not profit from EU accession and still suffer from corruption.

5.2. Gender differences

Scientists in the field of social and political sciences quite often mark low level of political activity of women in the various societies, connected with existence of the traditional woman's roles adopted by women in the course of early socialisation, which are a serious obstacle on their way to public activities and involvement in decision-making process at the state level [Andreenkova, (2000)]. We follow these ideas and present here historical retrospective of the conditions that model individual social roles of women and have impact on their presence in the public domain of the 27 transition economies chosen for our analysis.

Communist-Era Characteristics of Women's Situation

The October Revolution of 1917 brought about significant changes into women's lives, who gained access to many professions and education. In USSR, mass involvement of women into public production began in 1930ties [Bondarenko, 1997). In Soviet Era 90% of women were employed, and made up 52 % of the national labour force [Goscillo, (1996), as cited in Chittenden, (2000)] . In mid 80ties in the industrial society of USSR, women participation was the highest, and 92% of the capable of working women have studied or worked [Bondarenko, 1997).

However, manifested equality did not brought to the real equality, and moreover during this period women gained double load "work-home", which men did not have (1997), and were only weakly integrated in the Soviet family [Ashwin *et al.*, 2004). Ashwin *et al.* (2004) claims, that although women were drawn into the workforce in large numbers during industrialization, however, the idea of domestic work as inalienably female was never challenged by the ruling party. Due to involvement of women into workforce a problem of holding both positions "household keeper-(soviet) worker" occurred, as men's roles haven't changed so much as those of women. Men haven't got involved as strong into household activities, as women have into work. As main reason for this situation Ashwin *et al.* (2004) names the fact, that essentialist views of sexual difference were taken for granted not only in the ruling party, but also within wider society. Despite their equal or higher educational attainment relative to men, women's careers typically ended in the lower or middle tiers of the professional pyramid [Remennick, (2007)].

Post-Communist/ Post Soviet Era Characteristics

In the post-soviet era active involvement of women in social, political and economic structures was hindered by return of the patriarchal relations in a society, which, dependent on the cultural and historic past, are more or less dominant (e.g. Tajikistan, Azerbaijan vs. Russia, Ukraine). As Bondarenko (1997) writes, revival of old patriarchal views and growth of nostalgia about traditional woman's roles were promoted by economic crisis and wreck of former system. These views were largely shared by women themselves, who got tired of "emancipation" of the former period and from double workload. Remennick (2007) posits that exhausted by their multiple roles and burdens, many women valorized traditional femininity, represented in their eyes by slim and sexy, stay-at home suburban women from American and French movies. Similar processes have taken place in most of the post-communist countries. Social transformations of femininity ideals brought back idealization of femininity and its traditional characteristics of possessing "gentleness, sensitivity, maternal instincts and the capacity to love" [Goscillo, (1996), as cited in Chittenden, (2000)] . Younger generations of Russian women no longer strived for independence and interesting jobs; instead they dreamed of successful and rich husbands [Remennick, (2007)]. In the „Oriental" post-soviet respublics the traditional view of a secondary role of women in society, has found its way to reappear with new intensity.

Situations in the households haven't changed however due to economic reasons. Although from the ideological point of view there is no need any more for the family with two bread winners, from the economic point of view it is necessary as ever before [Ashwin 2006). Nowadays a family model with man-breadwinner and woman-housewife is virtually a fantasy. If a stay-at-home wife could be a symbol of status for the rich men, men with average income do not consider such women as potentially attractive partners [Ashwin, 2006). Many women have even turned to be the only bread winner of the family. At the same time even those men who were unemployed or had part-time jobs have not joined housekeeping on the more active basis, and as before they provide little help to their wives who dedicate, for example in Russia, 13-15 hours per day to work and household activities [Morvant, 1995 as cited in Bondarenko, 1997). However as Ashwin (2006) writes, women also hold to the soviet gender roles and thus they might consciously, or not, keep men apart from participation in the household duties.

Women's Participation in Public Domain

With the collapse of communist system the traditional divisions between male and female occupations were reinstated, with women pouring back into services, clerking, sales, and the beauty industry, while leaving business, technology and finances to men [Remennick, (2007)]. In general women occupy least prestigious and least paid professions [Bondarenko, (1997)]. Privatization had negative consequences for women, as entrepreneurship was meant in the first place for men [Bondarenko, (1997)]. According to the state statistics, in 1994 among co-owners of the commercial enterprises (about 900 thousand) there were 39% women, among owners of small co-operatives - 23%, among private entrepreneurs with hired workers – 17% to 19%, farmers - 20%, individual entrepreneurs – one third [Andreenkova, (2000)]. These data reveal the fact that in entrepreneurship quantity of women is essentially below quantity of men.

Chances of participation in politics for women are hindered by different factors, and perhaps the most important of them is high level of corruption. This leads to under-representation (or poor representation) of interests of more than half of the population of transition economies in legislative and executive authorities. Results of the two first democratic elections in the Russian and Ukrainian parliaments (1993 and 1995 in Russia both 1994 and 1998 in Ukraine) have shown that women are presented both parliaments lesser, than men. In Russia (1995) only 10 %, and in Ukraine (1998) 7 % from 450 members of the lower chamber made women. The same situation has developed not only in central, but also in local elected authorities [Andreenkova, (2000)]. On the basis of information provided by National Parliaments by October 2008 (IPU, 2008) average number of women elected to the lower or single House in all 27 transition states was 16.9%[5], ranging from the highest of 31.82% in Belarus to the lowest in Georgia (6%). The 10 states that are the members of European Union have on average 18.2%[6] women in Parliament.

Deputy of the Bundestag chairman of German-Central-Asian parliamentary group H. Vegener, claims that in Tajikistan women have limited possibilities of participation in politics, including parliamentary elections [Nigora Buhari-zade, (2005)] . In her opinion, the most serious obstacle for women's participation in politics is the existing in East opinion about a secondary role of women in society, and also corruption of authorities in Tajikistan. The member of political council of Social-democratic party of Tajikistan M. Mamadshoev blames widespread corruption, which influences distribution of places in government, to have a baneful influence on representation of women in authorities [Nigora Buhari-zade, (2005)] .

Employment and the government today still favours male workers even though they might be less qualified or reliable [Goscillo, (1996), as cited in Chittenden, (2000)]. Due to this favouritism, women are more likely to be laid off [Goscillo, (1996), as cited in Chittenden, (2000)] . This results in the fact that, for example, in 2007 in Russian Federation 63.3% (FSSS, 2007) of all unemployed was women. In Russia and Ukraine women occupy lower position in parties and rarer than men, take managing positions (51% and 74%, 60% and 71%) [Andreenkova, (2000)]. Women-political candidates are less trusted by economic and political elite, it is considered that women possess worse skills for achieving of business agreements [Andreenkova, (2000)]. Women, who are being perceived as more moralistic than men are

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[5] Calculations by authors based on IPU (2008).
[6] Calculations by authors based on IPU (2008).

less trusted by representatives of "grey" business, and receive less support and resources for carrying out of successful election campaign [Andreenkova, (2000)].

However, not all women remained politically passive. Unlike in the Soviet times, when the political participation of women had no feministic direction, transition results in the birth of feministic movements in the FSU. In the late 1980s and early 1990s, several very promising federated women's organizations emerged, uniting thousands of women into a new and vocal public that worked through the independence movement to demand path-breaking changes in state policies concerning families. During the 1990s, hundreds of new women's organizations were established, many of which benefited from extensive foreign funding and training [Hrycak, (2005)].

Attitude towards Corruption of Women in Post-Communist Countries

Corruption is widely disseminated in post-soviet area, thus women in this area might face corruption quite often and could tolerate it better, and even have no negative attitude to it, compared to women from "western" nations. For example article "The tolerance to corruption[7] in Kazakhstan becomes social norm" by the company Ksilon Astana CG (2008) reveals that, more than half, namely 54,3% surveyed Kazakhs have quite tolerant attitude towards corruption. Although men are more tolerant to corruption, than women, difference doesn't seem very large. Amount of people being tolerant to corruption (i.e. those who consider that without it "nothing can be achieved" and that "with bribes it is easier to do business") is 57.5% of men and 51.7% of women in the sample. On the contrary, findings from the examination of business people in Georgia reported that female business owners and managers were less likely to give bribes than their male counterparts [Swamy *et al.*, (2001)].

In the interview to the Radio Svoboda (2002) G. Sillaste, professor of sociology said that she thinks that in Russia women in general liberally concern the corruption phenomenon. Until it doesn't concern them personally, women regard it as a very distant from her fact. In the same interview Russian feminist M. Arbatova [Radio Svoboda, (2002)] notices that often, while speaking about corruption we forget that it exists not only on the level of authorities, but also in schools, kindergartens, hospitals. These are the institutions where most of the jobs are occupied by women. Arbatova [Radio Svoboda, (2002)] says that we try to convince ourselves that presence of women in "big politics" and economy is a panacea. However for the post-communist and post-soviet countries this might be an incorrect statement. This is supported by Remennick (2007), who writes that many women were also better at navigating soviet bureaucracy and managing their families' contacts with welfare, medical and other institutions, which at times were extremely corrupted. We think that being quite often in contact with everyday-corruption might have resulted in adaptation to the existence of it.

Based on the abovementioned analysis we state that both men and women have equally often exposed to corruption in our sample although through different sources: men are more "familiar" with corruption in business and higher echelon of authorities, whereas women - in lower levels of bureaucracy, institutions of education, medical services etc. However we expect that the effect of psychological differences between men and women in their attitudes towards corruption dominates over liberal views of women on corruption which has been fostered in the Soviet Union as well in the era of transition.

6. Data and Variables for the Regression Analysis

For the analysis of the relationship between gender and corruption a specific sample of countries sharing common cultural and historical legacy was chosen – transition countries. Thus 28 countries form the sample of this analysis (See Appendix A). The data for this paper was collected from the wide range of sources, which can be found in Appendix C, together with the detailed description of the variables. Summary statistics of the sample can be found in the Appendix B.

The main corruption measure in this paper is the corruption index created by the World Bank ($CORRUPT_{WB}$), which according to Kaufmann *et al.* (2008) is the most credible currently available corruption measure. $CORRUPT_{WB}$ measures the exercise of public power for private gain, including

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[7] Tolerance to corruption is defined as readiness to resort to corruption, as to "effective remedy" of achievement of own purposes. It was measured by a survey in which people had to answer a question, what did they think of that Kazakh citizens sometimes should give bribes for the decision of their problems.

both petty and grand corruption and state capture [Kaufman *et al.*, (2008)]. The aggregate estimates are based on the 340 individual variables, which are taken from 35 different sources, produced by 32 different organizations. However in order the results more comparable to the previous works, the analysis was repeated with the Transparency International corruption index CPI (CORRUPT$_{CPI}$), which is based on the perceptions of the degree of corruption as seen by business people and country analysts.

Based on the fact that the corruption index measures not only political corruption, but a general level of corruption, social and political activity of women is measured by four variables: the proportion of parliamentary seats held by women in the upper and lower houses of parliament (WPARL), women's share of legislators and managers (WMANAG), percentage of women in the adult labour force (WLABOR), and gender empowerment index, measuring equality of opportunities for women and men, which among other factors also takes into account all three abovementioned proportions (GEM). This index combines inequalities in the areas of political participation and decision making, economic participation and decision making, and power over economic resources. This should provide deeper insight into the relationship between corruption and gender.

As Dollar *et al.* (2001) suggest GDP per capita value (ln(GDP), and ln(GDP) squared) is included as control variable in regression, as both level of corruption and political opportunities available to women are affected by the overall level of social and economic development. Greater political and civil freedom might result in higher women participation and decreased corruption, thus Freedom House Civil liberties index is included (CIVIL), which accounts for freedom of expression, assembly, association, education, and religion, equality of opportunity, economic freedom and rule of law. An alternative measure of liberal democracy is based on suggestion of Sung (2003) and consists of indices that estimate freedom of press (PRESS) and rule of the law (LAW). Freedom of press index by Reporters without Borders considers the number of journalists murdered, expelled or harassed, and the existence of a state monopoly on TV and radio, as well as the existence of censorship and self-censorship in the media, and the overall independence of media as well as the difficulties that foreign reporters may face. Rule of Law index measures perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence [Kaufman *et al.*, (2008)].

The proposition of the existence of the negative relationship between more active women participation in the social and political life and corruption was estimated with the help of multivariate regression. Multivariate regressions were run separately for each measure of women activity, and as well as a combination of them. Since the sample size was initially very small, plus a problem of missing values arose, findings of the current analysis should be considered very critically, and no firm conclusions can be drawn.

7. Empirical Results
In the spirit of Dollar et al (1999) basic specification of this paper is the following:

$$CORRUPT_{WB} = \beta_1 + \beta_2 WACTIV + \beta_3 \ln(GDP/capita) + \beta_4 [\ln(GDP/capita)]^2 + \beta_5 CIVIL + \varepsilon \qquad (1)$$

Here WACTIV stands for 4 measurements of women participation in economic and social life, namely: percentage of women in parliament (WPARL), in managerial and legislative positions (WMANAG), in labor force (WLABOR), and finally a common index calculated by UNDP gender empowerment index (GEM).

In order to account for the proposition of Sung (2003), who said that that if we take different measure of liberal democracy, connection between women participation measures and corruption index becomes insignificant, a regression of second specification is run, where freedom of press (PRESS) and rule of law (LAW) are included instead of the civil liberties index (CIVIL):

$$CORRUPT_{WB} = \beta_1 + \beta_2 WACTIV + \beta_3 \ln(GDP/capita) + \beta_4 [\ln(GDP/capita)]^2 + \beta_5 LAW + \beta_6 PRESS + \varepsilon \qquad (2)$$

Finally in order to make my results comparable to the previous works I run two more additional regressions of the above-mentioned structure where as a measure of corruption CPI index of the Transparency International is used:

$$CORRUPT_{CPI} = \beta_1 + \beta_2 WACTIV + \beta_3 \ln(GDP/capita) + \beta_4 [\ln(GDP/capita)]^2 + \beta_5 CIVIL + \varepsilon \qquad (3)$$

$$CORRUPT_{CPI} = \beta_1 + \beta_2 WACTIV + \beta_3 \ln(GDP/capita) + \beta_4 [\ln(GDP/capita)]^2 + \beta_5 LAW + \beta_6 PRESS + \varepsilon \qquad (4)$$

Table 1 shows the results from the regression specification one, Table 2 – of specification two and so on. In all regressions the reported standard errors are corrected for heteroskedasticity.

We start by analyzing the coefficient on the WPARL (-0.30) in Table 1, which is negative and significant at the 5% level. It means that a one standard deviation increase in WPARL (0.07) would be accompanied by a decrease in corruption by a 0.17 of a standard deviation. This relation is found to be significant in the three out of four specifications. In Table 2 and 3 coefficients on WPARL are also negative (-0.23 and -2.68 respectively) and significant at 10%. A one standard deviation increase in WPARL in Table 2 results in decrease in corruption by 13% of a standard deviation, and in specification (3) as well by 13%. This is in line with the previous research, thus we conclude that increase of women representation in parliament has a positive effect for a country through its negative (linear) relationship to corruption.

Coefficient on the WLABOR is of the right sign (negative) in three of the four specifications; this is in line with the findings of Swamy *et al.* (2000) who found negative relationship between corruption and participation of women in the labor force. However we fail to reject null hypothesis of zero coefficient, thus there is no sufficient evidence for the linear relationship between $CORRUPT_{WB}$ and $CORRUPT_{CPI}$, and WLABOR. Most probably because it is traditional that most of the women are included in the labor force due to traditional in communist regime inclusion of women in labor force as well as uneasy economic situation. Moreover women have to participate in the so called "lower level" corruption on a day to day basis, which is especially widespread in health and education sectors, where as well most of the women work. Thus more active participation of women in labor force would not bring significant reduction in corruption.

Women's share of legislators and managers, which is the indicator of the presence of women in decision-making positions, is consistently positively associated with corruption in all of the specifications of regression (1 to 4) however it never reaches the significant level.

The Gender Empowerment Measure (GEM), which takes into account all three measures of women participation in social and economic life, is negatively related to corruption, meaning that the more equality between men's and women's opportunities there are in a country, the less corruption there will be. It is clear from Table 1 and 2 that an increase in one standard deviation in GEM (0.08) is associated with the decrease in WB corruption index in the size of 0.16 to 0.20 of a standard deviation. From Table 3 and 4 we see that the same increase in GEM would be associated with 14% and 18% of a standard deviation decrease in corruption. However it is statistically significant at 10% only in the second specification, presented in the Table2.

The strongest negative relationship in all specifications is between measures of liberal democracy and corruption measured by both indices. It is also significant at the 1% level. From the Table 1, one can see that a one standard deviation increase in civil liberties index CIVIL (1.93) is followed by a decline in corruption measure of WB which varies from approximately 73% to 87% of a standard deviation. On the other hand Table 4 demonstrates that a one standard deviation increase in the rule of law index LAW (4.36) will result in decrease in corruption indices $CORRUPT_{WB}$ from approximately 77% to 96% of a standard deviation. Index $CORRUPT_{CPI}$ would react to a similar increase in CIVIL by decrease of the sizes from 71% to 89% of a standard deviation (see Table 3); and to an increase of one standard deviation in LAW by a decrease from approximately 75% to 99% of a standard deviation (see Table 4). A positive association between the wealth of the countries and corruption is found in all specifications of regression for this specific sample, however this relationship is of the inverted U-shape form i.e. after the countries in our sample would reach some specific level of wealth corruption would start decreasing. This is in line with previous research that found that high economic performance is in essence incompatible with poor public governance [Sung, (2003)].

Table 1. Regression $CORRUPT_{WB} = \beta_1 + \beta_2\,Wactivity + \beta_3\,\ln(GDP/capita) + \beta_4\,(\ln(GDP/capita))2 + \beta_5 CIVIL + \varepsilon$

	1	2	3	4	5
C	-0.547***	-0.492***	-0.608***	-0.450**	-0.456
	(0.036)	*(0.177)*	*(0.041)*	*(0.244)*	*(0.152)*
WPARL	-0.304**			-0.136	
	(0.131)			*(0.241)*	
WLABOR		-0.204		-0.339	
		(0.399)		*(0.628)*	
WMANAG			0.020	0.089	
			(0.122)	*(0.128)*	
WEM					-0.243
					(0.233)
GDP	(0.017)	0.023*	0.030**	0.021	0.033*
	(0.013)	*(0.012)*	*(0.015)*	*(0.017)*	*(0.020)*
GDP2	-0.011*	-0.016*	-0.024**	-0.020**	-0.022**
	(0.008)	*(0.008)*	*(0.011)*	*(0.011)*	*(0.011)*
CIVIL	-0.055***	-0.054***	-0.066***	-0.068***	-0.059***
	(0.007)	*(0.008)*	*(0.007)*	*(0.011)*	*(0.011)*
N	27	27	21	21	21
adjR2	0.76	0.73	0.77	0.76	0.78
SER	0.06	0.06	0.06	0.06	0.06

Table 2. Regression $CORRUPT_{WB} = \beta_1 + \beta_2\,Wactivity + \beta_3\,\ln(GDP/capita) + \beta_4\,(\ln(GDP/capita))2 + \beta_5 LAW + \beta_6 PRESS + \varepsilon$

	1	2	3	4	5
C	-0.157**	-0.179	-0.203**	-0.234	-0.026
	(0.068)	*(0.198)*	*(0.081)*	*(0.237)*	*(0.142)*
WPARL	-0.232*			-0.073	
	(0.135)			*(0.236)*	
WLABOR		-0.010		0.095	
		(0.386)		*(0.657)*	
WMANAG			0.063	0.049	
			(0.110)	*(0.163)*	
WEM					-0.318*
					(0.212)
GDP	0.016	0.021	0.040**	0.040*	0.045**
	(0.016)	*(0.017)*	*(0.018)*	*(0.024)*	*(0.022)*
GDP2	-0.010	-0.014*	-0.023**	-0.022*	-0.021*
	(0.008)	*(0.008)*	*(0.012)*	*(0.014)*	*(0.012)*
LAW	-0.026***	-0.027***	-0.028***	-0.028***	-0.026***
	(0.005)	*(0.005)*	*(0.006)*	*(0.007)*	*(0.006)*
PRESS	0.0004	0.001	-0.0003	-0.0002	0.0003
	(0.001)	*(0.001)*	*(0.001)*	*(0.002)*	*(0.001)*
N	27	27	21	21	21
adjR2	0.77	0.75	0.79	0.75	0.81
SER	0.06	0.06	0.06	0.06	0.05

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ (one-tailed)

Table 3. Regression $CORRUPT_{CPI} = \beta_1 + \beta_2 Wactivity + \beta_3\,\ln(GDP/capita) + \beta_4(\ln(GDP/capita))2 + \beta_5 CIVIL + \varepsilon$

	1	2	3	4	5
C	-5.064***	-4.612**	-5.693***	-3.257	-3.893**
	(0.436)	(2.046)	(0.503)	(2.822)	(2.038)
WPARL	-2.682*				-1.496
	(1.646)				(3.001)
WLABOR		-1.738			-5.428
		(4.692)			(7.289)
WMANAG				0.734	1.802
				(1.469)	(1.410)
WEM					-2.584
					3.144
GDP	0.299*	0.347**	0.423**	0.289	0.456*
	(0.177)	(0.162)	(0.193)	(0.220)	(0.266)
GDP2	-0.169*	-0.214**	-0.332**	-0.289**	-0.305**
	(0.109)	(0.112)	(0.136)	(0.136)	(0.134)
CIVIL	-0.657***	-0.652***	-0.770***	-0.799***	-0.681***
	(0.079)	(0.089)	(0.093)	(0.128)	(0.139)
N	27	27	21	21	21
adjR2	0.75	0.73	0.74	0.73	0.75
SER	0.73	0.75	0.73	0.74	0.71

Table 4. Regression $CORRUPT_{CPI}=\beta_1+\beta_2 Wactivity+\beta_3 \ln(GDP/capita)+\beta_4(\ln(GDP/capita))2+\beta_5 LAW+\beta_6 PRESS+\varepsilon$

	2a	4a	6a	8a	10a
C	-0.174	-0.709	-1.059	-0.598	0.960
	(0.878)	(2.161)	(1.014)	(2.671)	(1.975)
WPARL	-1.782			-0.672	
	(1.612)			(3.016)	
WLABOR		0.750		-1.329	
		(4.116)		(7.657)	
WMANAG			1.257	1.514	
			(1.259)	(1.903)	
WEM					-3.361
					(2.965)
GDP	0.272*	0.308**	0.529**	0.469*	0.583**
	(0.163)	(0.172)	(0.206)	(0.288)	(0.285)
GDP2	-0.154*	-0.184**	-0.319**	-0.297*	-0.294**
	(0.098)	(0.096)	(0.144)	(0.161)	(0.150)
LAW	-0.331***	-0.336***	-0.321***	-0.306***	-0.296***
	(0.069)	(0.066)	(0.073)	(0.091)	(0.082)
PRESS	0.008	0.009	-0.004	-0.008	0.002
	(0.010)	(0.010)	(0.015)	(0.025	(0.017)
N	27	27	21	21	21
adjR2	0.77	0.77	0.77	0.73	0.78
SER	0.69	0.70	0.70	0.74	0.67

* $p<0.1$, ** $p<0.05$, *** $p<0.01$ (one-tailed)

7.1. World Surveys Analysis

Numerical analysis aimed at determination of the existence of the inverse relationship between women in participation in the public life and corruption is continued by the analysis World Value Surveys. This is done, following the paper by Swamy *et al.* (2001) who analyzed the data from the World Values Survey and found that women were more likely than men to condemn bribe taking. World Values Survey is a continuous project aimed at studying values of different nations around the globe. Fife waves of the surveys were conducted from the years 1981 to 2007. One of the numerous questions, respondents are being asked, is connected to bribe justification. Namely, participants are asked to assess on the scale from 1 (never justifiable) to 10 (always justifiable) the act of accepting by someone a bribe in the course of their duties.

Table 5 presents average percent of respondents who have chosen one or another answer to this question for the 20 countries chosen for the analysis. First glance of the data enables us to conclude that on average a little bit more women (M=66.97, SD=13.16) than men (M=61.25, SD=14.29) think bribery can't be justifiable. The same is true for the respondents who would always justify bribe (women: M=1.31, SD=1.29; men: M=2.18, SD=1.60). A statistical test of the null hypothesis that there is no gender difference in choosing the option "bribe is never justifiable" versus the alternative one – women choose this option more often, we can't reject null hypothesis as the difference is insignificant (Mann Whitney Z=-1.27, p=0.102, one-sided). Figure 3 presents the data on the choice of the option "bribe is never justifiable" for each of the transition economies chosen for the analysis.

On the other hand if we jointly analyze the answers falling in the categories which evaluate bribe taking as more justifiable (7 to 10) we can see that average percentage of male respondents whose answers fall in one of these categories (M=6.45, SD=3.70) is significantly higher than average percentage of women (M=4.81, SD=3.49) falling in these categories (Mann-Whitney Z = -1.678, p<0.05, one-sided). Figure 4 depicts the aggregated percentage of male and female respondents whose answers are falling in categories 7 to 10 for each of the 20 countries used in the analysis.

Table 5. Gender differences in the attitude towards bribery

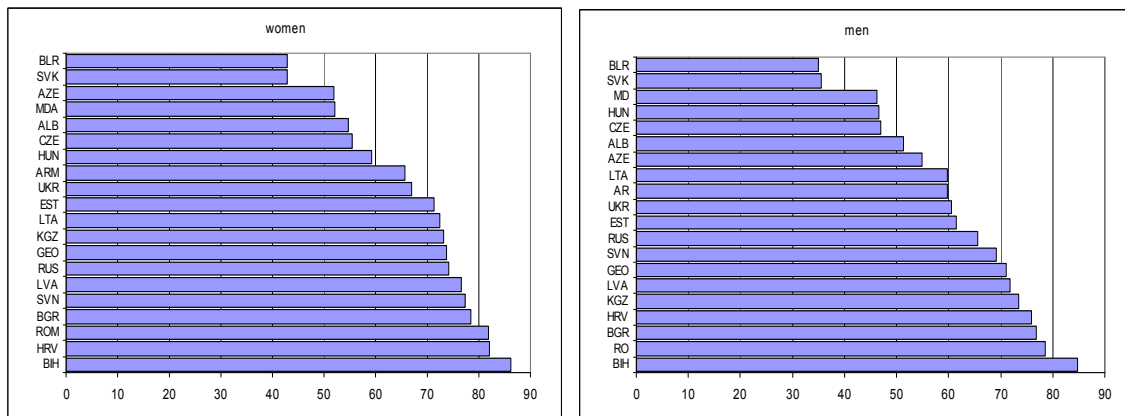|	Men	Women
Never justifiable	61.25	66.97
2	11.13	10.68
3	8.09	7.15
4	4.35	3.43
5	6.16	4.97
6	2.58	2.00
7	1.95	1.47
8	1.44	1.43
9	0.89	0.60
Always justifiable	2.18	1.31

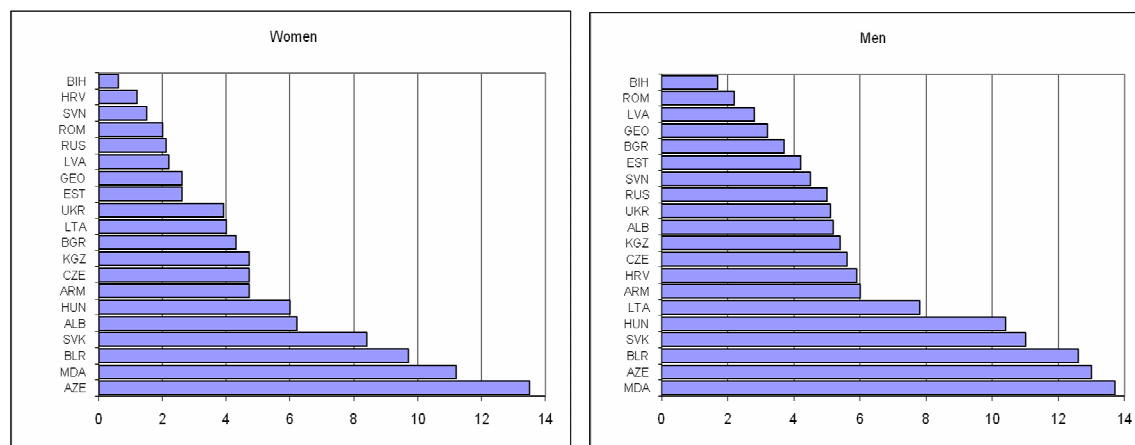**Figure 3**. "Bribe is never justifiable" for each country of the analysis

Figure 4 - Justification of a bribe in countries of analysis (aggregated categories 7-10)

8. Acknowledgements

9. Conclusions

The goal of this paper was to analyze the existence of the negative relationship between women social, economic and political activity, expressed as women's share in parliament, in adult labour force, in decision-making positions, and gender empowerment measure, and corruption measure for the group of countries who share common cultural and historical legacy. As such group of countries former communist and USSR countries were chosen. We believe that this was a very important step in the research of gender relation to corruption, as previous studies [Dollar *et al.*, (1999), Swamy *et al.*, (1999), and Sung, (2003)] did analyze "impersonalized" large common samples, which included African, Western and Eastern countries. Taking into account intuition of Alatas *et al.* (2008) we were conscious of the fact that gender differences found by the abovementioned authors might be culture-specific, and that these findings might not apply to our sample.

We explored issue of relationship between gender and corruption from the two sides: first we regressed a measure of corruption of World Bank and Transparency International on several measures of women participation and control variables, and as a second step, based on the data from World Values Surveys we analyzed attitude of women in our sample towards bribery. Our findings suggest that the gender differences found in previous studies indeed might to some extent be culture related, as we get positive (although) insignificant relationship between women's share of legislators and managers and corruption index, which can't be explained. Amount of women in the labour force can't be a good predictor of changes in corruption index either, as most of the women in countries in our sample due to uneasy economic situation and communist labour traditions are already in the labour force. However analysis of the coefficient on the variable measuring women's share in parliament is consistent with findings of the previous research, although they show numerically a bit lower influence of WPARL on corruption index. Coefficient on the WPARL is negative and significant in the three of the four regression specifications, and it shows that a one standard deviation increase in WPARL is connected to a decrease in corruption measures varying from13% to 17%. To compare: Dollar *et al.* (2001) found that one standard deviation increase in WPARL will result in a decline in corruption by 20% of a standard deviation; Swamy *et al.* (2000) found that same increase in WPARL would be followed by a decrease in corruption measure which is slightly higher than 20% of a standard deviation.

Our second line of analysis revealed, that although more women than men find the bribe taking behaviour as never acceptable, this difference is not significant. However this difference turns to be significant when we jointly analyze the answers falling in the categories which evaluate bribe taking as more justifiable (7 to 10), where on average more men were likely to choose an answer falling in one of these categories.

Empirical evidence presented in our paper enables us to conclude that an increase in women representation in parliament has a positive effect for a country through its negative (linear) relationship to corruption. However we understand that due to a really small sample size the results could not be considered as fully credible. As the next stage of this research a panel data analysis could be utilized, to check if data support the conclusions of the cross-section analysis.

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Appendix A - Countries Included in the Analysis

Albania	Lithuania
Armenia	Macedonia
Azerbaijan	Moldova
Belarus	Montenegro
Bosnia and Herzegovina	Poland
Bulgaria	Romania
Croatia	Russian Federation
Czech Republic	Serbia
Estonia	Slovakia
Georgia	Slovenia
Hungary	Tajikistan
Kazakhstan	Turkmenistan
Kyrgyzstan	Ukraine
Latvia	Uzbekistan

Appendix B - Summary statistics of variables

Variable	Mean	SD	Observ.
WB corruption[ab]	0.43	0.12	27
CPI corruption[b]	3.54	1.45	27
Women in parliament	15.85	6.95	27
Women in labor force	46.71	2.88	27
Women manager/legal	30.95	8.48	21
Gender Empowerment Index	0.57	0.08	21
GDP/capita (in thousands US$)	4.92	4.20	27
Civil Liberties[b]	3.04	1.93	27
Rule of Law	8.67	4.36	27
Press Freedom[b]	21.94	23.00	27

[a] Normalized variable on the interval [0,1], with 0 meaning the most corrupted country, and 1 the least corrupted. Original variable in the interval [-2.5, 2.5].
[b] Variable values are multiplied by (-1) in statistical analyses to allow easier interpretation of coefficients

Appendix C - Variables and Sources

Variable (Year)	Source & Notes
WB corruption index (2007)	WB Worldwide Governance Indicators. Access through: www.govindicators.org Ranges between -2.5 (highly corrupt) to 2.5 (highly corrupt)
CPI Score (2008)	Transparency International. Access through: www.transparency.org Ranges between 10 (highly clean) and 0 (highly corrupt).
Women in Parliament (2008)	Inter Parliamentary Union. Access through: www.ipu.org Percentage of parliamentary seats held by women in the upper and lower Houses.
Women in adult labor force (2007)	United Nations, Statistics and indicators on women and men. Access through: http://unstats.un.org Percentage of women in adult (15+) labor force.
Women legislators and managers (2001-2006)	United Nations, Statistics and indicators on women and men. Access through: http://unstats.un.org Percent. Of women legislators and managers of all workers in this occupational group.

GDP per capita (2005)	UNDP, Human Development Report 2007/2008. Access through: http://hdr.undp.org Measured in thousands of USA dollars.
Civil Liberties (2008)	Freedom House. Freedom in the World 2008: Country Subscores. Access through: www.freedomhouse.org Ranges from 1 (the most free) to 7 (no freedom).
Rule of Law (2008)	Freedom House. Freedom in the World 2008: Country Subscores. Access through: www.freedomhouse.org Ranges from 16 to 0. Where 0 means no rule of law.
Freedom of press (2008)	Reporters Without Borders. Access through: www.rsf.org Ranges from 0 to 100, where 100 stands for the worst press situation.
Gender Empowerment Measure (2008)	UNDP, Human Development Report 2007/2008. Access through: http://hdr.undp.org Ranges from 1 (absolute equality) to 0 (absolute inequality).
Acceptance of a Bribe (1996-2003)	World Value Survey. Online Data Analysis. Religion and Morale. Justification of social behaviors. Access through: www.worldvaluessurvey.org Ranges from 1 (never acceptable) to 10 (always acceptable).

EXCHANGE RATE PASS-THROUGH TO DOMESTIC PRICES IN THE CENTRAL EUROPEAN COUNTRIES

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Abstract:

   Exchange rate plays an important role in transmitting pressures from the external shocks to the domestic economy. Development of inflation in the domestic economy is significantly determined by the ability of exchange rate to transmit external price related pressures to the domestic market. Considering the new EU member countries obligation to adopt euro the loss of the monetary sovereignty should be analyzed not only in the view of the direct positive and negative effects of this decision but also in the view of many indirect effects. While the exchange rates of majority of the EMU candidate countries are strongly affected by the euro exchange rate on the international markets there is still room for them to float partially reflecting changes in the national economic development. Ability of the exchange rate to transfer external shocks to the national economy remains one of the most discussed areas relating to the current stage of the monetary integration process in the European single market.

   In the paper we analyze the ability of the exchange rate to weaken or eventually to strengthen the transmission of the external inflation pressures to the national economy in the Czech Republic, Hungary, Poland and the Slovak republic. In order to meet this objective we estimate a vector autoregression (VAR) model correctly identified by the Cholesky decomposition of innovations that allows us to identify structural shocks hitting the model. Variance decomposition and impulse-response functions are computed in order to estimate the exchange rate pass-through from the foreign prices of import to the domestic consumer price indexes in the Visegrad countries. Ordering of the endogenous variables in the model is also considered allowing us to check the robustness of the empirical results.

Keywords: exchange rate, inflation, VAR, Cholesky decomposition, variance decomposition, impulse-response function

JEL Classification: C32, E52

1. Introduction

   Ability of the exchange rate to transfer external shocks to the national economy remains one of the most discussed areas relating to the current stage of the monetary integration process in the European single market. New European Union (EU) member countries that accepted the obligation to adopt euro have to consider many positive and negative aspects of the euro adoption especially in the view of time they need for the implementation of all necessary actions to be ready to give up their monetary sovereignty. We do not want to speculate about the approximate date of the future European Monetary Union (EMU) enlargement especially due to increased uncertainty of the economy agents in the time of the global financial and economic crisis that also worsen the macroeconomic stability in the EMU candidate countries as well as their ability to meet the Maastricht convergence criteria. On the other hand it is still convenient to analyze the wide spectrum of effects related to giving up the relative flexibility of the national exchange rates after the euro adoption. While the exchange rates of majority of the EMU candidate countries are strongly affected by the euro exchange rate development on the international markets there is still room for them to float partially reflecting changes in the domestic economic development.

   Among many of impulses that the exchange rate transmits from the external environment to the national economy we highlight the price effects of changes in the foreign import prices on the domestic price indexes. The degree of the exchange rate pass-through to the domestic prices emphasizes its role as the external price shocks absorber especially in the situation when the exchange rate development is less vulnerable to changes in the foreign nominal variables.

   In the paper we analyze the ability of the exchange rate to weaken or eventually to strengthen the transmission of the external inflation pressures to the national economy in the Czech republic, Hungary, Poland and the Slovak republic. In order to meet this objective we estimate vector autoregression (VAR) model correctly identified by the Cholesky decomposition of innovations that allows us to identify structural shocks hitting the model. Variance decomposition and impulse-

response functions are computed in order to estimate the exchange rate pass-through from the foreign prices of import (we use an index of the prices of import goods denominated in the foreign currency) to the domestic consumer price indexes in the Visegrad countries. Ordering of the endogenous variables in the model is also considered allowing us to check the robustness of the empirical results.

2. Overview of the literature

Vulnerability of the exchange rates to the exogenous shocks came to the centre of an academic discussion shortly after a break-down of a Bretton Woods system of fixed exchange rates at the beginning of the 1970s. Uncertainty on the foreign exchange markets together with higher volatility of exchange rates increased a sensitivity of domestic economies to the foreign partners' economic development as well as to the world leading economies' exchange rate movements. Exchange rate pass-through as the relationship between exchange rate movement and price adjustments of traded goods came to the centre in academic and policy circles [Lian, (2007)]. Toshitaka (2006) estimated exchange rate pass-through of six major industrial countries using a time-varying parameter with stochastic volatility model. Author divided an analysis into impacts of exchange rate fluctuations to import prices (first-stage pass-through) and those of import price movements to consumer prices (second-stage pass-through). Takatoshi (2005) examined the pass-through effects of exchange rate changes on the domestic prices among the East Asian countries using the conventional pass-through equation and a VAR analysis. In order to identify the VAR model authors used a Cholesky decomposition to identify structural shocks and to examine the pass-through of the exchange rate shock to the domestic price inflation. They conclude that while the degree of exchange rate pass-through to import prices is quite high in the crisis-hit countries, the pass-through to CPI is generally low. Takatoshi and Kiyotaka (2006) estimated five and seven variable VAR model (including all three price variables to check the robustness and to investigate directly the pass-through effect across the prices.) in order to examine the pass-through effects of exchange rate changes on the domestic prices. Cortinhas (2007) also tested the sensitivity of the results from the VAR models using several alternative ordering of the variables with mixed results. Ca' Zorzi *et al.* (2007) on the sample 12 emerging markets in Asia, Latin America, and Central and Eastern Europe investigated that exchange rate pass-through declines across the pricing chain, i.e. it is lower on consumer prices than on import prices.

3. Econometric model

In order to analyze the transmission of the external inflation pressures to the domestic price inflation we estimate a vector autoregression model (VAR) that can be written by the following moving average representation

$$CY_t = A(L)Y_{t-1} + u_t \qquad (3.1)$$

where $Y_t = [ip_t, m_t, e_t, y_t, p_t]$ is a N x 1 vector of the contemporaneous endogenous variables (ip - foreign prices of import, m - money supply, e - exchange rate, y - production gap, p - domestic price index), C is an N x N matrix with ones on the main diagonal and possibly non-zero off-diagonal elements representing the contemporaneous relationship among the endogenous variables of the model, $A(L)$ is a polynomial variance-covariance matrix in the lag operator L representing the relationship among variables on the lagged values and u_t is a N x 1 normalized vector of shocks to the model (foreign prices of import shock, nominal shock, exchange rate shock, production gap shock, inflation shock).

By multiplying equation (3.1) by an inverse matrix C^{-1} we obtain the reduced-form of the VAR model (this adjustment is necessary because the model represented by the equation (3.1) is not directly observable and structural shocks cannot by correctly identified):

$$Y_t = C^{-1}A(L)Y_{t-1} + C^{-1}u_t = B(L)Y_{t-1} + e_t \qquad (3.2)$$

Equation (3.2) reveals the relationship between u_t and e_t, that is given by

$$C^{-1}u_t \;=\; e_t \text{ or } u_t \;=\; Ce_t \tag{3.3}$$

where *B(L)* is again a matrix representing the relationship among variables on the lagged values and e_t is a N x 1 vector of serially uncorrelated structural disturbance (errors) of the model.

In order to identify our model there must be exactly $n^2 - \left[\left(n^2 - n \right) / 2 \right]$ relationships among the endogenous variables of the model, where *n* represents a number of variables. We have to impose $\left(n^2 - n \right) / 2$ restrictions on the matrix *C* based on the Cholesky decomposition of the residual variance-covariance matrix that define matrix *C* as a lower triangular matrix. The lower triangularity of *C* implies a recursive scheme among variables (the Wald chain scheme) that has clear economic implications and has to be empirically tested as any other relationship. Identification scheme of the matrix *C* implies that some structural shocks have no contemporaneous effects on some endogenous variables given the ordering of the endogenous variables. It is clear that the convenient causal ordering of variables is necessary to identify structural shocks and reflects the distribution chain of pricing[1].

More explicitly written equation (3.3) following our identification scheme is given by

$$\begin{bmatrix} u_{ip,t} \\ u_{m,t} \\ u_{e,t} \\ u_{y,t} \\ u_{p,t} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ c_{21} & 1 & 0 & 0 & 0 \\ c_{31} & c_{32} & 1 & 0 & 0 \\ c_{41} & c_{42} & c_{43} & 1 & 0 \\ c_{51} & c_{52} & c_{53} & c_{54} & 1 \end{bmatrix} \begin{bmatrix} e_{ip,t} \\ e_{m,t} \\ e_{e,t} \\ e_{y,t} \\ e_{p,t} \end{bmatrix} \tag{3.4}$$

To check the robustness of our empirical results we estimate three VAR models identified through the restrictions resulting from the recursive Cholesky decomposition of the residuals for each country from the Visegrad group - model A ($Y_t = [ip_t, m_t, e_t, y_t, p_t]$); model B ($Y_t = [ip_t, y_t, m_t, e_t, p_t]$); model C ($Y_t = [ip_t, y_t, e_t, m_t, p_t]$).

In each model we assume different ordering of the variables that reflects the different distribution chain of pricing. This approach has a potential to thoroughly estimate the ability of the exchange rate to transmit external inflation pressures to the domestic economy assuming that different ordering of the variables respects the economic logic of the chain of pricing and it also reflects the structure of the economy. It also allows us to compare the results with those of other studies.

It is also possible to analyze the variability as well as the responses of the variety of the price indexes (CPI, PPI, ULC, and IPD). Another suitable alternative is to alternate different variables in the beginning of the distribution chain in the role of external inflation source (i.e. different energy prices, key import commodities, intermediate or final goods).

Additionally, if the estimated results from variance decomposition as well as the impulse-response analysis confirm the model is not very sensitive to the endogenous variables ordering, the Cholesky decomposition method can be interpreted as providing robust results.

In order to meet the objective of the article to analyze the ability of exchange rate to transmit external price related pressures to the domestic prices we examine variance decompositions from the estimated VAR models focusing only on the interpretation of the sources of exchange rate and inflation variability in the selected group of countries. Similarly we estimate accumulated impulse-responses of the exchange rate and inflation.

4. Data and results

We use the quarterly data ranging from 1999Q1 to 2008Q3 (49 observations) for the foreign prices of import, money supply represented by the monetary aggregate M3, nominal effective exchange rate (NEER), production gap, and inflation represented by the adjusted domestic consumer price index (indicator of core inflation). Time series for the monetary aggregate M3 are seasonally

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[1] In the paper we only want to analyze the degree of exchange rate pass-through along the distribution chain of pricing not its determinants.

adjusted. The production gap was estimated by the Hodrick-Prescott filter applied to the quarterly real GDP.
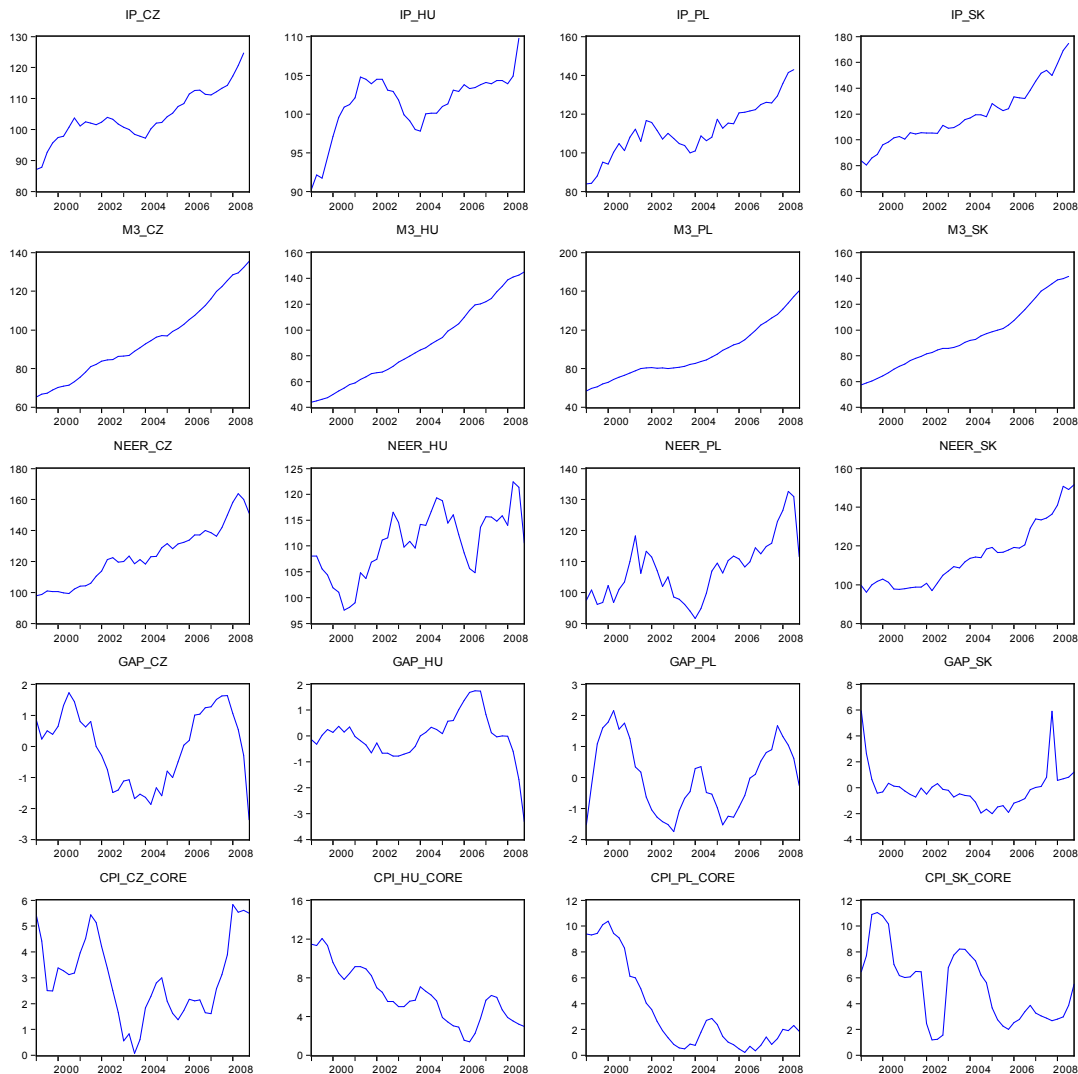

Figure 1. Variables

Before estimating the model we test the time series for stationarity and cointegration. The augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP) tests were computed to test the endogenous variables for the existence of the unit roots. Both ADF and PP tests indicate the variables are non-stationary on the values (except for the production gap in Hungary and the Slovak Republic where both ADF and PP tests indicated the time series are stationary on the values) so that the null hypothesis of a unit root cannot be rejected for any of the series. Testing variables on the first differences indicates the time series are stationary so that we conclude that the variables are I (1) and the time series for the production gap in Hungary and the Slovak Republic are I (0).

Because the most of the endogenous variables have a unit root on the values it is necessary to the test the time series for cointegration using the Johansen cointegration test. The test for the cointegration was computed using two lags as recommended by the AIC (Akaike Information Criterion) and SIC (Schwarz Information Criterion). The results of the Johansen cointegration tests seem to be clear in comparison with the results of the unit root tests. Both trace statistics and

maximum eigenvalue statistics (both at 0.05 level) indicate there is no cointegration among the endogenous variables of the model. The results of the Johansen cointegration tests do not correspond with the results of the unit root tests (for Hungary and the Slovak republic) because it implies that there is no long-run equilibrium relationship among the variables of the model (they follow the different stochastic trend in the long run).

The results of unit root and cointegration tests are not reported here to save space. Like any other results, they are available upon request from the author.

To test the stability of the VAR model we also applied a number of diagnostic tests. We found no evidence of serial correlation, heteroskedasticity and autoregressive conditional heteroskedasticity effect in the disturbances. The model also passes the Jarque-Bera normality test, so that errors seem to be normally distributed. The VAR models seem to be stable also because the inverted roots of the models for each country lie inside the unit circle, although several roots are near unity in absolute value (figure 2).
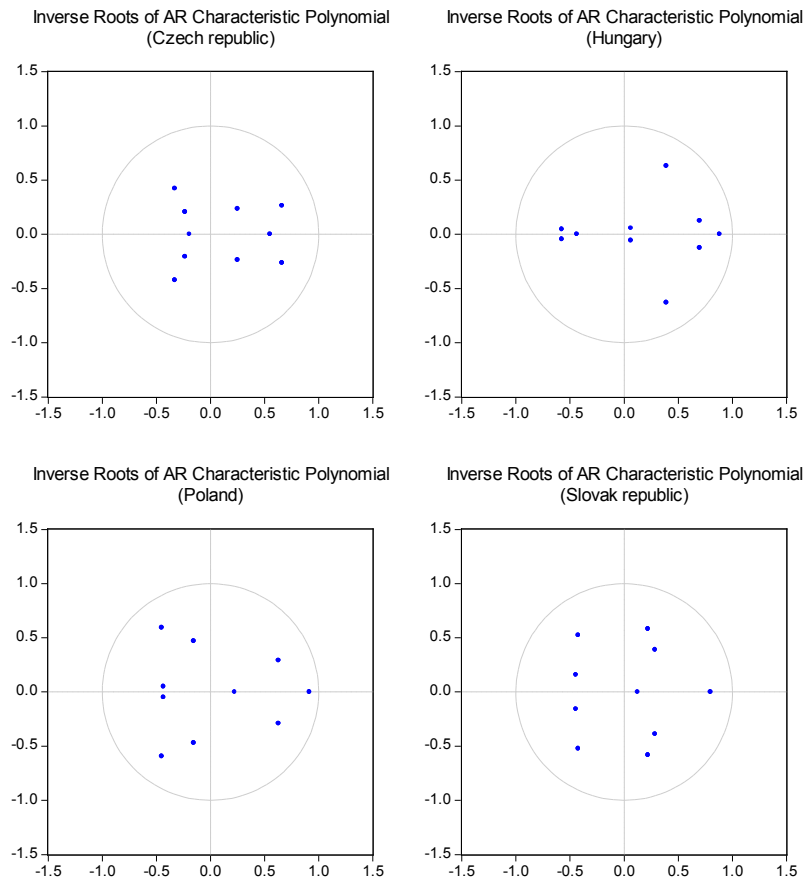

Figure 2. VAR stability condition check (Visegrad countries)[2]
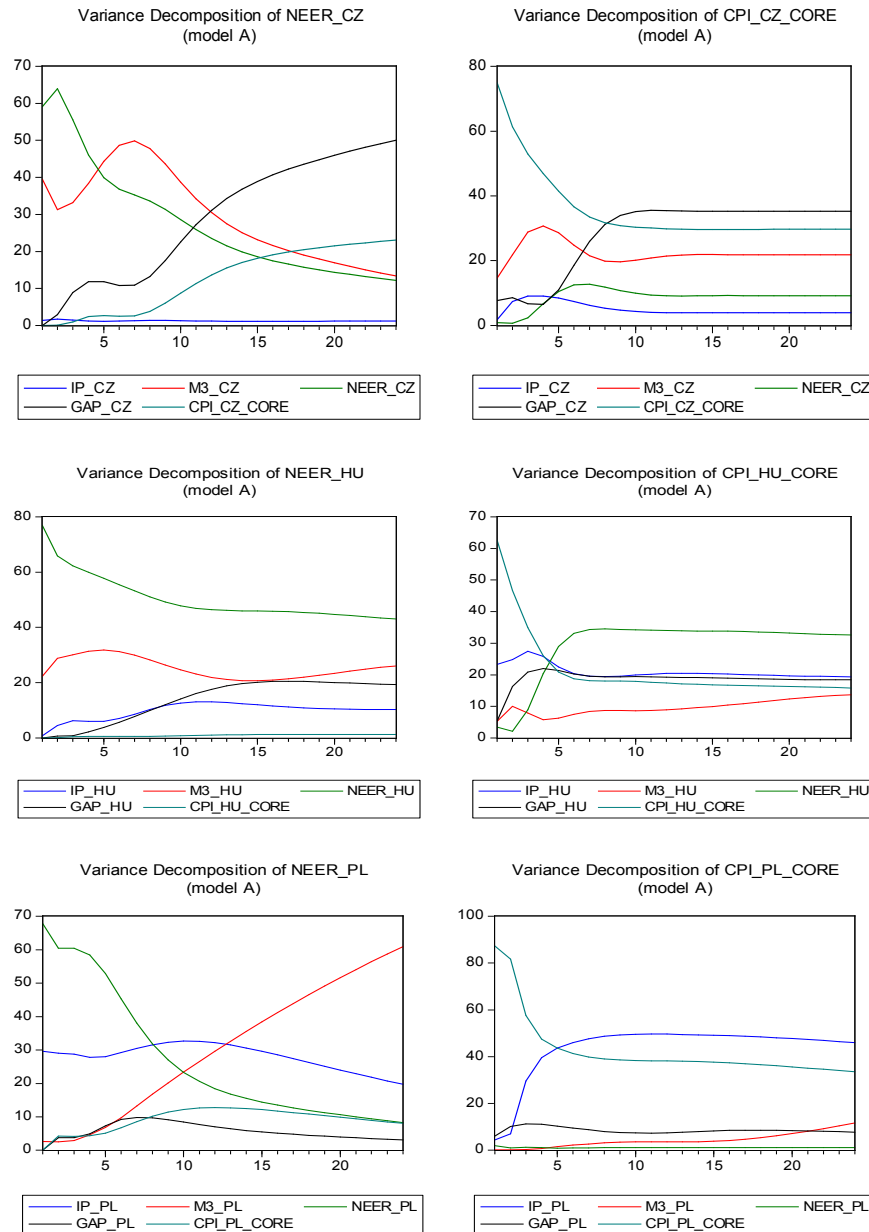
Source: Author's calculations.

Following the results of the unit root and cointegration tests we estimate the model using the variables in the first differences so that we can calculate variance decompositions (we focus on the foreign prices of import contributions to the NEER conditional variance as well as NEER contributions to the CPI conditional variance) and impulse-response functions (we focus on the responses of NEER to foreign prices of import one standard deviation as well as the responses of CPI to NEER one standard deviation) in each country from the Visegrad group. In the figure 3 and 4 we

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[2] The results of the VAR stability condition check are reported only for the model A. Like any other results, VAR stability condition check for models B and C are available upon request from the author.

summarize variance decomposition and impulse-response function for the model A (Y_t = [ip_t, m_t, e_t, y_t, p_t]). In the figure 5 and 6 we summarize variance decomposition and impulse-response function for the model B (Y_t = [ip_t, y_t, m_t, e_t, p_t]). In the figure 7 and 8 we summarize variance decomposition and impulse-response function for the model C (Y_t = [ip_t, y_t, e_t, m_t, p_t]).

4.1 Model A (Y_t = [ip_t, m_t, e_t, y_t, p_t])

In the model A we consider the exchange rate shocks are determined by the monetary policy shocks. At the same time the nominal exchange rate shocks affects output gap contemporaneously, but not vice versa (assumption is given by the Cholesky structure that allows us to identify the model).
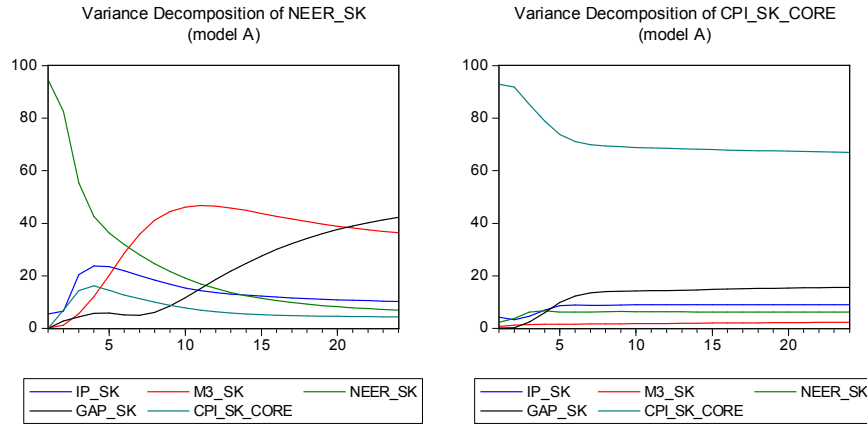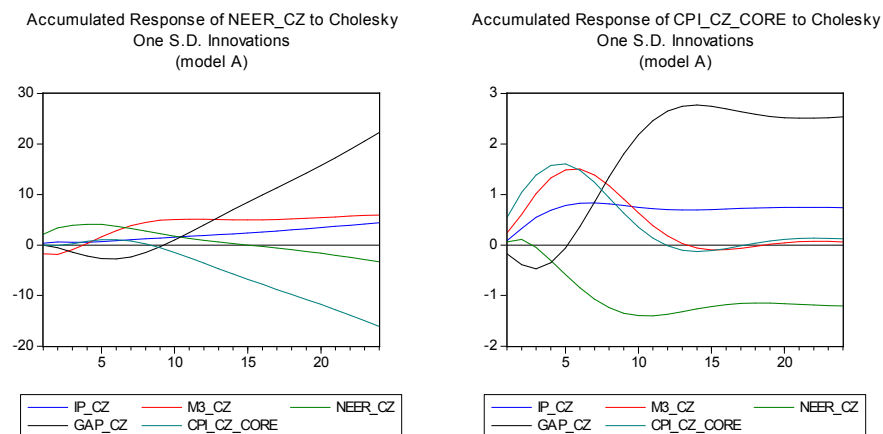
Figure 3. Variance decomposition of NEER and CPI (Model A)
Source: Author's calculations.

The figure 3 reflects variance decomposition of NEER in the Czech republic, Hungary, Poland and the Slovak republic in order investigate the relative importance of the foreign import prices shock in the NEER fluctuations. It also depicts variance decomposition of CPI to investigate the relative importance of the exchange rate shock in the CPI variability. The percentage contribution of the foreign import prices to the variance of NEER doesn't offer clear results among selected group of countries. In the Czech Republic the foreign import prices shock doesn't seem to have much influence in the NEER variability during the whole period of 24 quarters. On the other hand this shock is responsible for around 30 percent of the NEER variability in the first 3 years in Poland. While in Hungary the weight of the foreign import prices shock continuously increases during 11 quarters in the Slovak republic it was only during first 4 quarters and then its impact steadily decreases.

The figure 3 also shows variance decomposition of the domestic consumer prices in the Visegrad countries. The contribution of the NEER shock in the CPI variability is quite large in Hungary (a sharp increase of the weight is visible during first 7 quarters) reflecting high vulnerability of the domestic price development to the external determinants affecting exchange rate path. In the three remaining countries the role of the NEER shock in determining the domestic inflation seems to be rather low (even though it reaches around 10 percent in the Czech Republic).
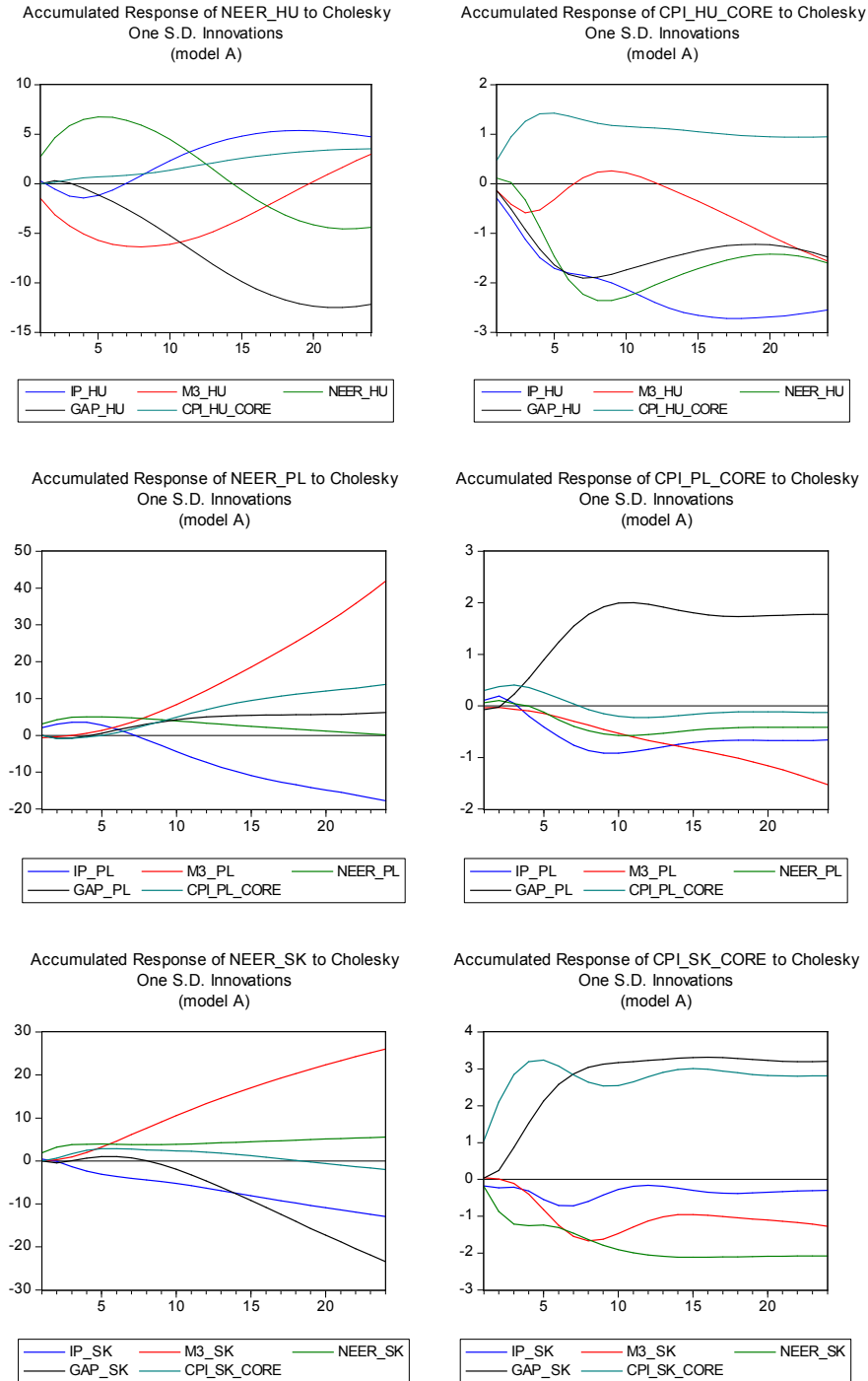
Figure 4. Response of NEER and CPI (Model A)

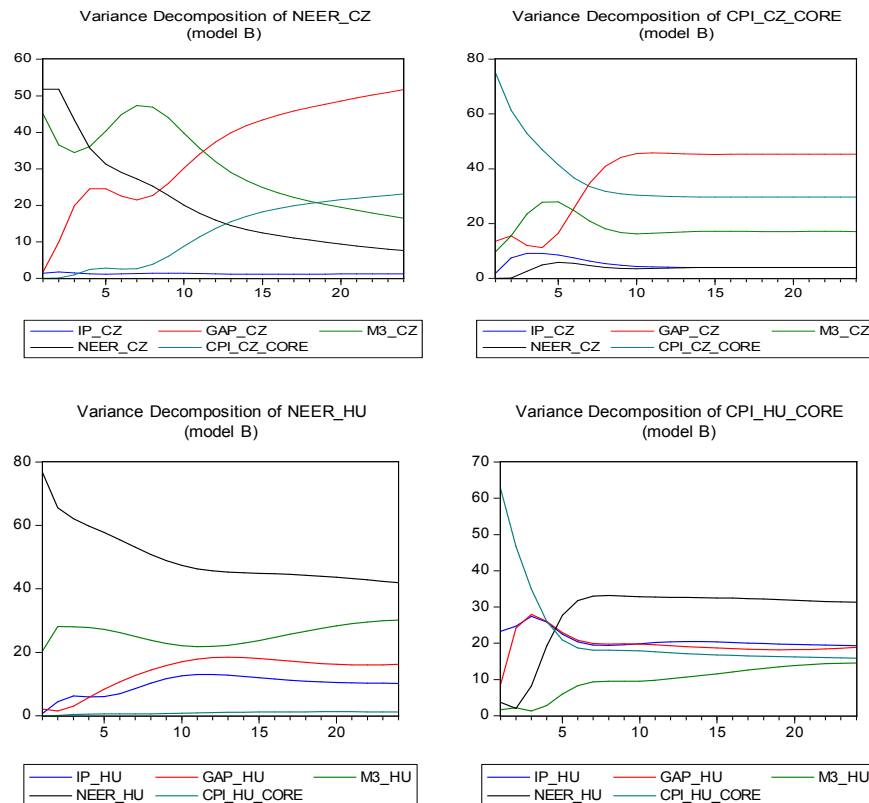**Source:** Author's calculations.

The figure 4 depicts the estimated accumulated impulse-response functions that show responses of NEER to the Cholesky one standard deviation shocks in the Czech Republic, Hungary, Poland and the Slovak republic. We would expect the foreign import prices shock increases NEER (NEER appreciates) upon impact, most likely because of the direct contribution of lower import expenditures to the drop in the foreign exchange demand. It is also suitable to consider the exchange rate will not

respond immediately to the foreign import prices shock due to lagged reactions of agents (due to i.e. timed import contracts) or even not in the right direction especially because of mixed unclear expectations of the agents. The weaker is the response of NEER to the foreign import prices shock the better is the absorption capability of the exchange rate to neutralize the potential effects of the external inflation pressures resulting from the foreign import prices shock on the domestic price development. After the foreign import prices shock NEER belatedly appreciates in the Czech Republic and Hungary while in Poland and the Slovak republic NEER depreciates over the time.

The figure 4 also shows the estimated accumulated responses of CPI to the Cholesky one standard deviation shocks in the selected group of countries. We would expect the positive exchange rate shock (appreciation of NEER) decreases the domestic inflation. This scenario is clearly visible in all countries from the group except Poland. In Poland CPI seems to be less responsive to the exchange rate shock over the time (inflation decreases only at 0.4 percent). In the Czech Republic, Hungary and the Slovak republic inflation decreases during first 8-12 quarters after the positive exchange rate shock. The CPI response seems to be fast and quite large in Hungary (almost 2.4 percent after 8 quarters) while in the Slovak republic it takes 13 quarters until the positive impact on inflation reaches full effect (almost 2.2 percent) and in the Czech republic it takes 11 months (almost 1.4 percent). At the same time we observe the exchange rate shock has a permanent effect on inflation in all three countries (inflation remains permanently lower after the exchange rate appreciates).

4.2 Model B ($Y_t = [ip_t, y_t, m_t, e_t, p_t]$)

In the model B we have adjusted the ordering of the variables so that the output gap is now at the second place. We consider the exchange rate shocks are determined by the monetary policy shocks as well as output gap shocks.
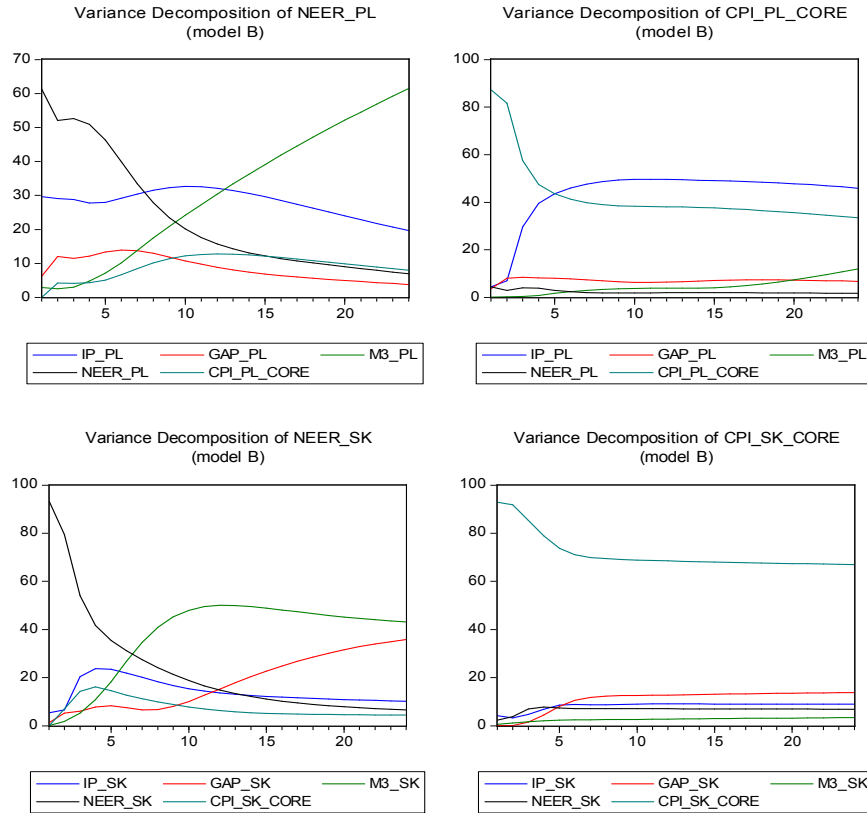
Figure 5. Variance decomposition of NEER and CPI (Model B)

Source: Author's calculations.

The Figure 5 reflects variance decomposition of NEER in the countries from the Visegrad group in order investigate the relative importance of the foreign import prices shock in the NEER fluctuations in the model B with adjusted ordering of the endogenous variables. When we compare figures 3 and 5 we investigate a high degree of similarity in the results of the models A and B. Changed ordering of the variables doesn't seem to have any impact on variance decomposition of NEER.

The Figure 5 also shows variance decomposition of the domestic consumer prices in the Visegrad countries in the model B with adjusted ordering of the endogenous variables. The results for the model B seems to be also similar to those in the model A for all countries. Even thought certain differences reports results for the Czech republic where the contribution of the exchange rate to the inflation variability is little smaller (the difference is on average around 3.5 percent during whole period) in the model B.
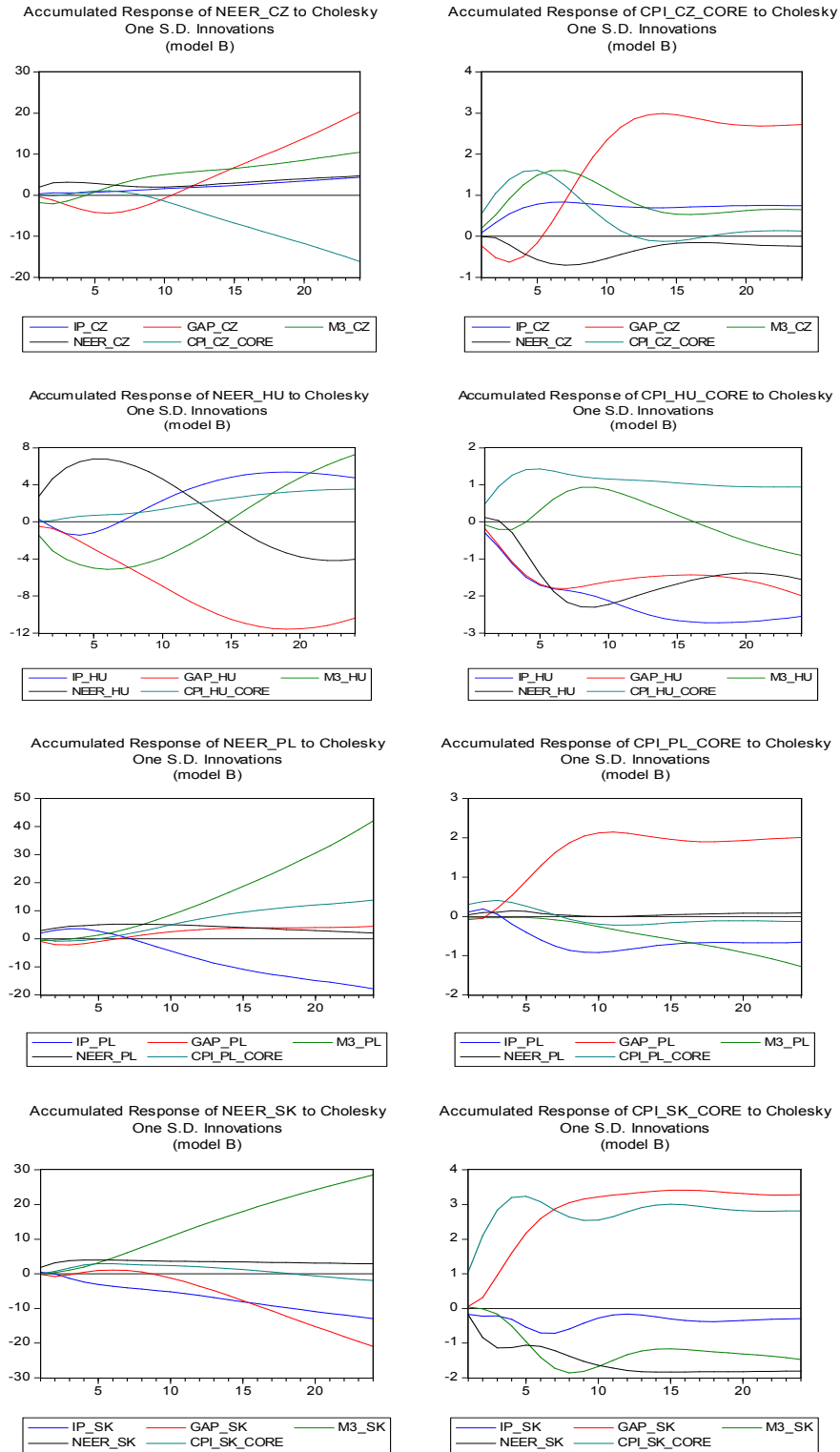
Accumulated Response of NEER_CZ to Cholesky
One S.D. Innovations
(model B)

Accumulated Response of CPI_CZ_CORE to Cholesky
One S.D. Innovations
(model B)

Accumulated Response of NEER_HU to Cholesky
One S.D. Innovations
(model B)

Accumulated Response of CPI_HU_CORE to Cholesky
One S.D. Innovations
(model B)

Accumulated Response of NEER_PL to Cholesky
One S.D. Innovations
(model B)

Accumulated Response of CPI_PL_CORE to Cholesky
One S.D. Innovations
(model B)

Accumulated Response of NEER_SK to Cholesky
One S.D. Innovations
(model B)

Accumulated Response of CPI_SK_CORE to Cholesky
One S.D. Innovations
(model B)

Figure 6. Response of NEER and CPI (Model B)

Source: Author's calculations.

The figure 6 depicts the estimated accumulated responses of NEER and CPI to the structural shocks in the Czech Republic, Hungary, Poland and the Slovak republic in the model B with adjusted ordering of the endogenous variables.

While the responses of NEER to the foreign import prices don't seem to be affected by the changes in the order of the variables in all countries the behaviour of the domestic inflation after the exchange rate shock differs among countries in the models A and B. In the Czech republic the exchange rate shock seems to have smaller impact on the inflation in the model B. Since the tenth quarter the difference was around 0.8 percent on average. In Hungary we didn't investigate any differences among models A and B relating to the CPI responses to the exchange rate shock. While in the model A the results for Poland reflects CPI seems to be less responsive to the exchange rate shock, in the model B inflation doesn't respond to the exchange rate shock over the time with sufficient statistical significance (the CPI neutrality is clearly visible). In the Slovak republic we observe almost similar behaviour of CPI after the exchange rate shock in both models even though there are certain minor differences in the path of the response curve in the middle of the selected horizon.

4.3 Model C ($Y_t = [ip_t, y_t, e_t, m_t, p_t]$)

In the model C we have switched the ordering of the monetary aggregate M3 and the exchange rate (according to the model B) so that we consider the exchange rate shocks are not determined by the monetary policy shocks. At the same time the nominal exchange rate shocks affect monetary aggregate contemporaneously, but not vice versa.
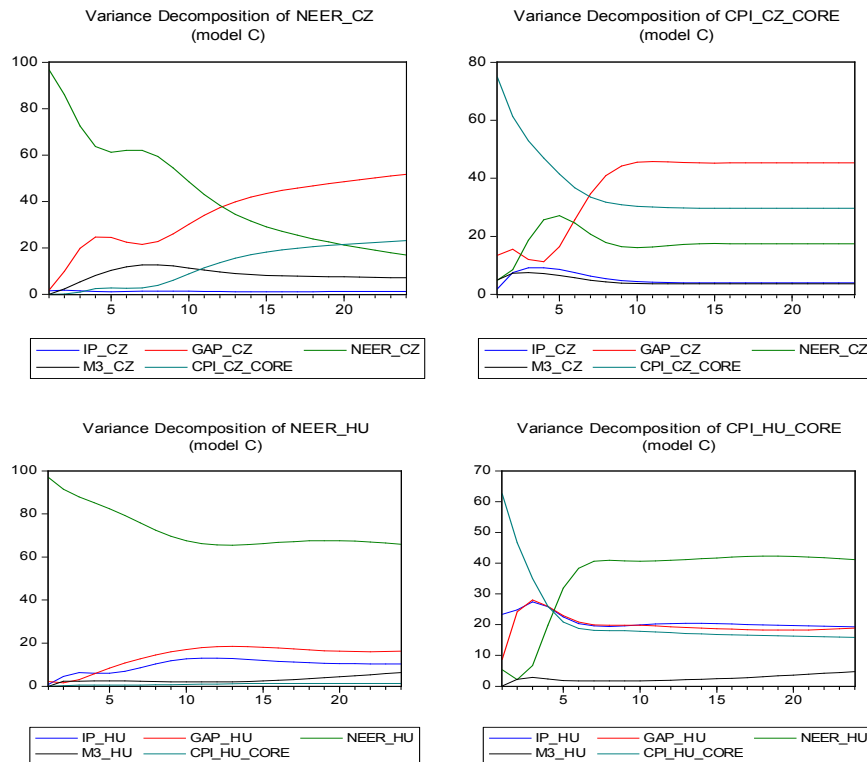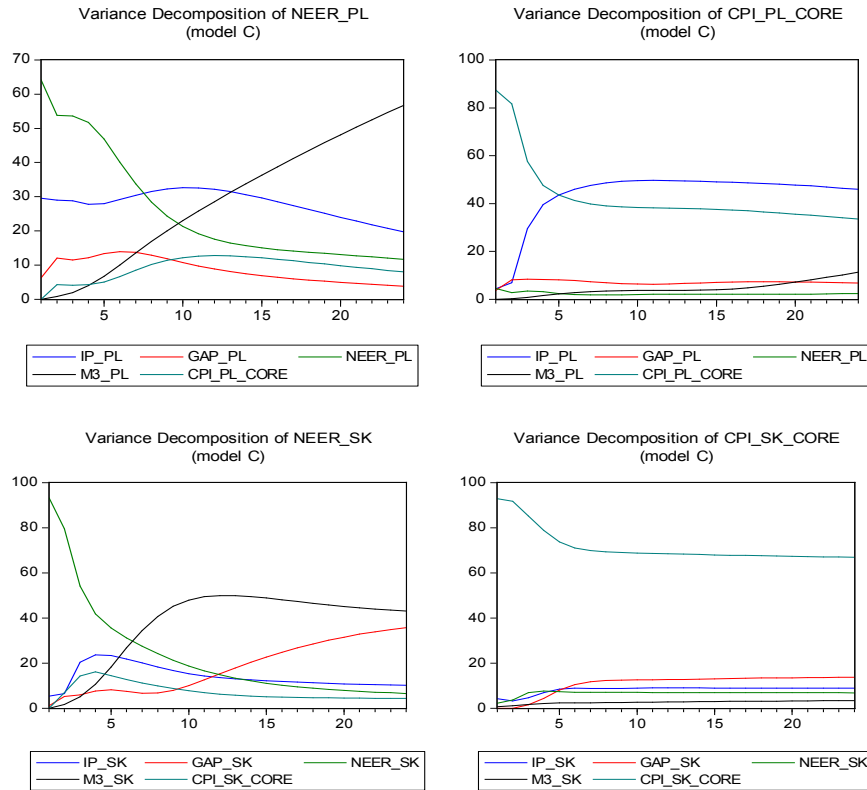
Figure 7. Variance decomposition of NEER and CPI (Model C)

Source: Author's calculations.

The figure 7 shows variance decomposition of NEER in the countries from the Visegrad group in order investigate the relative importance of the foreign import prices shock in the NEER fluctuations in the model C with adjusted ordering of the endogenous variables. When we compare variance decomposition of NEER from figures 3 and 7 we investigate again a high degree of similarity in the results of the models A and C. Changed ordering of the variables repeatedly doesn't seem to have any impact on variance decomposition of NEER.

The figure 7 also shows variance decomposition of the domestic consumer prices in the Visegrad countries in the model C with adjusted ordering of the endogenous variables. The results for the model C seems to be also similar to those in the model A and B for Poland and the Slovak republic. On the other hand the results from the model C reveals (similarly like the model B) certain differences in variance decomposition of CPI in the Czech republic where the contribution of the exchange rate to the inflation variability is little higher (the difference is on average around 9 percent during whole period) in the model C. Differences were also observed in variance decomposition of CPI in Hungary where the contribution of NEER to the CPI variability is higher on average at around 9 percent during whole period in the model C.
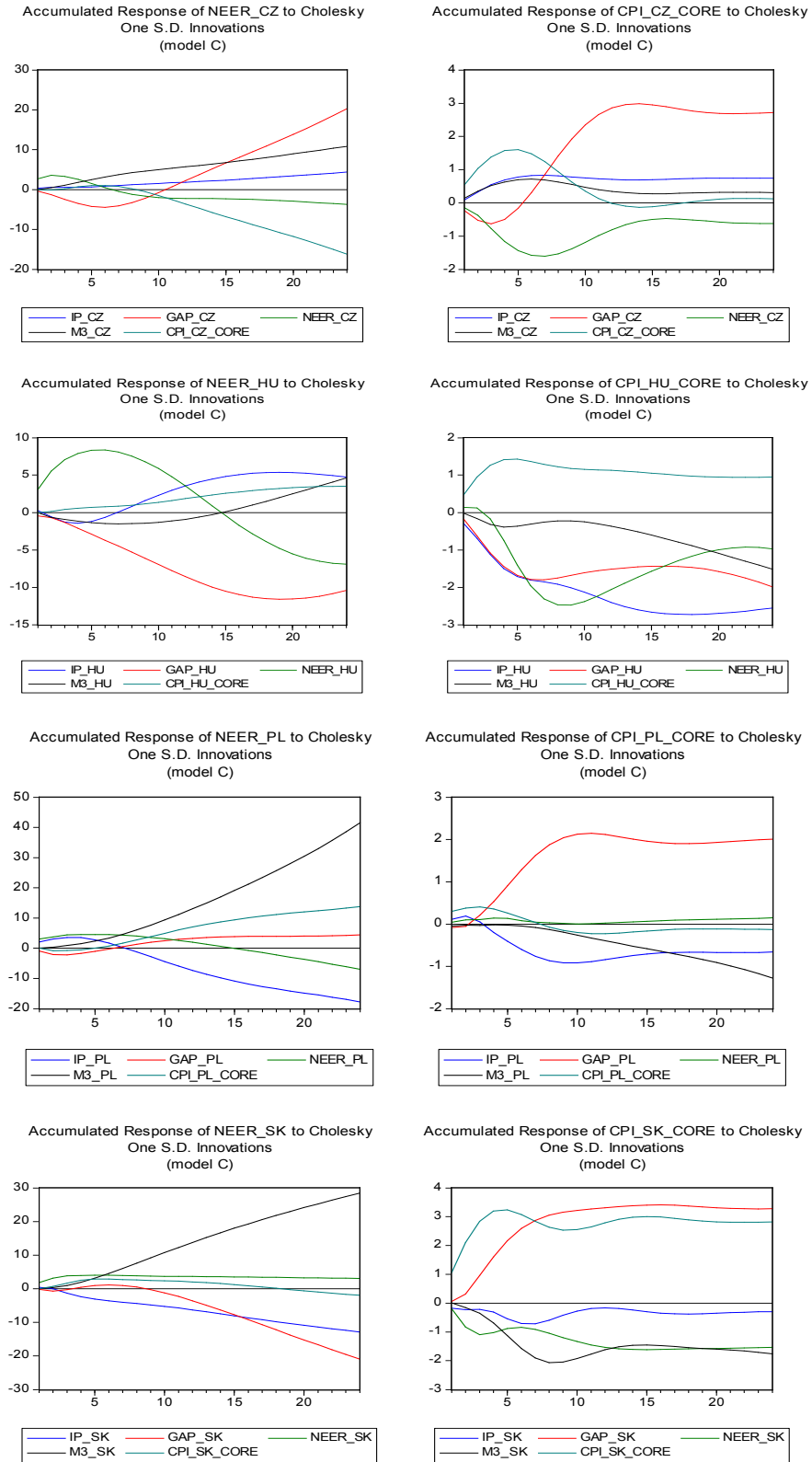
Accumulated Response of NEER_CZ to Cholesky
One S.D. Innovations
(model C)

Accumulated Response of CPI_CZ_CORE to Cholesky
One S.D. Innovations
(model C)

Accumulated Response of NEER_HU to Cholesky
One S.D. Innovations
(model C)

Accumulated Response of CPI_HU_CORE to Cholesky
One S.D. Innovations
(model C)

Accumulated Response of NEER_PL to Cholesky
One S.D. Innovations
(model C)

Accumulated Response of CPI_PL_CORE to Cholesky
One S.D. Innovations
(model C)

Accumulated Response of NEER_SK to Cholesky
One S.D. Innovations
(model C)

Accumulated Response of CPI_SK_CORE to Cholesky
One S.D. Innovations
(model C)

Figure 8. Response of NEER and CPI (Model C)

Source: Author's calculations.

The figure 8 depicts the estimated accumulated responses of NEER and CPI to the structural shocks in the Czech republic, Hungary, Poland and the Slovak republic in the model C with adjusted ordering of the endogenous variables.

The responses of NEER to the foreign import prices don't seem to be affected by the changes in the order of the variables in all countries (just like in the model B). In the Czech Republic the exchange rate shock seems to have smaller impact on the inflation in the model C (similarly like in the model B) but there are still some differences that have to be explained. In the model C the inflation in the Czech Republic dropped faster (during first 7 quarters) after the exchange rate shock according the model A (here it takes around 11 quarters). Long run impact on the inflation is also varying. While in the model A inflation remained lower at approximately 1.20 percent in the model C it was only 0.6 percent. In Hungary the response of inflation to the exchange rate shock was almost similar among all three models so that the ordering of the variables didn't affect the results with sufficient statistical significance. The only difference we identified was the weaker long run effect of the exchange rate shock on the inflation in model C in comparison with models A and B. In Poland the results in the model C seems to be similar to the results in the model B as the inflation didn't respond to the exchange rate shock in the selected period. In the Slovak republic we observe almost similar behaviour of inflation after NEER shock in comparison with models A and B. Even thought there are minor differences in short term path of the inflation response to the exchange rate shock among the models.

5. Conclusion

In the paper we have analyzed the exchange rate pass-through do the domestic prices in the group of Visegrad countries (the Czech republic, Hungary, Poland, the Slovak republic) in terms of exchange rate (we used NEER) ability to transmit pressures from the external price shocks (we used the foreign prices of import shock) to the domestic inflation (we used adjusted consumer price index - core inflation) using vector autoregression model identified by the Cholesky decomposition of innovations. In order to test the robustness of the results we have estimated three models with different causal ordering of the endogenous variables. The analysis was split in two parts. In the first step we have analyzed the contribution of the foreign prices of import shock to the NEER variability as well as the accumulated response of NEER to this shock. In the second step we have analyzed the contribution of NEER shock to the CPI variability as well as the accumulated response of CPI to this shock.

Comparing the result for each country from the Visegrad group has revealed following important facts. The contribution of the foreign prices of import shock to the exchange rate variability differs among the Visegrad countries. While in Poland the foreign import prices shock is responsible for around 30 percent of the NEER variability in the Czech Republic this shock doesn't seem to have much influence in the NEER variability. In Hungary and the Slovak republic the weight of this shock differs in the short run (even though it still remains rather low) but in the long-term perspective its contribution to the NEER variability is quite similar. Changed ordering of the variables doesn't seem to have any impact on variance decomposition of NEER. On the other hand impulse-response functions of NEER offer quite differing results for all countries. While in the Czech Republic and Hungary NEER appreciates with a lag after the foreign import prices shock in Poland and the Slovak republic NEER depreciates over the time. Changed ordering of the variables didn't affect the estimated results. We may conclude the foreign import prices shock mostly determine the NEER variability in Poland (followed by the Slovak republic and Hungary) while in the Czech Republic it played a negligible role. The foreign import prices shock affected NEER in Poland and the Slovak republic (in the Slovak republic with the less contribution) negatively so that it can be considered as the potential source of the inflation pressures. In the Czech republic and Hungary the foreign import prices shock affected NEER positively but only in Hungary it can be considered as the potential source of disinflation (due to the negligible impact of the foreign import prices shock to the NEER variability).

Differing results among countries also offers variance decomposition of CPI. The contribution of the NEER shock in the CPI variability is quite large only in Hungary. In the three remaining countries the role of the NEER shock in determining the domestic inflation seems to be rather low. Changed ordering of the variables doesn't seem to have significant impact on variance decomposition of CPI except for the Czech Republic where the model C revealed little higher NEER shock contribution to the CPI variability. The impulse-response analysis has confirmed our expectations. In

all countries except Poland (inflation in Poland seems to be less responsive (model A) or even neutral (models B and C) to the exchange rate development) CPI decreases after the NEER shock. The most intensive CPI decrease we have examined in Hungary followed by the Slovak republic and the Czech Republic. Changed ordering of the variables has slightly changed the results in the Czech Republic.

The degree of the exchange rate pass-through to the domestic prices seems to be quite high in the Czech Republic, Hungary and the Slovak republic. On the other hand NEER significantly determines CPI only in Hungary, while in the remaining countries the exchange rate pass-through is eliminated due to low NEER contribution the CPI variability.

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FORECASTING FINANCIAL INDEXES WITH MODEL OF COMPOSITE EVENTS INFLUENCE

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Abstract
    In this article we propose the model for the forecast of various financial indexes: stock markets indexes; currency exchange rates; crediting rates. Behaviour of financial indexes depends on psychological sentiments of players (investors, traders) and their inclination to buy or sell financial tools. We have made the supposition that political, economical, financial and other events are preconditions for formation of the future psychological sentiments of players. Therefore, for forecasting financial indexes we estimate influence of all topical events on the future inclination of players to buy or sell. The proposed model calculates the composite influence of events on the basis of estimations of influence direction, influence force, influence time, events importance and confidence to the information about events. The model fulfils the calculations with help of fuzzy integral Sugeno (1972). We have used this model for forecasting indexes of various economical natures: Ukrainian stock index (PFTS); exchange rate EUR/USD; crediting rate KievPrime 1M and quotations of Eurobonds Ukraine 2015. We also have estimated errors and horizons of forecasts.

Keywords: forecasting model; financial index; events influence; fuzzy integral; fuzzy measure

JEL Classification: C63, C65, D81, G11, G14

1. Introduction

    The forecasting problem of financial indexes is topical both from the view-point of practice, and from the view-point of the economic theory. On practice the accurate forecast allows to correctly define opening and closing values at trading. The accurate forecast also is the main condition of high profit for investors which invest in securities and the commodities. From the view-point of an economic science, financial indexes are situation indicators in countries economy, internal and external markets. For example, stock indexes reflect investment appeal of the big enterprises and the companies. The indexes behaviour shows health and problems of economy. The prices of commodity markets reflect balance of supply and demand - the main indicator of market economy. As shows Neziri (2009), the credit default swaps can predict financial crises. The accurate forecast of financial indexes is also necessary condition for adequate government decisions concerning effective budgetary planning, production stimulation and determination of rational structure of the state purchases.

    In article we accent attention on forecast accuracy and on forecast horizon. Some researchers consider other parameters. For example, they consider operations profitability on the stock exchange which depends also from of some external conditions, regulatory rules and norms. Use of profitability parameter is justified: in some cases even the accurate forecast does not provide operations profitability on the market. However the accurate forecast always is necessary profitability condition.

    In article the concept „the financial index" we consider in a broad sense. The behaviour of financial index reflects the situation in complete economic system. In other words, the financial index we consider as one-dimensional projection of this system. For example, such system is the world market of production and consumption of grain. In this case, the wheat price can be considered as financial index. Indexes of stock exchanges, exchange rates, the prices of black and precious metals also can be considered as financial indexes.

    The publications analysis in this area has shown that the forecasting problem of financial indexes also is topical in modern researches. Researchers use various methods for the decision of this problem.
    Neural networks. Many researchers use neural networks. For example, the research [Lin Chin-Shien, Khan Haider Ali, Huang Chi-Chung, (2002)] analyse the using effectiveness of neural network for prediction of trend direction of stock index. It is shown that the neural network predicts the trend direction in 58 % of cases with forecast horizon „the next day". The network was tested on 13 well-known indexes. Lawrence Ramon (1997) proposes using the neural network for forecasting the stock prices in the market depending on variables set (fundamental, technical, macroeconomic indicators

which are grouped in 7 classes). He declares that the neural network provides accuracy of 92 % concerning prediction of movement direction of the price with forecast horizon „on the next day". Paper [Liu Yong, Yao Xin, (2001)] demonstrates the forecasting results of Hang Seng index by means of an evolutionary neural network. Research [Chen Yuehui, Yang Bo, Ajith Abraham, (2006)] analyses the using of neural trees ensemble with genetic algorithm for the forecast of indexes NASDAQ and S&P. The forecast error with horizon „the next day" averages up to 1 %. Olson Dennis, Mossmanb Charles, 2003 describe the forecast method of Canadian stock return also with using of neural network. Research shows that neural networks win against techniques of logistic regression (logit).

Regression techniques. Researchers also widely use the regression techniques for the forecasting of financial indexes. Caiado Jorge (2004) analyses the forecasts of Portuguese stock index PSI-20 which are performed by means of various autoregressive models. Paper [Bradley Michael D., Jansen Dennis W., (2004)] investigates the forecast of stock returns and growth of industrial production with use of linear and nonlinear models, including models of autoregress. Clements Michael P., Franses Philip Hans, Norman R. Swanson (2004) consider the problems of use of linear and nonlinear models for the forecasting of economic and financial time series. Chana Kam Fong and Grayb Philip (2006) investigate the possibility of use of autoregressive models for the account of seasonal fluctuations in the forecast of daily electricity prices.

Artificial intelligence. Researchers also use the newest techniques of artificial intelligence. Wuthrich B., Cho V., Leung S., Permunetilleke D., Sankaran K., J. Zhang, W. Lam (2007) describe use of technique „data mining" for the forecasting the main stock indexes of Asia, the Europe and America. The technique provides the accumulation and the analysis of texts with experts forecasts in influential financial mass-media. This work declares that forecast accuracy of indexes movement direction with horizon "the next day" amounts from 40 % up to 45 %. We explain the low forecast accuracy by low accuracy of primary forecasts which are used as entrance data. Peramunetilleke Desh and Wong Raymond K. (2007) use the technique „data mining" for the forecasting the exchange rates with forecast horizon 2-3 hours.

Classical techniques of forecasting. Marshall Ben R., Cahan Rochester H. (2005) investigate the using of popular rules of the technical analysis for forecasting the returns of trading operations on the New Zealand stock market. According to this article, the technical analysis not provides returns in the long horizon.

We can expand the techniques list which are used for the forecasting the financial indexes. However collecting the full techniques list is not the purpose of this research. We wished to pay attention to one common attribute of techniques of forecasting. All these methods use the statistical values of financial indexes and other connected parameters out of the past. The main idea of these methods is the decision of following problem: on the basis of values processing out of the past it is necessary to make the index behaviour forecast in the future. We assume that such problem is not completely correct from the view-point of philosophy of forecasting and behaviour of complex economical systems.

Values of financial index depend on direction and force of many factors (variables) which act at the current time-moment t (see figure 1). These factors determine psychological sentiments and expectations of sellers and buyers on the market. They reflect the objective economic data, political situation and situation in corporative sector. For example, the message about rise of budget deficit causes activity of currency sellers on the market. In other words, the aggregate of factors out of past and present which act at the current time-moment t, completely determines value of financial index in this time-moment. Hammoudeha Shawkat, Choi Kyongwook (2005) and Rapach David E., Wohar Mark E., Rangvid Jesper (2004) have investigated the most obvious dependences of financial indexes from these factors. Values of many factors cannot appreciably change at short time interval. Therefore the forecast on the basis of statistical values not very deviates from the real values of index, if only suddenly not appears the new critical factor. However, with time the changes arise in factors aggregate. New factors appear and old factors end the influence (the market forgets the old events). Real trend of index greatly deviate from forecast trend. Consequently we can reduce an error and increase forecast horizon if we shall estimate influences of the past and current factors in the future.
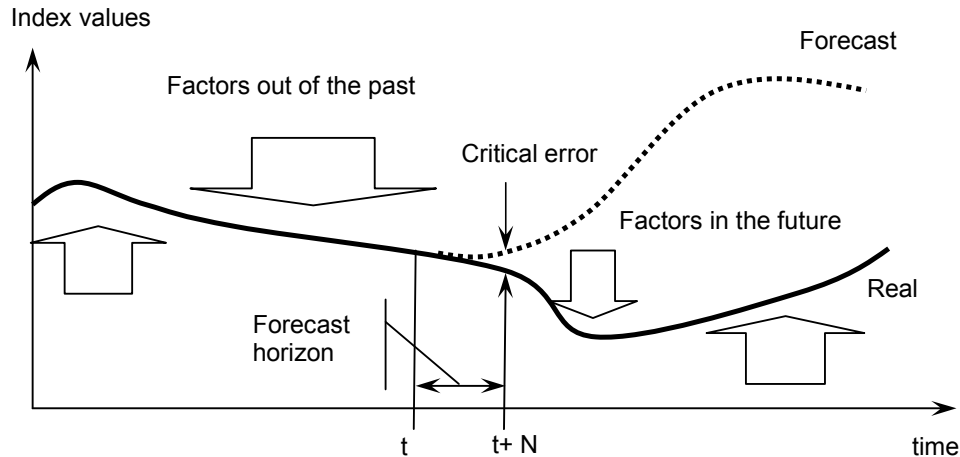
Index values

Factors out of the past

Forecast

Critical error

Factors in the future

Real

Forecast
horizon

t   t+ N   time

Figure 1. Dependence of values of financial index from direction and force of factors

Acknowledgement of this conclusion is the short horizon of the forecast in used techniques though these methods use various mathematical approaches and paradigms for data processing. The short horizon can be sufficient for speculators, but it is insufficient for long-term investments. The reason of short horizon of the forecast consists in fast growth of differences between situations in complex economic system at the time-moment t and $t+N$ with increase N. In modern economic systems and in conditions of the global information environment these differences become essential already in 1-2 days. Therefore, use of the statistical information for the accurate forecast with sufficient horizon is inefficient. Only information processing about the influence of forecast factors in the future can provide high accuracy and long horizon of forecast.

2. Idea of the model

Financial and economic mass-media publishes the information messages about events which can influence players' sentiments and financial indexes. These events reflect values of various forecast factors. For example, events is: the publication of macroeconomic indicators, experts opinions or officials opinions, declarations of political and economic intentions, the states actions, using of economic sanctions, news of large corporations and the companies. Following parameters describe events influence on financial indexes.

Influence direction. Event can increase or decrease values of financial index. For example, growth of industrial production causes growth of stock indexes and on the contrary. The influence direction answers the question: where the index will move after event publication? In different situations the same event influences differently. For example, the rise of oil-prices produces to quotations fall on the Japanese stock market (growth of export price). But the rise of oil-prices produces to quotations growth on USA stock market (growth of oil-companies incomes).

Influence force. Influence force of event reflects influence amplitude. For example, event „Decrease of funds target rate on 0.25 %" has smaller influence, than event „Decrease of funds target rate on 1 %". Influence force answers the question: how strongly the index will change after event publication? Influence force of event can be measured in discrete scale. For example: „small force", „greater force", „very much greater force" and so on.

Influence time. Event influence is changeable. Figure 2 demonstrates four time-moments which describe event life cycle.
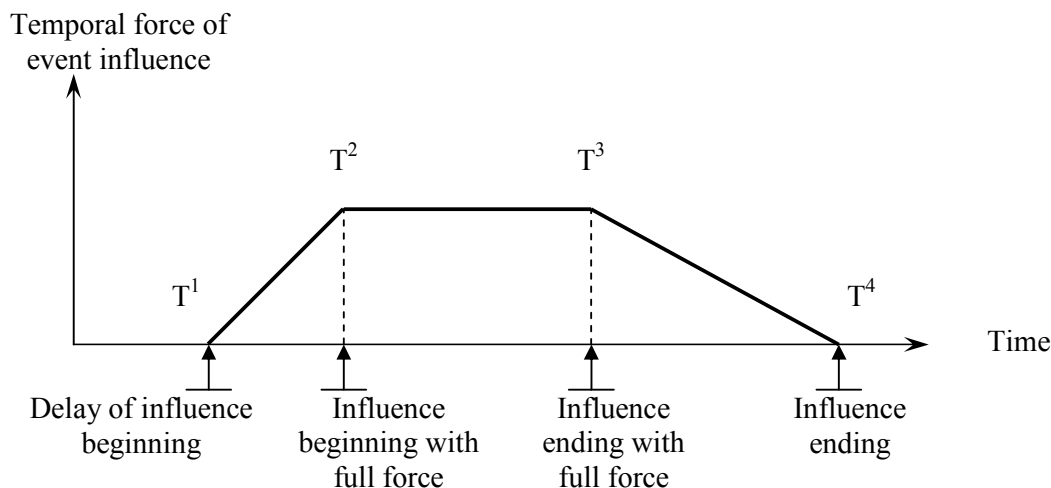
Figure 2. Formalization of event life cycle

The form of event life cycle depends from event nature. For example, event which describes publication expectation of the macroeconomic indicator has gradual influence increase in beginning and has quick influence decrease in the publication moment. Event which corresponds to the publication of the macroeconomic indicator has quick influence growth, time interval of influence with full force and gradual influence decrease. Gradual influence increase formalizes process of gradual familiarization with the information about event. Gradual influence decrease formalizes event topicality decrease and decrease of market participants' attention to event. Event can influence financial index right away after publication and also can influence with delay. For example, expectation of the macroeconomic indicator starts to influence 1-2 days before the publication of real value of indicator.

Confidence to the information about event. This parameter reflects information properties of event. Mass-media publishes the information about event in messages. Each message has the author and source of the information. The confidence to mass-media, the author and source of the information characterizes confidence to the information about event. The confidence formalizes the certainty level concerning estimation of influence force of event (estimation accuracy of influence force). For example, influence force of event on index can be characterized as „very much greater force". However the source of the information does not deserve full confidence. It means that the real estimation of influence force of event can differ from the specified. In other words, the estimation of influence force becomes more uncertain.

Event importance. Event importance reflects an event influence degree on financial index. In other words, it is dependence force of event and financial index. For example, event „Decrease of funds target rate" practically unambiguously raises stock indexes and, therefore, has high importance. Event „Trade balance level" has smaller influence on stock indexes.

The quantity of information messages about events during one day can amount to five hundred and more. About fifty messages are the most informative. These events directly influence financial indexes. Figure 3 demonstrates events aggregate which influence financial index.
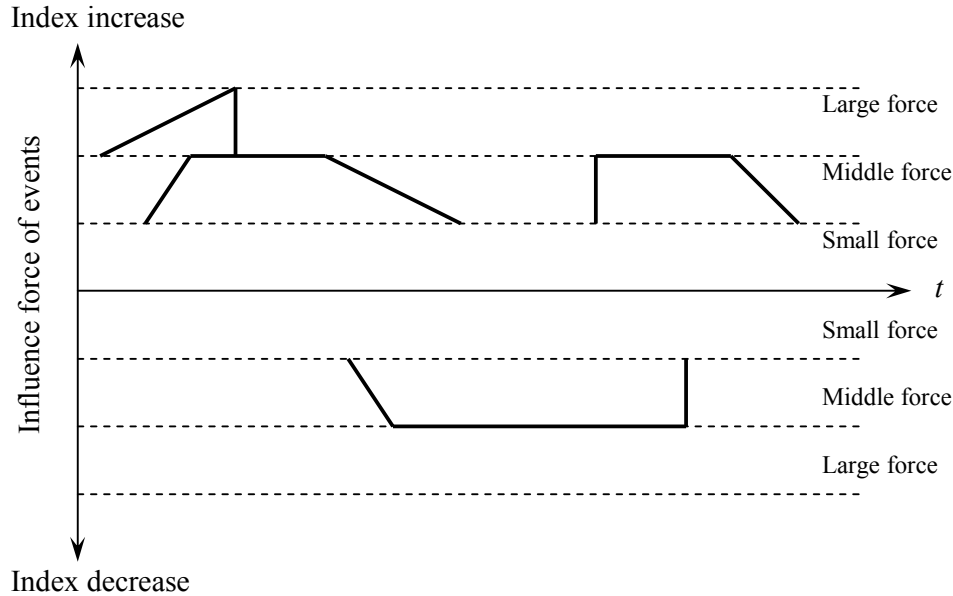
Figure 3. Events aggregate which influence financial index

Thus, the estimation of events aggregate influence on financial index during each time-moment is the forecast of index change force. Forecast basis is the processing of the current information about events which will influence financial index in the future. Here we have the following problem: it is necessary to receive the generalized estimation of joint influence of all events with taking into account of the specified parameters.

3. Mathematical model

We shall designate set of events as: $E = \{e_i, i = \overline{1,I}\}$. We describe each event by parameters sequence $e_i = \langle d_i, a_i, T_i, c_i, p_i \rangle$, where:

d_i - is event influence direction, $d_i = \{1, -1\}$, $d_i = 1$ - the increase of index value, $d_i = -1$ - the decrease of index value;

a_i - is influence force of event, $a_i \in \{1,2,3,...10\}$, $a_i = 1$ - very small influence force, $a_i = 10$ - large influence force;

T_i - is event life cycle, $T_i = \{T_i^1, T_i^2, T_i^3, T_i^4\}$ - according to figure 2;

c_i - is confidence to information about event, $c_i \in \left]0;1\right]$, $c_i \ll 1$ - minimal confidence, $c_i = 1$ - maximal confidence;

p_i - is event importance, $p_i \in \left]0;1\right]$, $p_i \ll 1$ - minimal importance, $p_i = 1$ - maximal importance.

Expert determines the initial events estimations in terms of this sequence. Model performs two calculations steps for each time-moment. On first step the model calculates the resultant influence force of each event. The model uses for this:

▪ direction and influence force;
▪ confidence to information about event;
▪ position of current time-moment in event life cycle.

On second step the model calculates the composite influence force of all events according to their importance. As result the model calculates the possibility distribution in the kind of membership on influence force axis. This axis also is axis of index change force.

Step 1. Calculation of resultant influence force of each event.

Let's define the linguistic variable "influence force" as memberships aggregate on force gradation set:

$$F = \left\{ \left\langle f_j, \mu_j(x) \right\rangle, j = \{1,2,3,...21\}, X = \left\{ x_j \right\} \right\},$$ (1)

where f_j - is name of force gradation x_j;

$\mu_j(x)$ - is membership which describes influence force according to f_j;

X - is the set of influence force gradations.
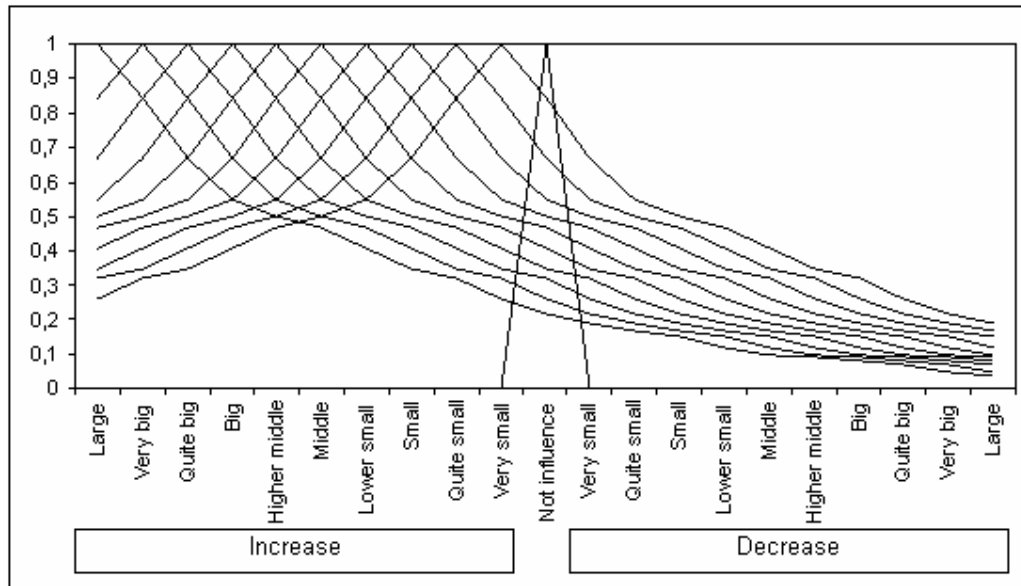
Linguistic variable "influence force" is shown on Figure 4.

Figure 4. Linguistic variable "influence force"

The step 1 consists of several substeps.

Step 1.1. Selection of membership which describes the influence force of event.

We select the pair $\left\langle f_i, \mu_i(x) \right\rangle$ from F according to direction d_i and the influence force a_i of event on financial index:

$$\forall d_i > 0 : \left\langle f_j, \mu_j(x) \right\rangle, \quad j = a_i$$
$$\forall d_i < 0 : \left\langle f_j, \mu_j(x) \right\rangle, \quad j = -a_i$$ (2)

As the result we have the membership which corresponds to estimations of direction and the influence force of event.

Step 1.2. Correction of influence force of event for taking into account confidence to the information about event.

The confidence to the information about event determines the certainty level concerning estimation of influence force of event. The low confidence to the information means „uncertainty", „ambiguity" of force estimation. In case of low confidence the real influence force of event can have other values. The high confidence to the information about event, on the contrary, means unambiguity of force estimation. Exponentiation operation of membership which we have selected on step 1.1 formalizes this reasoning:

$$\sigma_i(x_j) = \mu_i(x_j)^{c_i} \ \forall j = \overline{1,J} \ . \tag{3}$$

Step 1.3. Taking into account of event life cycle.

The model takes into account the event life cycle as change of influence force of event during time (TF - temporal force):

$$TF_i = \begin{cases} \dfrac{t - T_i^1}{T_i^2 - T_i^1} & \forall \quad t \in [T_i^1; T_i^2] \\ 1 & \forall \quad t \in [T_i^2; T_i^3] \\ \dfrac{T_i^4 - t}{T_i^4 - T_i^3} & \forall \quad t \in [T_i^3; T_i^4] \\ 0 & \forall \quad t \notin [T_i^1; T_i^4] \end{cases} \tag{4}$$

where t - current time-moment of modelling;

$T_i^1 - T_i^4$ - according to figure 2.

This expression allows calculating influence force of event according to its life cycle which is formalized by trapeze.

Step 1.4. Calculation of resultant influence force of event.

The model calculates the implication of the corrected influence force of event (Step 1.2) and of temporal influence force of event (Step 1.3):

$$\eta_i(x_j) = 2 \frac{\sigma_i(x_j) * TF_i}{\sigma_i(x_j) + TF_i} \quad \forall \quad TF_i \neq 0, \quad \forall \quad j = \overline{1,J} \ . \tag{5}$$

As result the model calculates the new membership which formalizes resultant influence force of event (according to its parameters) in current time-moment.

Step 2. Calculation of composite influence force of all events.

The model uses fuzzy integral Sugeno (1972) for calculation of composite influence force of all events on financial index:

$$v(x_j) = \smallint_Y \alpha_j(y) \circ \beta(y) \quad \forall \quad j = \overline{1,J}, \tag{6}$$

where $\smallint$ - is symbol of fuzzy integral Sugeno;

$Y = \left\{ e_i, \quad i = \overline{1,I} \mid TF_i \neq 0 \right\}$ - is the events set which influence in current time-moment;

$\alpha_j(y) = \left\{ \eta_i(x_j), \quad e_i \in Y \right\}$ - is membership out of membership densities of events from Y for gradation from x_j ;

$\beta(y) = 2^Y \rightarrow [0,1], \quad \beta(y) = \left\{ p_i \mid e_i \in Y \right\}$ - is fuzzy measure of the importance out of importance estimations of events from Y .

As result the model calculates the membership ($v(x) : X \rightarrow [0,1]$). This membership formalizes composite influence force of all events on financial index in current time-moment.

To use the received membership to calculation of forecast values of index it is necessary to execute defuzzification. In other words, it is necessary to execute transformation of possibility

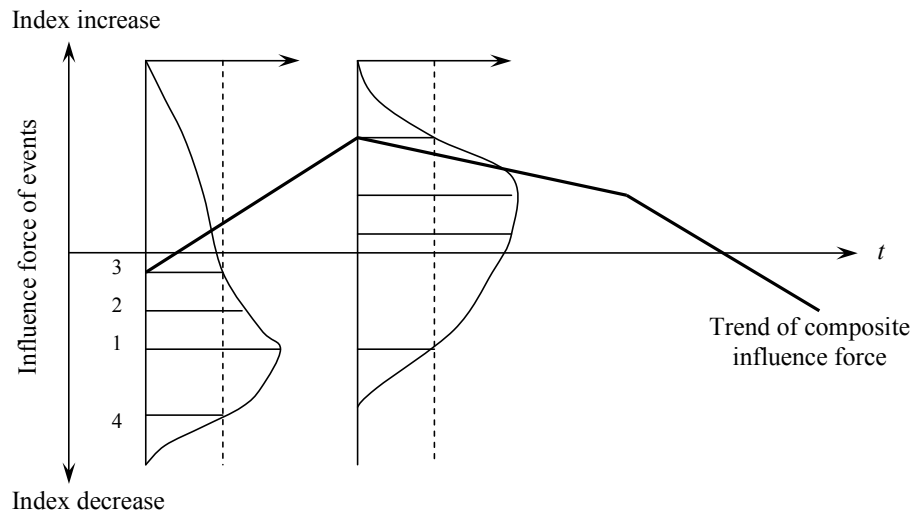distribution to single value of composite influence force of events. Figure 5 demonstrates the defuzzification.

Figure 5. Defuzzification

Membership has four parameters which are most often used for defuzzification (parameters numbers correspond to numbers on figure 5):

1. Force value which corresponds to maximum of membership

2. Force value which corresponds to the gravity centre of membership

3. Force value which corresponds to minimum on force axis for fixed level of possibility

4. Force value which corresponds to maximum on force axis for fixed level of possibility

If to connect values of these parameters for all time-moments, we shall receive four trends which reflect the forecast of composite influence force of events on financial index. In calculations the model uses arithmetic-mean of values of all these parameters.

Described model allows determining the composite influence force of events, but not the absolute value of index. Influence force is similar to derivative of financial index. Composite force determines change speed of financial index. The model calculates the absolute value of index according to expression:

$$JF_{t+1} = JF_t + k * F_{t+1}, \quad JF_0 = J_0, \qquad (7)$$

where JF_t - is absolute value of financial index;

J_0 - is real value of financial index at time-moment $t = 0$;

F_t - is composite influence force of events (arithmetic-mean of values of defuzzification parameters);

k - is coefficient which transforms scale X to changes range of financial index.

Thus, the model calculates the absolute forecast values of financial index which can be used for decision-making. We have incarnated the model in software „Expert Professional Master Forecast". We have used this model for forecasting indexes of various economical natures:

- Ukrainian stock index (PFTS);
- exchange rate EUR/USD (Forex market);
- crediting rate KievPrime 1M;
- quotations of Eurobonds Ukraine 2015.

For forecasting these indexes we have analysed only public information sources, mainly electronic mass-media from America, Europe, Russia, and Ukraine which publish economic and financial news, news of governments and banks. We have not used any internal information. We have

classified events majority for simplification of estimations. In table 1 we demonstrate this events classification for Ukrainian stock index PFTS. For other indexes the events classification differ from this.

Table 1. Events classification which influence on stock index PFTS

Events class	Average estimation of life cycle	Average estimation of influence force
Results of stock markets of the USA, EU, Russia, Japan, Asia	0-24 hour	2-3
Expectations publication of macroeconomic indicators of the USA, EU, Russia, Japan, Asia	0-24 hour	3-4
Values publication of macroeconomic indicators of the USA, EU, Russia, Japan, Asia	7-30 days	3-4
The prices-changes on the world commodity markets	0-15 hour	1-2
The prices-changes on the world markets of precious metals	0-15 hour	1-2
The prices-changes on the world oil-markets	0-15 hour	2-3
Domestic political events	15-40 days	2-4
Events of fund of the state property, events of establishments of state regulation, events of National bank of Ukraine	5-10 days	2-5
Foreign policy and external economic events, agreements, declarations	1-1.5 months	3-4
Values publication of macroeconomic indicators of Ukraine	5-10 days	2-3
Values publication of industries indicators of Ukraine	10-20 days	1-2

We have used following parameters for analysis of forecasts errors:
▪ prediction accuracy of index movement direction at next day;
▪ absolute percentage error of forecast (further - percentage error);
▪ admissible forecast horizon.

We have used standard dependences for calculation of prediction accuracy of index movement direction and percentage error of forecast.

We have determined the admissible forecast horizon in conformity with following reasoning. In fixed time-moment we have ended input of events estimations into model. But we continued supervision of percentage error of the forecast. In some time-moment the percentage error has exceeded some threshold value. We define the difference of these time-moments as admissible forecast horizon. We have chosen threshold value of percentage error according to the criteria which have been described in http://www.e-mastertrade.com/en/main/technical_analysis/about_forecasting.asp:
▪ the forecast with error of 0 % - 23 % - is the forecast of the first-rate quality;
▪ the forecast with error of 24 % - 33 % - is the forecast of high quality.

Moreover, we have used additional parameter for analysis of forecast error of Ukrainian stock index. It is dependence of percentage error from events estimation quality. We in series have changed estimations of influence direction of last events to opposite estimations until percentage error has not increased twice. Estimations change is equivalent to the blunders of expert concerning estimation of events influence. This parameter allows determining the stability (robustness) of model.

4. Investigation of the forecast of Ukrainian stock market index PFTS

Ukrainian stock market calculates the index PFTS along 18 corporations. Market capitalization on September 01st 2008 amounts to $75 000 000 000. We have collected and analysed messages about events from January, 01st till July, 01st 2008. Figure 6 demonstrates the forecast results of index PFTS.
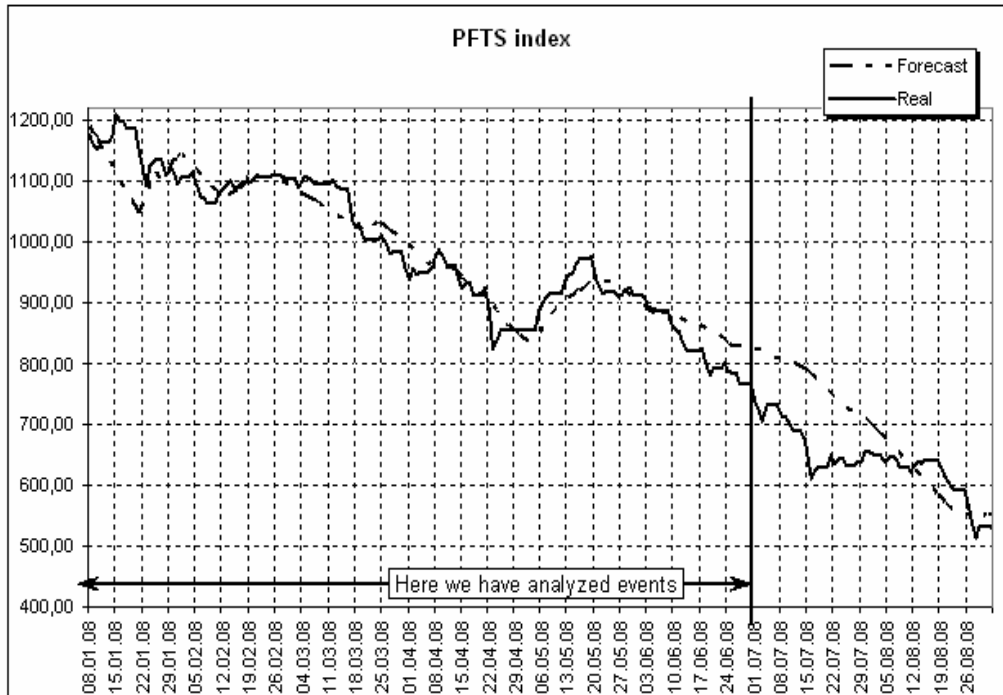
Figure 6. Forecast of index PFTS

As have shown calculations, prediction accuracy of index movement direction at next day is very low (44.3 %). Therefore the considered model is inexpedient to using for daily speculations. Probably, estimations errors of events life cycle have predetermined the low prediction accuracy. These errors can cause shift of forecast trend concerning real trend of index. Determination discreteness of time parameters of events also can decrease the prediction accuracy, because these parameters for events majority we have determined with precision „up to one day". However prediction accuracy of index movement direction on next week amount 69.4 %. According to classification of forecasts quality it is the forecast of high quality.

Figure 7 shows percentage error of the forecast. Percentage error of the forecast does not exceed 11 % during from January, 01st till July, 01st, 2008. The maximal errors have appeared in the moments of quick index changes (on January, 20th, on April, 24th and on June, 20th). Such changes of error we consider as separate fluctuations. We also have smoothed the error's graph with help of polynom. In this case the smoothed error's value does not exceed 5% and also increases at greater fluctuations of stock index.
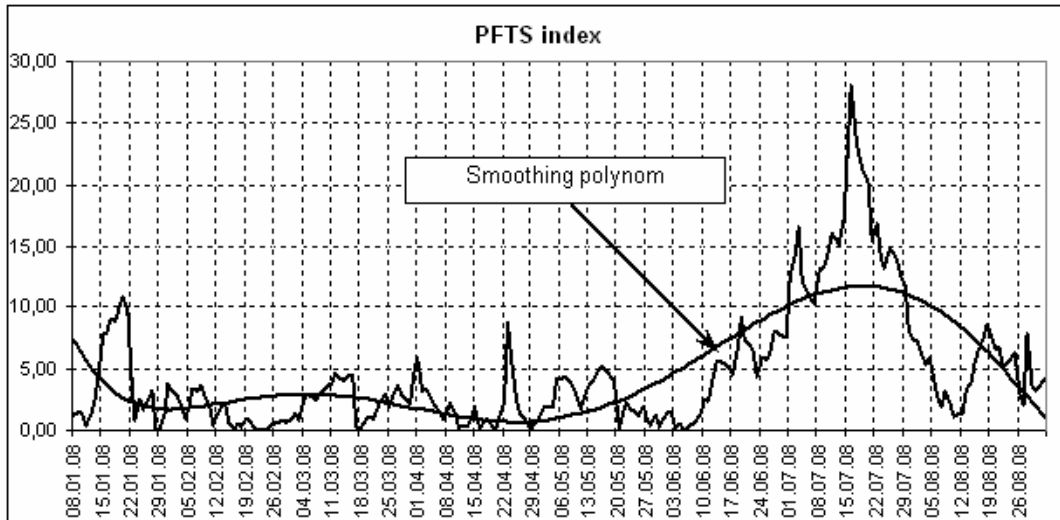
Figure 7. Percentage error of forecast of index PFTS

For estimation of forecast horizon we have analysed events and have introduced their estimations into model till July, 01st, 2008. After that we have observed index PFTS and have estimated the forecast error. The error has exceeded threshold of 23 % on July, 15th. However, in this time-moment the index greatly has fallen. Therefore we consider the quick increase of error as fluctuation and use the smoothed graph for the error's analysis. In this case the maximal error does not exceed 15 %. It is the confirmation of high forecast quality. Therefore the forecast horizon exceed one month with observance of admissible error. The forecast horizon directly depends on duration of life cycle of events which we use at forecasting.

We also have estimated the dependence of percentage error from events estimation quality. Calculations show that deliberate change of influence direction of last 28 events (4.7 % from the general number of events) increases the percentage error of the forecast in 2 times. We emphasize, that the error at estimation of event influence direction is very blunder. Therefore it is possible to suppose, that the considered model is steady enough to quality of entrance data.

5. Investigation of the forecast of exchange rate EUR/USD on Forex

We have collected and analysed messages about events from January, 01st till February, 09st 2009. Figure 8 demonstrates the forecast results of exchange rate EUR/USD. Figure 9 demonstrates the forecast error of exchange rate EUR/USD. On figures 8, 9 the vertical line shows time-moment when we have ended data input into model.
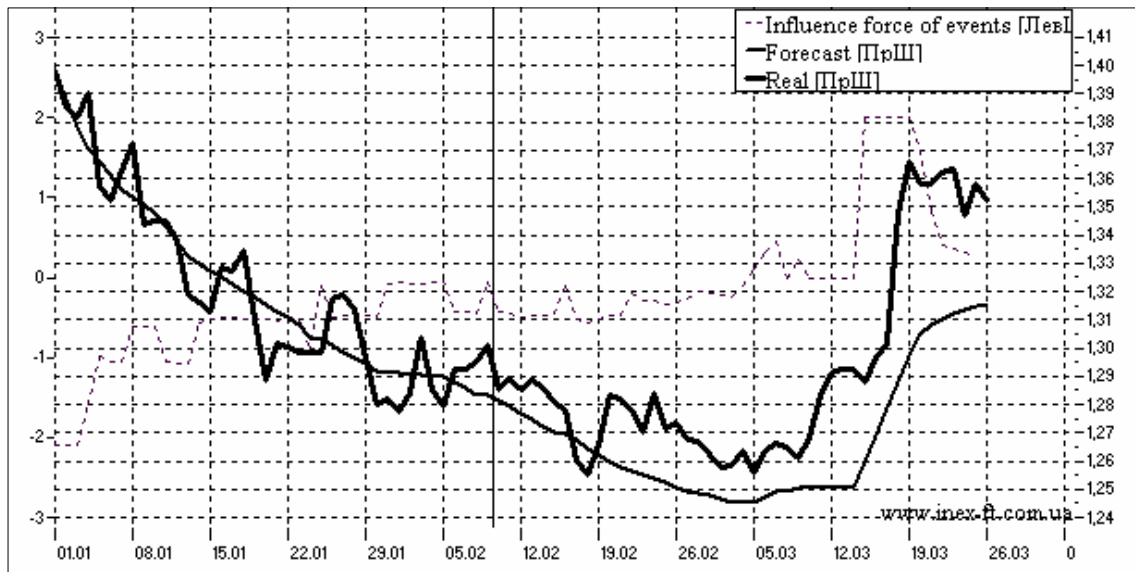
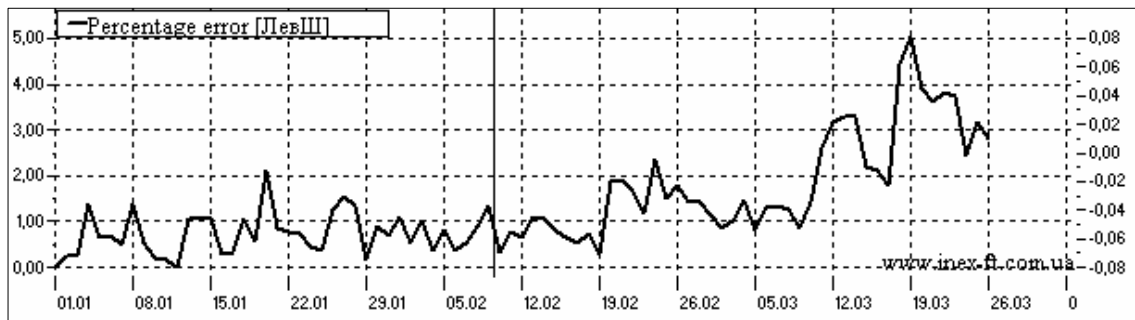**Figure 8.** Forecast of exchange rate EUR/USD

Figure 9. Percentage error of forecast of exchange rate EUR/USD

As have shown calculations, prediction accuracy of trend movement direction at next day has amounted 65%. It is not high accuracy. As shows the analysis of error's graph, the percentage error not exceeds 5% on horizon 40 days. It is very important that the forecast trend displays the turning point on horizon 15-20 days. We regard this forecast as the forecast of the first-rate quality.

6. Investigation of the forecast of crediting rate KievPrime 1M

The Ukrainian banks use the crediting rate KievPrime as the cost indicator of credit resources on the interbanking market of Ukraine. Reuters calculates KievPrime daily according to technique which is similar to technique for calculation of crediting rate LIBOR. Rates of eight Ukrainian banks participate in calculation KievPrime. This market has very small volume: capitalization amounts approximately $30 000 000 000. Forecasting of indexes in the small markets causes the heightened interest from the view-point of checking of appropriateness and adequacy of forecast model in extreme conditions. We have collected and analysed messages about topical events from September, 01st till October, 16st 2008. It is period of financial crisis aggravation in Ukraine. Figure 10 demonstrates the forecast results and the forecast error.
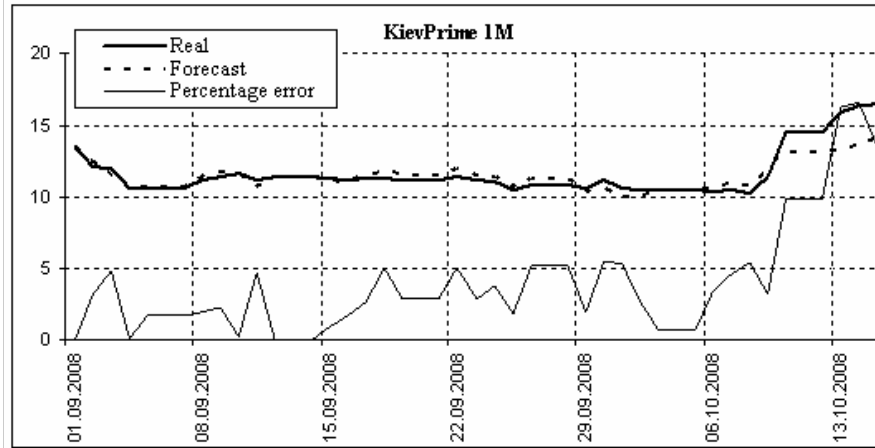
Figure 10. Forecast of crediting rate KievPrime 1M

As have shown calculations, prediction accuracy of trend movement direction at next day has amounted 83%. The average weighted error has amounted 4.26%. From this view-point we classify the forecast as the forecast of the first-rate quality.

For an estimation of forecast horizon we have purposely created conditions of the maximum uncertainty. We have inputted estimations of events into model only for the first day of forecasting: on September, 01st, 2008. Figure 11 shows forecast results. Analysis of error's rise shows that the forecast horizon amounts „More than one week". Forecast trend also displays the turning point that also testifies to forecast high quality.
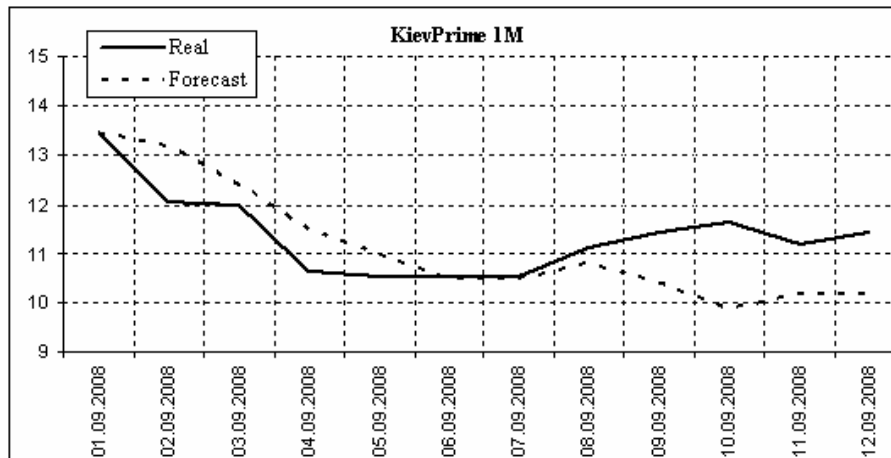

Figure 11. Forecast of crediting rate KievPrime 1M in conditions of the maximum uncertainty

7. Investigation of the forecast of quotations of Eurobonds Ukraine 2015

Quotations of Eurobonds are confidence indicators to economy of Ukraine. We have collected and analysed messages about topical events from September, 01st till October, 10st 2008 (financial crisis aggravation in Ukraine). Figure 12 shows the forecast results; figure 13 shows the forecast error.
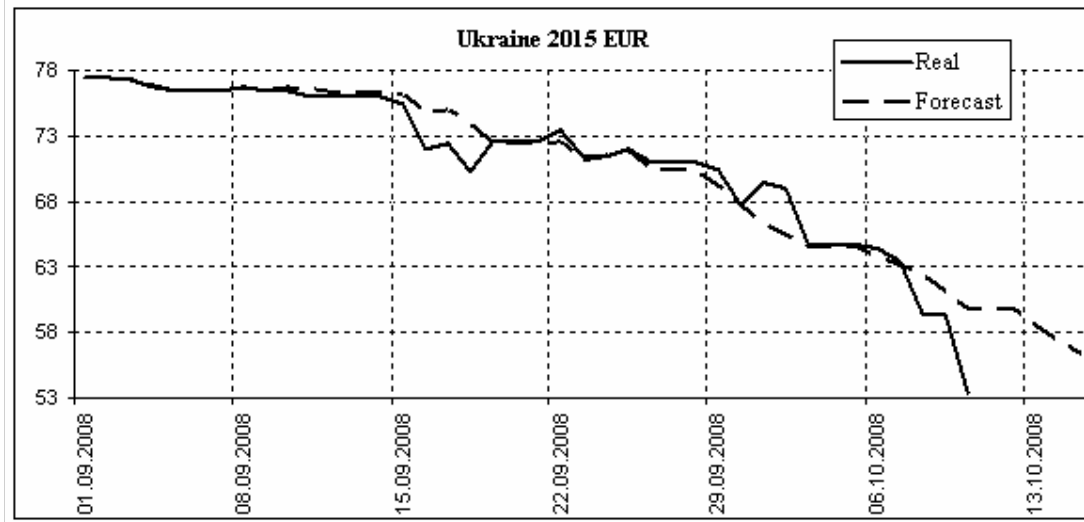
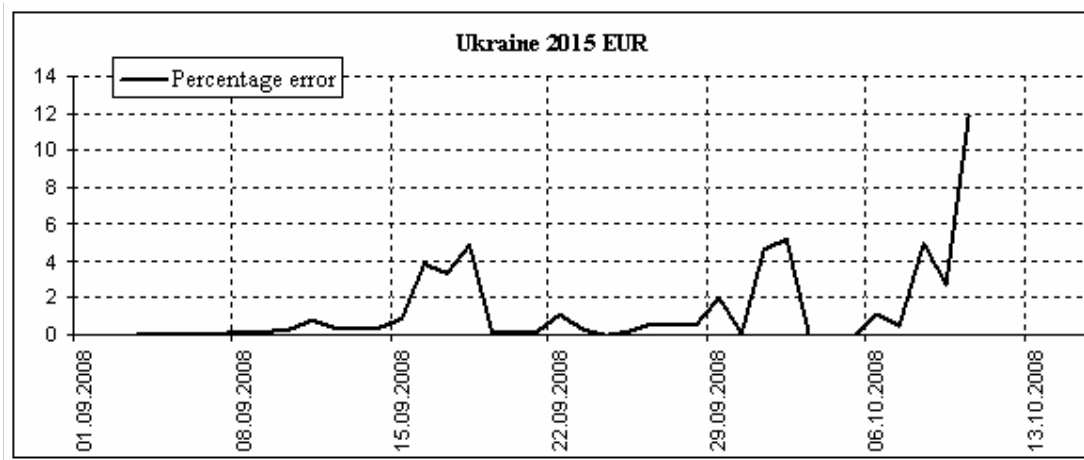**Figure 12.** The quotations forecast of Eurobonds Ukraine 2015

Figure 13. Percentage error of quotations forecast of Eurobonds Ukraine 2015

As have shown calculations, prediction accuracy of trend movement direction at next day has amounted 84%. The average weighted error has amounted 2.08%. We also classify this forecast as the forecast of the first-rate quality.

For an estimation of forecast horizon we also have inputted estimations of events into model only for the first day of forecasting. Figure 14 shows forecast results. Analysis of error's rise shows that the forecast horizon amounts „More than one week". Forecast trend also displays the turning point that also testifies to forecast high quality.
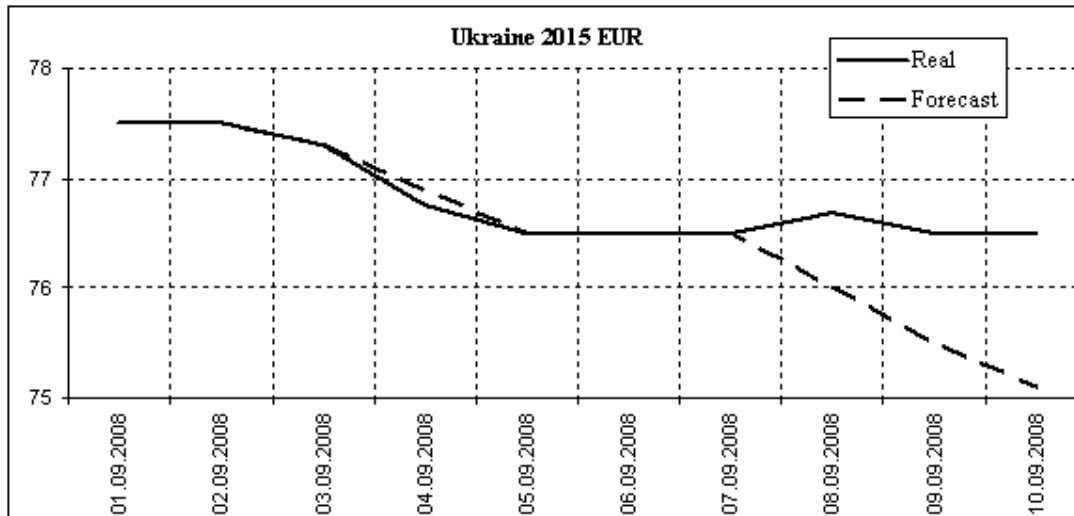
Figure 14. Quotation forecast of Eurobonds Ukraine 2015 in conditions of the maximum uncertainty

5. Conclusions

1. The offered model provides high accuracy of forecasts of financial indexes which have the different economic nature. The forecast error amounts 11 % for Ukrainian stock market index PFTS. For other indexes the error does not exceed 5 % on admissible horizon of the forecast.

2. The forecast horizon greatly depends on market volume. For the small markets the forecast horizon exceeds one week. For the markets with high capitalisation the forecast horizon amounts more than 40 days. Moreover, the forecast horizon directly depends on duration of life cycle of events which have used in forecast. We assume that the model can provide the essentially larger forecast horizon if we shall use the events as tendencies with long life cycle. Then the forecast accuracy will depend on events set integrity and accuracy of their estimations.

3. The proposed model demonstrates not high accuracy of prediction of index movement direction at next day because of low discreteness of time-estimations of events influence.

4. The model has high stability to blunders of the expert at estimation of events influence.

6. References

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NEEDS SEEDED STRATEGIES

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Abstract

This paper addresses the issue of developing strategies starting from the identification and comprehension of true consumer needs. Needs and opportunities are linked to markets, benefits and strategies through a specific 3D model based on Maslow's pyramid. A further model, denoted the PIE (Persons, Institutions and Enterprises), also contextualises needs seeded strategies also for institutions.

Furthermore the paper builds on declared and latent needs and the author shows how both can live together, or separately, irrespective whether or not one sees them from the demand or supply side. The argument is that demand strategies are essentially based on declared needs and are 'red ocean' in nature while supply strategies pace consumers by hitting latent needs and produce 'blue ocean' favoured strategies.

It is argued that current strategy frameworks e.g. Porter's competitive advantage, Wernerfelt's resource-based strategy and Hax and Wilde's integrated competitive advantage models, need to pace rather than chase the consumer. Strategies are considered as being the outcome of strategic choices that enterprises need to answer in order to stay or become (more) competitive. If an enterprise is to build its strategy on satisfying consumer needs then it is necessary to view resources from two perspectives, namely customers and assets. For each one of these two resources three possible scenarios are discussed namely that the resources are Insufficient, Limited or Abundant

Keywords: Strategy, Blue-ocean, Red-ocean, Declared, Latent, Needs

JEL Classification: A2, L2, M3, M30

1. Introduction

The fundamental idea behind needs seeded strategies is to break a long lasting paradigm of strategic thought that stipulates that strategy starts and ends with primarily either a view on the external or internal contexts or a weak mix of the two. This is done by linking customer needs (declared or latent) to enterprise strategy through a complete all-round process, envisaged here as a 3D pyramid model [Ward and Lasen, (2009)]. To achieve this the idea is to focus on excelling in satisfying the needs of the customer and/or consumer in a sustainable and consistent way (throughout the strategy development and deployment process) so that it becomes the creed of the people involved (both inside and outside of the enterprise). By people one implies all of those involved, from the legislators (e.g. government) to the citizens, from the manufacturer or service provider to the end-user of the product or service and so on. The scope is omni-comprehensive and it can only be truly achieved by fully understanding and believing that needs are at the core of all industries and marketplaces. To be fair since the epochal work of Porter in the late 70s and early 80s we have witnessed a slow but distinctive shift towards customer centred strategies meaning that enterprises have become much more aware of the effects of their strategies on the customer. These may be roughly described under three distinct schools of modern strategy framework thought, namely Porter's competitive advantage, Wernerfelt's resource-based strategy and Hax and Wilde's integrated competitive advantage, and the Delta model.

The first two were idealised and subsequently disseminated from the early 80s onwards and respectively tackled first the industry [Porter, (1980)] and internal working of the enterprise [Wernerfelt, (1984), pp.171-180, Penrose, (1995), pp.56-57, Ghertman *et al.* (1997), pp.185-200]. The third school focuses much more clearly on the customer, emphasising the growing dependency on services such as e-commerce [Hax and Wilde, (2001), pp.143-174] and how the enterprises locks into the marketplace and customer. The following table focuses considerably on rivalry and competitive advantage as key drivers for any organisation but all three frameworks view the customer from a supply (or enterprise) perspective. In order to re-balance this approach towards the demand (customer) perspective enterprises depend heavily on other frameworks, tools, models that identify the true needs of the customer and consequently set about aligning the organisation to satisfy them. However, the

approach chases[1] rather than paces the customer. Whatever framework is preferred or followed it is common to address strategy development by tackling a basic three step sequential process consisting of:

1. Analysing the situation of industry and marketplace (external analysis) and enterprise (internal analysis) using models such as SWOT, PESTELI [Shinkins and Hollins, (2006), pp.14-15] etc.

2. Assessing the data, information and knowledge gained and preparing a collection of strategic scenarios or options.

3. Selecting the strategy based on at least three basic indicators profitability, sustainability and realisable objectives.

4.

Table 1. Schools of Strategic Framework

		School of Strategic Framework	
	Industry and Business [Porter, 1980]	Resource Based [Wernerfelt, 1984]	Delta Model [Hax and Wilde, 1994]
Prime focus of Strategy	Match enterprise to Industry and Business	Coerce large or dispersed enterprises and relative BSUs	Match the enterprise, customer and suppliers
Focus of competitive advantage	Cost leadership, differentiation or focus	Resources, Capabilities and Core competencies	Ensuring best product provides total customer satisfaction and best match.
Measure or orientation of Competitive advantage	Activities and processes	Ensuring people focus on core products, services and activities – ARC model[2].	Adaptiveness especially at tactical and operational levels (through aligned processes). Providing selected customers and suppliers with what they want in order to maximise profits. Being innovative
Customer location	Marketplace	Workplace	'Customer' space
Demand or Supply Perspective	Supply	Supply	Mostly Supply
Strategy focus	Exploiting Rivalry (external)	Exploiting Rivalry (internal)	Exemplifying and exploiting Rivalry (internal and external)

Since all strategies are living examples of matching the enterprise to its environment (internal or otherwise) the three steps process has feedback that provides the enterprise with the necessary monitoring capability to adjust the strategy as needed. However, even with efficient feedback there is always a time lag and, moreover, the enterprises are still 'chasing' rather than 'pacing' the customer. The process is therefore closed-loop in nature and depicted as follows:

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[1] Indeed the original intent of Marketing was to specifically understand what the customer wanted and consequently promote the appropriate goods and services.

[2] ARC (Architecture, Routines and Culture) was developed by Saloner et al. [2001, pp.39-64] to assess internal enterprise operations.
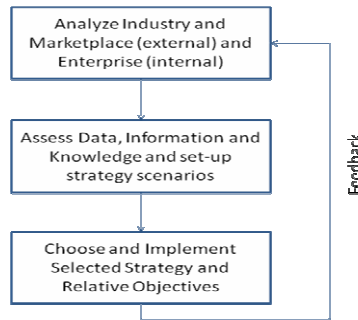
Figure 1. The Basic Strategy Development Process

Depending on the status of the enterprise, marketplace and industry this adjustment usually occurs every 1 to 3 years [Ward, (2009)] and entails making (further) strategic decisions or choices. Such choices involve asking the difficult, and sometimes very obvious, questions. Indeed one of the most pressing and intricate questions that enterprises need to answer on a regular basis is 'are we satisfying our customer[3] and consumer needs?' Once this question is answered the enterprise can endeavour to answer further questions such as 'how are we satisfying our customers and consumer', 'to what extent are we satisfying our customers and consumer' 'how would the customer tell us what he or she wants?' and so on.

Many models and methods have been deliberately invented to tackle this issue including models such as QFD [Akao, (2004)], benefits exploration by Strategos (www.strategosinc.com), focus groups [Merton *et al.*, (1956)], experience maps, psychographic classification of customers [Piirto, (1992)], voice of the consumer [George *et al.*, (2005), pp.193-213], Bowman's Strategic Clock [cited in Johnson *et al.* (2008)], technology and marketing road maps and many more.

However, the first strategic step an enterprise must take is to realise that a strategic choice or a collection of strategic choices are inevitable for the satisfaction of the customer, and moreover, the correct alignment of the enterprise with respect to the customer's needs. Indeed, and especially over the last decade, there has been a slow shift towards answering a much more difficult question concerning 'strategic choice' which is epitomised in the book by Kim and Mauborgne (2005) on red and blue ocean strategies. In this paper one holds that strategic choice is black or white, not shades of grey, and many enterprises prefer to stay in the 'red' ocean because this is what they 'know' and where they can chase both the competition and customer. However, it is truly only 'knowing' the latent needs of their customer(s) that sets enterprises apart, moreover it inherently implies satisfying these untapped demands [Kim and Mauborgne, interview available through www.insead.edu/alumni/newsletter/February2005/Interview.pdf]. Sadly customer orientation seems to be promoted more with words than deeds [Webster, (2005), pp.121-126].

But answering the call for strategic choice goes much farther and, answering strategic choice questions is probably the most difficult of all upper management tasks and conveyed beautifully by Kotler when speaking about the scope of the marketing function in an organisation that is, "Does marketing create or satisfy customer needs?" (2003, page 29).

Here are a series of other examples of strategic choice question:

Table 2 . Examples of Strategic Choice

Declared	Vs.	Latent
Customer (client)	Vs.	Consumer
Price	Vs.	Value
Supply	Vs.	Demand
Seller	Vs.	Buyer
Red	Vs.	Blue
Satisfy	Vs.	Create
Short-term	Vs.	Long-term

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[3] We differentiate customer from consumer since the former identifies a trade partner (one who purchases products to sell to consumers) while the latter implies the end-user or actual consumer of the product or service.

Declared	Vs.	Latent
4P	Vs.	4C
Rational	Vs.	Holistic
Prescriptive	Vs.	Descriptive
Old Economy	Vs.	New Economy

How an enterprise decides will depend on several factors including enterprise culture, state of the economy, industry and/or marketplace, orientation of the enterprise towards the marketplace[4], stage of development of the enterprise [Poole and Van de Ven, (2004)] and so on.

However, the argument here is that the consumer[5] needs to be at the core of the choice as well as initiate the process of strategy selection. For example, if we start from the 5 needs pyramid we can associate the various layers with the three basic types of market.
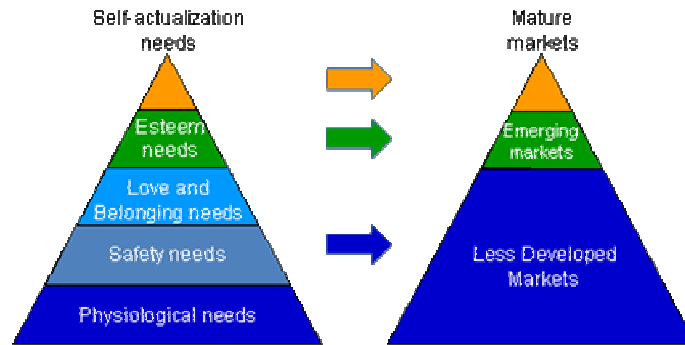

Figure 5. From Needs to Markets

In a very similar fashion we can link the markets with the benefits as depicted below:
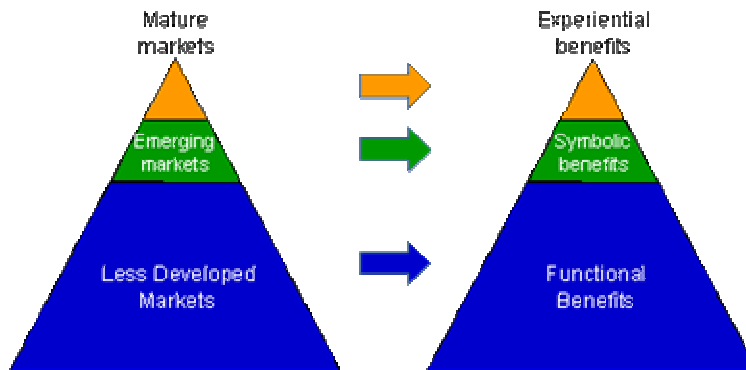

Figure 6. From Markets to Benefits

It should not be too difficult to imagine that the concept of a 3D model that maps needs to markets then to benefits and finally to strategies not only represents a simple and effective communication tool but also lends itself to various formations of faces or facets of a 4 sided pyramid in many other fields or aspects of enterprise management.

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[4] Marketplace implies the space where the enterprise, customer e.g. trade partner, and consumer interact.
[5] Unless otherwise stated from hereon the use of the term 'consumer' implies both customer and consumer.
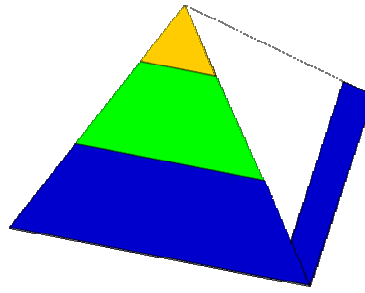
Figure 7. Assembling a 3D model from Needs to Strategies

Each facet of the pyramid can accommodate varying numbers of layers, for example the 5, 7 or 8 layer versions of Maslow's pyramid. However, in order to link the facets it is necessary that the layers are coherent, follow a rational sequence and are correctly grouped as seen in figures 2 and 3.

In the final, unfolded, pyramid, starting from the base, we have cost leadership strategies, then differentiation strategies and, at the apex, focus strategies, all as described by Porter [(1980), pp.35-40]. The pyramid that we propose for a correctly 'needs seeded' strategies approach is depicted below and subsequently briefly announced:
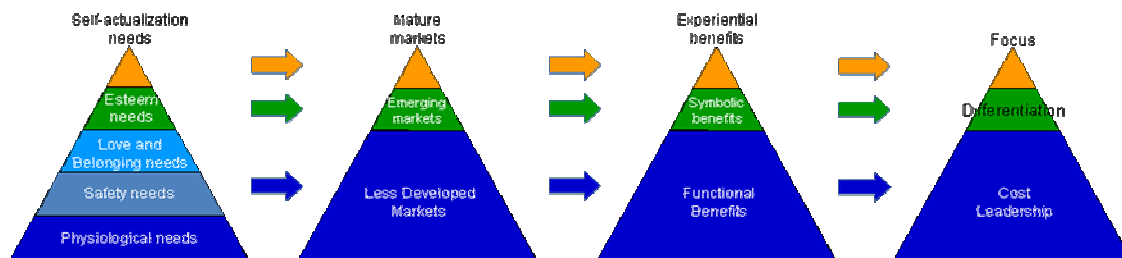

Figure 8. The Exploded 3D model from Needs to Strategies

Sides 1 and 2 (starting from left of figure 5) link the 5 fundamental needs as identified by Maslow[6] to three different markets or marketplaces, namely less developed markets, emerging markets and mature markets. In this depiction we have chosen 5 needs but also the 7 and 8 needs models are applicable, what changes is where the demarcation for the subsequent sides will be drawn.

In figure 5 grouped physiological, safety and belonging needs have been grouped and linked to less developed markets in view of the fact that these markets will primarily claim for those products and/or services that satisfy these 'primary' needs. However, it is quite plausible that less developed markets may be further stratified into at least 3 other sub-layers. A criteria for such stratification may well be the degree of social exclusion [Ward and Farmaki, (2006)] or where social exclusion criteria is both more prominent and practical. It should be noted that the scope of stratification in terms of classes is not a reflection or justification of further segmentation and segregation, rather a more effective approach in satisfying those needs. For example, many non-profit organizations often misunderstand their customers[7], resulting in poorly aligned needs based marketing strategies [Jones, (2008)].

In practical terms the less developed markets may, for example, be stratified as follows:

1. Extreme poor markets where food, water and shelter are the primary needs.

2. Very poor markets where bedding, clothes, food, water, shelter, protection both for humans and livestock, are primary needs.

3. Socially excluded markets where physiological and safety needs are less predominant (but

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[6] The great weight ascribed to Maslow's work can be traced not only to its historical significance, as it represented the chief structured theory developed in the field of psychology and human motivation, but also to its underlying intuitiveness [Soper, Milford and Rosenthal 1995 cited in Maddock and Fulton, (1996)], which later made the model easily adaptable to marketing purposes.

[7] Customers are viewed as 'consumers', local communities and also donors.

nevertheless extremely important) and belonging needs begin to surface.

Once we have established the stratification of the markets and linked them to needs we can tackle the differentiation of the product and product features (or service features). In figures 3 and 5 we have again chosen a simplified approach by using benefits as the criteria. In doing so we have depicted three levels of benefit:

1. Functional benefits [Akao, (2004), pp.85 and 215]
2. Symbolic benefits
3. Experiential benefits [Carù and Cova, (2003)]

Functional benefits are characterised by tangible elements of the product or service offering such as product reliability, responding to complaints, key basic features and so on. Here they have been related to the emerging or immature markets because the scope is not to impress rather than to serve as a purpose for the consumer and relative needs. In this context these needs are highly declared (hence easily measurable) and rarely latent. Symbolic benefits are perceived as belonging needs or concerning the social stratification of needs, this is where the brand image comes into strong play. If backed by functional benefits the second layer becomes a very strong competitive advantage because the customer perceives a strong will by the enterprise to understand the customer and satisfy both declared and semi-latent needs.

As we reach the top of the benefits pyramid we move into an area where consumer experience plays a much stronger role and latent needs are often hidden. This market is where the true sustainable competitiveness reigns and profitability is high. Moreover, it is blue-ocean in nature and, for example, where luxury products or the best-in-class enterprises hang out and dominate with their innovative products and services.

In the final facet of the pyramid we move to that of strategy. For convenience and clarity three general strategies based on Porter's school of thought on competitive strategy[8] have been chosen:

1. Cost leadership [Porter, (2004), pp.35-37]
2. Differentiation [Porter, (2004), pp.37-38]
3. Focus [Porter, (2004), pp.38-40]

This final facet is key to linking the originating customer needs to the most suitable strategic school of thought. Hence if the key customer needs are primarily at the bottom of Maslow's pyramid it is likely that cost leadership will be dominant (since, for example, price more than value will prevail here). Similarly at a higher level enterprises will need to differentiate their product or service offering and where a switch from price to price/value will occur. In the final tier the enterprise will provide specific targeted or focus product or service offerings to satisfy needs that are latent in nature. This tier also corresponds to satisfying 'being' needs and will most likely entail blue ocean strategy where value is much more important than price.

In conclusion and having paved the way to linking needs to strategies it is worth discussing very briefly the dissemination of such strategies and what types of decision will result.

Deploying strategies successfully involves all three strategic, tactical and operational levels within the organisation. Moreover, decisions are based on information and knowledge that is structured, semi-structured or non-structured [Vercellis, (2009)]. Together they form a particular mix of rational and irrational thought (see next figure) in which risk and risk aversion will take place (just like strategic choice generates strategic crossroads).

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[8] All three strategies have been successfully employed by enterprises competing in international markets and where both red and blue ocean strategies have been sustained.
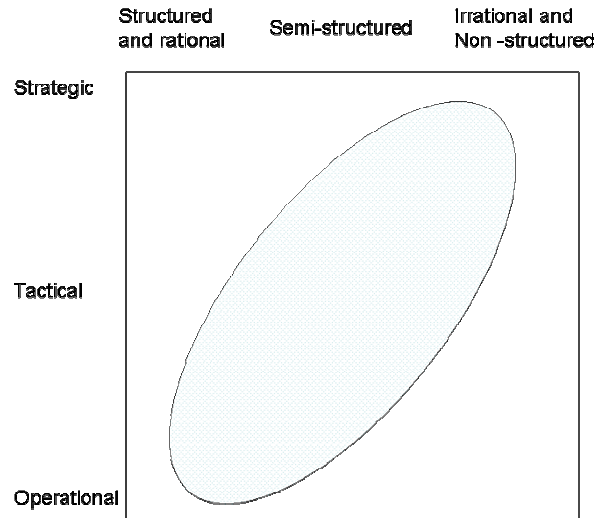
Figure 9. The context of decisions in practise

The point being raised here is that in order to satisfy customer needs (both declared and latent)

1. Strategy and strategic choices need to follow through all the organisation and may well need more or less detail depending on the organisational level involved [Ward and Rivani, (2005)].

2. Since in practise in enterprises decisions are based on a mix of rational and irrational thought, in real world terms, decisions and strategic choice lie somewhere in between. This area is not predefined and boxed rather it is *cloud-like* and evolutionary [Ward, (2008)].

3. According to Kahneman and Tversky [(1984), pp.341-350] decision making involves distinguishing between risky and riskless choices and the study of decisions addresses both normative and descriptive questions[25]. Enterprises therefore will make calculated risks to varying degrees during the development and deployment of the strategy. If the enterprise favours satisfying declared needs then such decisions will be normative otherwise the enterprise will opt for blue-ocean based strategies and suffice with descriptive types of decision based on a behavourial-organisational perspective [Harrison and Leitch, (2008), page 169].

2. Contextualizing Decisions from Sociological and Psychological Perspectives

If an enterprise is to build its strategy on satisfying consumer needs then it is necessary to view resources from two perspectives, namely customers and assets. For each one of these two resources we may picture three possible scenarios i.e. that the resources are Insufficient, Limited or Abundant. Blue ocean strategy sets out to deliberately create and foster abundant resources both in terms of assets (think of innovative products and services) and customers (new consumers and markets).

Red ocean strategy concentrates its efforts on limited resources and to some extent also on insufficient resources such as when signing strategic agreements with suppliers and competitors, forming alliances, joint ventures or deliberately setting up cartels. When resources are especially insufficient enterprises will eventually cooperate (to both survive and thrive) although to achieve this some competition may disappear either by going out of business or being absorbed during a Merger and Acquisition[26] [Galpin and Herndon, (2000), pp.8-9] or sometimes forming alliances if this will forge a duopoly or a dominant firm type of competitive scenario [Saloner *et al.*, (2001), pp.381-397]. This is one reason why it is difficult to split insufficient resource strategies from their limited counterparts.

In terms of strategy focus we will therefore have three possible scenarios depicted as follows:

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[25] Kahneman and Tversky state '….normative analysis is concerned with the nature of rationality and the logic of decision making….descriptive analysis, in contrast, is concerned with people's beliefs and preferences as they are, not as they should be.' [1984, page 341].

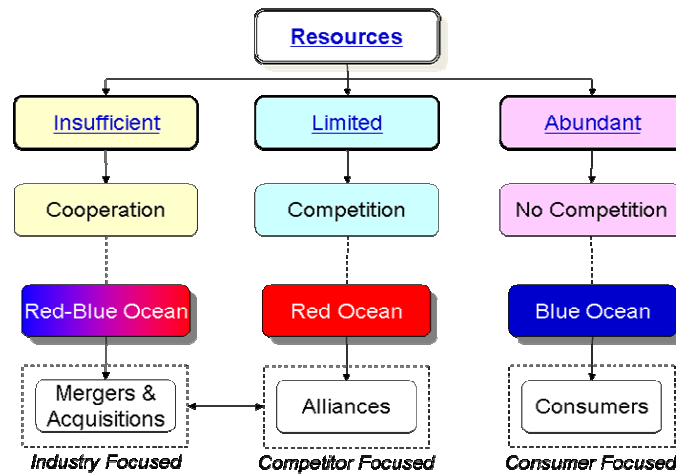[26] Typical of a so called *Growth* strategy.

Figure 10.Resource Decisions

Source: adapted from http://thebrain.mcgill.ca

Where resources are limited competition maybe <u>dispersed</u> or <u>concentrated</u> depending on many factors e.g. market type-situation, market saturation, product/service type etc.

When competing for dispersed consumers it is imperative that the enterprise dedicates effort to 'speed to market' strategies and providing the product/service needed at the right time[27]. Consequently this will imply strategies that primarily forge a very strong relationship with the consumer i.e. consumer focused strategies and where the innovation pipeline needs to be filled continuously. Note that this will enforce more incremental innovation rather than radical innovation which implies that strategies are not truly blue-ocean in nature or outcome. When the competition is concentrated the competitors will likely be very aggressive (as in the case of 'price wars') and this will forge both defensive and attacking strategies directly in the marketplace. This too will involve close liaison with the consumer but the 'war' is in the marketplace and involves competitors and traders. In other words the consumers are only the prey or spoils, hence the focus will be on competition and emphasizing aggressiveness towards the competitors.

Depending on the growth position of the enterprise and/or industry [Greiner, (1998)] this may well lead to forming alliances or if the market saturation is high opting for Mergers and Acquisition or delocalizing or searching for private equity input [Le Fonti, (2009)].
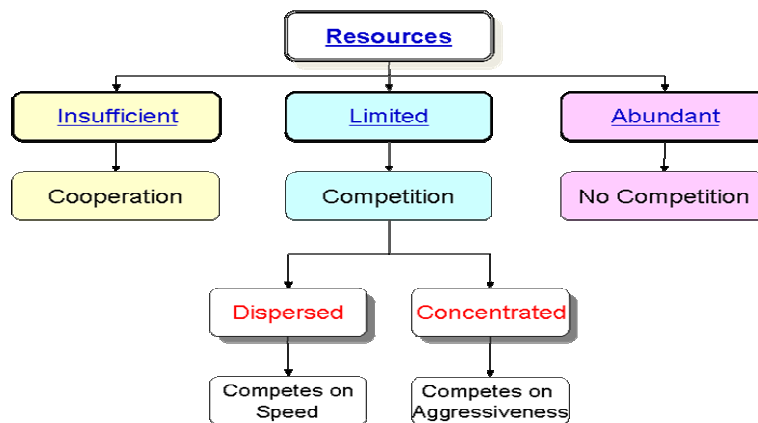

Figure 11. Competitive scenarios for Limited Resources

Source: adapted from http://thebrain.mcgill.ca

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[27] Also known as Time-To-Market or TTM

The psychological perspective concerns the risk [Penrose, (1995), pp.56-57] behaviour of the enterprise and consumer. The following model refers to risk, taking which is at the basis of consumer-enterprise behaviours and relative resultant strategies.
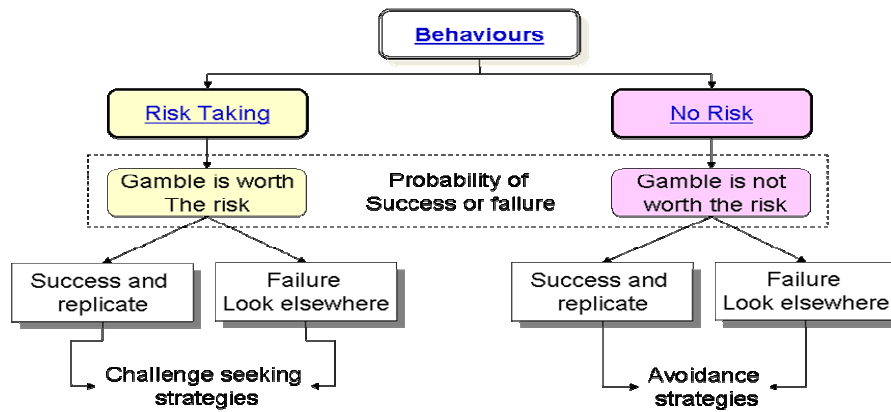

Figure 12. Risk and No Risk behavioural based strategies

If an enterprise or a consumer decides to take the risk thus inclining towards an irrational approach it means that the gamble is worth the risk (or is assumed so). Should the gamble pay off then the strategy will be considered a success and it is likely the strategy will be replicated: this is typical of successful attacking strategies. If the gamble does not pay off then the enterprise or consumer will look elsewhere, change strategy but nevertheless take the risk again. In both cases (success or failure) the strategies are challenge seeking strategies e.g. take-overs, acquisitions, bringing breakthrough ideas to market etc. and are typically blue-ocean by nature.

On the other hand the behaviour of the enterprise may be to take no risk (or minimize risk) since the gamble is not considered to be worth the risk. The resulting strategies will therefore be defensive and reactive in nature. Three possible behavioural outcomes are: flight, fight or inhibit action e.g. wait and see [Cannon, (1915)]. Flight implies abandoning the scene, fighting means fending off the aggressor and inhibition implies waiting and intervening later if the probability of success increases.

Enterprises that emphasize low risk strategies focus on incremental innovation, building or rather maintaining consumer loyalty, cost leadership, product focus, financials [Ghertman *et al.*, (1997)] etc. Although it is not the scope of this paper the framing of gains and losses is clearly key to understanding such behaviour. Kahneman and Tversky [Thaler cited by Kahneman and Tversky, (2000)] quite rightly promote decision frames and the idea of the value function [Kahneman and Tversky, (1979), (1980)] to explain how such decisions are managed and established. As Kahneman and Tversky focus more on the consumer as an individual it could be argued that enterprises behave differently but the author of this paper has seen many examples in industry where projects are stopped or pushed by lone key figures in the organization. Indeed not only can we observe that organizations are collective assemblies of individuals but usually run by a select few or even just one individual when it comes to strategic choice.

3. Demand or Supply, how do they differ?

Kim and Mauborgne (2005) emphasize the fact that enterprises need to step out of the red ocean and into the blue ocean because this provides greater freedom and allows companies to express their potential to the full. In other words they state that supplying the consumer with what he or she needs is much better in the long-run that satisfying demand[28]. In particular they roll-out a 5 point approach to strategy:

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[28] In the context of this paper and reasoning supply refers to the current pre-identified customer needs while demand refers to the future supply of goods and services by the enterprise to satisfy consumer demanded needs.

1. DO NOT compete in existing market space where competitors are sharks and red ocean tactics dominate. INSTEAD you should create uncontested market space where competition is non-existent and therefore Blue Ocean (unchartered) in nature.

2. DO NOT beat the competition. INSTEAD you should make the competition irrelevant leaving consumers the simple task of choosing your product or service offering.

3. DO NOT exploit existing demand which is known, chartered also by the competition. INSTEAD you should create and capture new demand i.e. you supply what is not yet there but which the consumer longs for perhaps unknowingly. In other words you create benefits.

4. DO NOT make the value/cost trade-off. INSTEAD you should break the value/cost trade-off by proposing value rather than price and thus let price become irrelevant or secondary.

5. DO NOT align the whole system of a company's activities with its strategic choice of differentiation or low cost. INSTEAD you should align the whole system of a company's activities in pursuit of both differentiation and low cost.

These last two points are worth considering in the context of this paper. Selling value instead of price is not new [Kotler, (2003)] also the concept of setting the right price is equally wrong because it assumes that the consumer is aware of the value/price ratio. In the case of true blue ocean products here one argues that initially this is not the case, or to be more precise the value of the benefits still need to be first explored (by the consumer) and only after will the value/price ratio surface. Point 5 is still heavily dependent on Porters' approach to strategic alignment, however, the true goal in blue ocean strategy is to provide consumers with products and services that are different, focused and lead-create the market and consumer. Kim and Mauborgne do not defy Porters approach which is Differentiation, Cost Leadership and Focus, rather one feels they re-package it. In this paper the emphasis is to ensure that the focus of the enterprise should be to deliberately meet the latent consumer needs. The outcome is that (new) markets are created, consumers are originally unstratified[29] or are deliberately destratified and benefits, especially new benefits, are created or old ones satisfied in a new or more creative way.

Four key components are hence typical of this process namely:

Figure 13. Supply strategy based on a Blue Ocean approach

As discussed previously enterprises are more likely to be more inclined to demand rather than supply and consequently demand motivated strategies are much more frequent and red is more dominant than blue in enterprise strategy. There are many reasons behind this preference including lower costs, lower short term risk, less unknowns etc. As a consequence institutions tend to control and/or curb industry and enterprises by reacting to change in market demand. For example, the current economic situation has fostered a whole series of appeals from enterprises to support them by government such as through actions including reduced taxation, less bureaucracy, more enterprise friendly legislation etc. In other words in our PIE model both the enterprise and institutions need to understand there respective needs and bounds of ownership.

The four key elements of supply based strategies are:
- Satisfy declared consumer needs.
- Develop the marketplace
- Refine market stratification e.g. segmentation based on socio-demographic trends

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[29] The concept of stratification is similar to that of segmentation except that consumers as seen as one complete 'herd'. Hence when an enterprise follows a blue ocean strategy consumers are not stratified rather they are as seen as one unique opportunity and class of consumer still to be stratified. Since prior to opting for this type of strategy consumers are usually stratified or placed in segments this new direction will 'de-stratify', hence the term 'de-stratification.

- Provide sought after benefits

It is also worth noting that supply motivated strategies react to clear declared needs and the prescriptive school of thought [Mintzberg et al., (1998)] tends to be the most dominant. Typically enterprises that are best-in-class for red ocean strategy will be very good at venturing into new products for current markets and new markets with current products, as depicted in the matrix to right of the following figure.
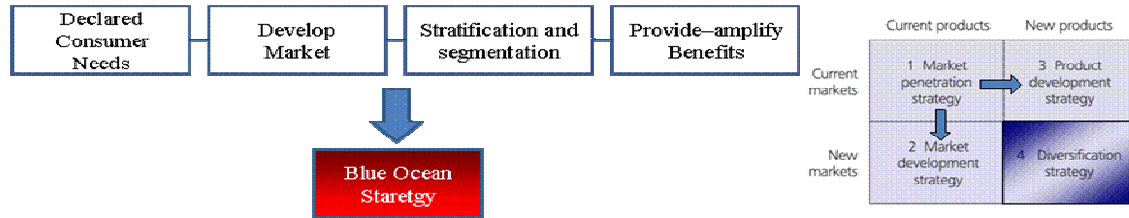

Figure 14. Demand strategy based on a Red Ocean approach

This matrix, known as Ansoff's matrix [Di Michael, (2003)], provides a clear picture of the direction of the enterprise and many continue to reap high (short-term) profits and have high market share based on this approach.

A much more promising and long-term perspective is to go for a diversification strategy, which is represented deliberately blue in colour in the above figure. The new products and new markets therefore imply that products and services are satisfying or will satisfy latent needs.

The Ansoff matrix can therefore also be read as shown below:

Figure 15. Ansoff and Red/Blue Ocean strategies

Taking one more step forward we can picture:
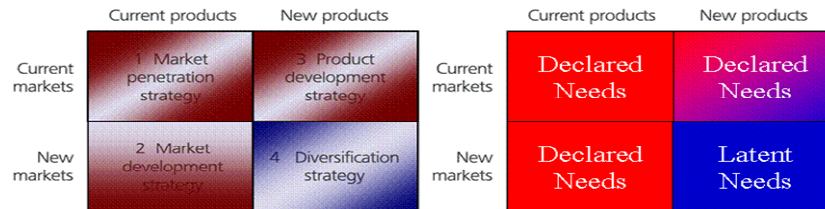
Figure 16. Ansoff and Declared/Latent needs

In this picture we see that the top right quadrant is shown as Declared Needs yet its colour is mixed between Red and Blue. Here the concept is that as we a new product offering becomes increasingly innovative and new markets are generated so the needs move towards the latent needs area. So in conclusion we obtain the following map of needs versus degree of innovation (perceived by the consumer).
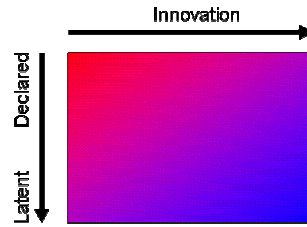
Figure 17. Needs and Innovation

4. PIE and Needs

The PIE model [Ward and Lasen, (2009)] views the opportunity from three different perspectives or players; Person, Institution and Enterprise (PIE). Here we return to PIE but now tuned to match-up with the needs, the contribution of these three players and the pyramid discussed previously:

1. For the individual (person) and/or community.

▪ The realization of what needs still require satisfying with an emphasis on latent needs. These needs may not be hierarchical hence they may be in any of the levels in the first part of the 3D model. Another important aspect is that subsequent parts of the 3D model will guide the enterprise in pin pointing the consumer and market better.

▪ It is argued that the prioritisation of needs based on a hierarchy is more in-line with declared rather than latent needs. That said it should be remembered that the first part of the pyramid may well be dedicated to just one layer or level that is subsequently expanded into other sub-levels. For example, suppose as an enterprise one decides to focus on safety needs and, for arguments sake, decides that these needs are split into 4 sub-levels as follows:

a. Protection needs: think of fences, bodyguards, anti-intrusion measures, guard dogs, private weapons, border quality controls etc.

b. Surveillance needs: think of CCTV (Close Circuit TV), private policing, sensors etc.

c. Law and order: think of police (private or public) and policing, laws, legislation, rules and procedures, neighbour watches etc.

d. Stability and respect: think of democratic processes, permanence of governance, governance, ombudsmen etc.

This could be depicted as follows[30]:
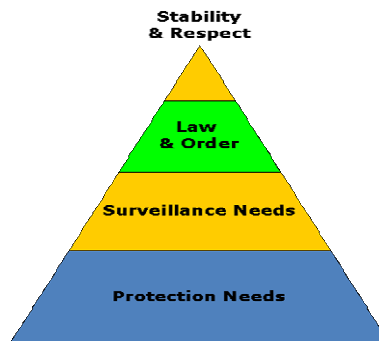
Figure 18. PIE and the Needs of the Individual Pyramid

2. For the institutions

▪ The realization of what needs still require satisfying with an emphasis on satisfying the latent needs of both individuals and communities. This implies that institutions will have to project the future so as to anticipate the needs of the consumer i.e. citizen. In this way the citizen take centre place for future institutional planning and protection.

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[30] The fact that a triangular shape has been chosen is purely arbitrary but nonetheless fits with Maslow's original hierarchical approach.

▪ The prioritisation of needs i.e. understanding what is more or less important and when they should be attained for the community and the good of each individual (see also the previous comments)

▪ Provides the necessary infrastructure, financial, socio-cultural and legislative support and not just for the satisfaction of declared needs. Note that the institutions are not expected to be risk takers nor are the allowed to put the consumer at risk. However, the same can be said about the responsibility of the institutions towards enterprises. This is sometimes known as the Omission bias and is founded on the concept of 'Do no harm' [Bazerman and Moore, (2008)].

So following on from figure 15 we may see that the institutions are expected to operate at all four levels but especially the upper two levels since if satisfied imply also that the other two lower needs are accounted for. In terms of declared needs we may find that people expect the institutions to be fair and unbiased but may want parallel structures to sustain them (i.e. latent needs) e.g. ombudsman, direct line to approved and external bodies for complaints, external quality control, gender support for specific issues, multi-language support etc.

3. For enterprises

▪ Uncover and pinpoint both individual and community latent needs so as to reflect and respect local customs in a responsible and sustainable manner. This is precisely what is done with CSR and providing products that reflect local respect. In the case of law and order statistical data concerning crime [www.europeansourcebook.org] is now readily available for the individual.

▪ Provide the products and services that consumers truly need and search for (hence with more emphasis on latent rather than declared needs) while respecting the environment. For example, in the case of surveillance consumers may want to access live CCTV from their mobile telephone or PC, or they may want to be informed by an abnormal condition arises in the household.

▪ Work together with the consumers and institutions to ethically sustain the demand for goods and services. Thinking long term this means promoting only declared needs that reflect sustainability. In the case of figure 14 if too much emphasis is placed on the lower two levels this may be interpreted as being a 'cheap' way out or that the institutions are avoiding taking their societal responsibility.

Although the examples discussed here seem to be too focused it should not be too difficult to re-calibrate for other circumstances. Three suggestions are promoted for putting PIE into practise:

1. The focus has to be on satisfying the individual or community and especially their latent needs. Hence the emphasis is not on the shareholder but on the stakeholder. Remember also that enterprise stakeholders are also consumers.

2. All three entities are engaged in the satisfaction of the needs.

3. Explore the full, long-term, benefits and implications of the product or service offering on all three entities.

5. Conclusions

This paper promotes a hands-on and rational strategy development approach based on a 3D model that not only depicts a complete needs-to-strategy path but discusses what this path is and how it can and should be adapted to match the enterprise to the marketplace.

The author emphasises the need to grasp and assimilate the key differences in making strategic choices through fuzzy decisions and realising that red and blue-ocean strategies have a similar adjacency trait. Although it is rare to find pure clear-cut decisions in everyday business scenarios this does not justify complacency when discussing consumer needs. Knowing and addressing consumer declared and latent needs [Woodruff and Gardial, (1996)] is all about sustainable competitive advantage and many enterprises are either unaware of what blue-ocean strategy can offer or ignore it to minimise risk and hopefully maximise short-term profit. This paper argues that shifting from satisfying declared to latent needs requires a cultural shift not only within the enterprise but also the institutions that supposedly support them as well as protect the citizen.

Given this approach it is hoped that the models and tools discussed are sufficient to at least spur change and look at the marketplace as an opportunity thus pacing rather than chasing the consumer perpetually.

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FUTURE MOTIVATION IN CONSTRUCTION SAFETY KNOWLEDGE SHARING BY MEANS OF INFORMATION TECHNOLOGY IN HONG KONG

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Abstract

Constructions accidents have led to many workers in Hong Kong seriously injure or even die every year. Huge sum of money has been spent on compensation by contractors. Lack of safety knowledge is one of the causes behind these accidents. While information technology has become part of the indispensible lives among youngsters and teenagers, it is foreseeable that construction workforce on site in the coming decade will meet certain level of computer skills and knowledge. With the help of information technology, geographical boundary in knowledge sharing among safety officers or relevant stakeholders from all over the world is removed. Faster knowledge sharing is also expected. Knowledge sharing among construction workforce in Hong Kong is still restricted in traditional face-to-face interaction. Use of information technology in construction companies is still piecemeal and limited on daily work communication. This paper aims to study the possible motivation in sharing construction safety knowledge inter and intra construction organizations.

Keywords: motivation, construction safety, knowledge sharing, Hong Kong

Jel Classification: M15, M12, M53

1. Introduction

Coupled with poor workforce safety behaviours and attitudes, outdoor operations and fast changing design, complex equipments and tools on sites, workers' safety is still a complex issue [Choudhry and Fang, (2008)]. Plenty of initiatives which include legislation, law enforcement, and safety training effectively reduce the number of industrial fatalities in the construction industry to 60.6 accident per 1000 workers in 2007 in Hong Kong the third lowest figure ever recorded (Hong Kong Labour Department, 2008). Nevertheless, construction accidents rates still rank 2nd among all the four major industrial activities in Hong Kong [Hong Kong Labour Department, (2007)](fig 2). Ways to lower the high accident rates on sites are still a can of worms among construction safety managers and officers across the board.
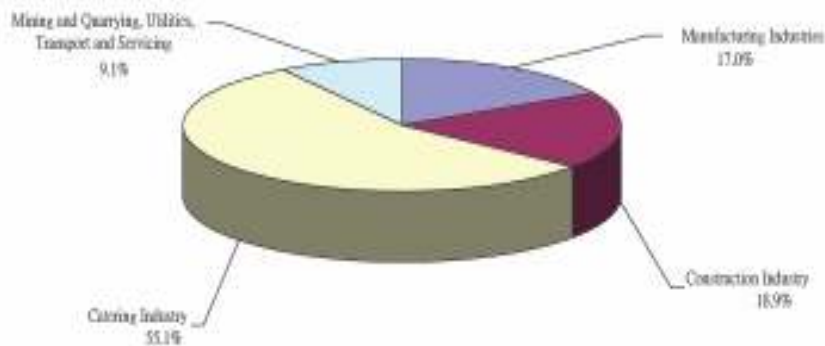
Figure 1. Accident rates in four major industries and Source: (Hong Kong Labour Department, 2007).

2. Construction safety knowledge sharing by IT

Many safety officers blame low education levels of workers as barriers in sharing safety knowledge by means of IT. Many of our predecessors are not well educated in the olden days. Hardly could we imagine an illiterate construction workers know how to operate information technology or read safety instructions. Yet, with the introduction of 9 years compulsory schooling since 1978 [Cheung *et al.*, (2004)], education level of the majority has increased. People who have attained an education level below primary school has been decreased from 6.9% in 2002 to 5.5% in 2007

[Education Bureau, (2007)]. Starting from school year 2008-2009, the HKSAR offers 12-year free education. It is expected that the education level of all the local born will increase in the future, so as our construction workers [HKSAR, (2007)]. Furthermore, IT has become part of the curriculum since kindergarten; many of the kids know IT well before they start their high school education. While number of computer users has soared over the years, knowledge sharing with the help of information technology is very limited. This paper aims to study possible motivation in sharing construction safety knowledge inter and intra construction organizations. With the help of improved software, it is foreseeable that there will be more and greater variety tools in knowledge sharing. At the present day, knowledge sharing initiatives with the help of IT are among private individuals only. Construction companies, which include those largest scale contractors, only provide face-to-face lessons to their new employees and every three years afterwards. Limited visual aids, e.g. video and DVD, are used in the lessons. Information technology is seldom used for knowledge sharing in between safety officers and workers.

3. Costs of construction accidents

Time and costs are the major concern of both clients and contractors. Accidents, however, are one of the factors which lead to increase in time and costs in construction projects. Contractors and/or clients may need to pay compensation to the workers if they are responsible. Table 1 illustrates some of the examples that the contractors and/or clients need to pay for the accidents in 2005-2006.

Table 1. Costs of compensation paid by contractors and/or clients decided by court

Case no	Nature of the case	Results	Compensation
[2006] HKEC 312	A worker struck on head by oxyacetylene cylinders	Death	$ 1,605,000.00
[2006] HKEC 1531	A worker struck by a falling metal tube, and had his head injured	Occasional headaches, neck plain and dizziness	$ 219,003.00
[2005] HKEC 607	A worker fell from height	Recurrent dizziness.	$ 1,945,057.80
[2005] HKEC 2182	A worker fell from height	Lost certain mobility of his right wrist	$ 21,606.00
[2005] HKEC 2156	A worker fall from height cause	Fractures in left knee, right ankle and thighbone	$ 2,387,435.40
[2005] HKEC 2156	A worker fell from a 3 m height, of retaining wall	Fractures on right knee	$ 2,387,435.40
Case no	Nature of the case	Results	Compensation
[2005] HKEC 1972	An assistant site supervisor struck on the back of his head by iron pipe	Depression	$ 1,491,528.00
[2005] HKEC 1493	A worker's fingers were crushed against the wall by pipe	Fingers were crushed	$ 25,049.00

Source: (Li, 2006).

Apart from the costs as shown in the table, there are also high indirect costs of construction accidents. Direct costs of accidents are relatively small when compared to the indirect costs. Numerous indirect costs which include loss of time for investigating the reasons for the injuries, reporting to the Labour Department and mass media etc [Saram and Tang, (2005)]. Accidents not only reduce family earning, but also bring sufferings and grief. To employers, accidents lead to lower staff morale and a negative impact on their companies' image which ultimately affect tendering opportunity [Li, (2006)].Table 2 shows material damages and non-material damages of the compensation which the clients need to pay for the accidents and table 3 illustrates estimated lost of time in construction accidents.

Table 2. Direct and indirect costs of construction accidents

Non-fatal accident cases	Fatal accident cases
Material damages	Material damages
Loss of earnings	Loss of dependency
Loss of earning capacity	Loss of wealth accumulation
Loss of personal property	Loss of earnings to the immediate family members
Medical expenses	Loss of personal property
Miscellaneous expenses	Funeral expenses
	Loss of services
Non-material damages	Non-material damages
Pain, suffering and loss of amenities	Bereavement
Loss of society	

Source: [Saram and Tang, (2005)].

Accidents lead to longer time to complete whole project is due to work re-arrangements, accident investigations etc. Assume an accident occurs and a worker injured, total number of hours can be as much as 44.26 hours. For instance, assume a victim earns $20 per hour, it then leads to a lost of $885.2 in the society. Detailed breakdown can be referred to Table 3. Moreover, contractors are also at risk from being barred from tendering for public works projects because of poor safety performance. In 2005, a total of 11 contractors were barred from tendering for public work. [Li, (2006)].

Table 3. Time lost in construction accidents

Relevant parties	Hours lost	Items of hours lost
Injured worker	3.7	on the day of injury
	8	lost subsequent to the day of injury
Transporting the worker	3	on the day of injury
	3	vehicle time and mileage
Crew costs	12	a crew of 5 to 4
Workers idled by watching	5	other workers' time
Damaged materials	2	repair the damage
	2	restore work conditions
Replacement worker	0.06	lost productivity
Supervisiory time	2.7	assit injured worker
	1.5	investigate the accident
	1.3	complete the report

Source: [Li, (2006)].

4. Causes of construction accidents

Low education level of construction practitioners [Cheng *et al.*, (2004)], human error, lack of training, sub-contracting etc. are some of the factors which led to accidents [Li, (2006)]. Health and Safety Executives concluded that human behavior is a contributing factor in approximately 80% of the accidents. Many studies revealed that the majority of accidents and resulting injuries are attributed to unsafe work practices of the workers rather than unsafe working conditions [Choudhry and Fang, (2008)]. New workers often become victim of accidents because they do not have the knowledge about potential hazards and problems on sites [Choudhry and Fang, (2008)]. "Don't know" is one of the significant factors responsible for unsafe workers' behavior on sites. It provides an explanation to 38 % of all construction "over-3-day injuries" [Edwards and Holt, (2008)]. Usually, near misses or incidents make workers realize the significance of safety practices on sites. Some people, therefore, advocates the importance to share these near misses more effectively among the workers [Choudhry and Fang, (2008)].

5. Knowledge and knowledge sharing

Knowledge is a mix of framed values, contextual information, experience and expert insight that provides a framework for accessing and integrating new knowledge, skill and information. This knowledge is absorbed by the memebers within organizations. Their understanding on knowledge is then demonstrated by the members' actions and processes [Dulaimi, (2007)]. Generally speaking, there are two types of knowledge: tacit and explicit. Tacit knowledge is acquired via imitation and practices. On the other hand, explicit knowledge is usually diffused throughout an organization in the form of rules and guidelines and expressed in codified form. Within an organization, knowledge is stored in the form of common organizational practices [Lin and Lee, (2004)].

Unlike air particle which can flow around freely, knowledge is tied to a subject who knows it well. Someone who has the ability to acquire and share knowledge is necessary [Hendriks, (1999)]. Knowledge sharing generally refers to the process where individuals iteratively refine an idea or thought in the light of experiences. The idea is then modified step by step or rejected progressively [Chua, (2003)]. Knowledge sharing can also be regarded as something which are different from but related to communication. It can also be referred to those other than but related to information distribution. Reconstruction is required to learn something from someone else or to share his or her knowledge [Hendriks, (1999)]. Knowledge can be shared by means of face-to-face interactions and synchronous and unsychronous communication via electronic respiratory. Organizations use various methods to boost knowledge sharing, e.g introducing incentive schemes for knowledge sharing. Ford, for instance, holds talk about the importance of knowledge sharing and organize some relevant events [Chua, (2003)]. A simplified model of knowledge sharing is shown in figure 2.

Knowledge sharing assumes there are at least two parties; one is the knowledge owner while the other is the knowledge receiver. The one who owns the knowledge should purposely and eagerly communicate his knowledge in form of acts, speech, writing and so on. On the contrary, perspective knowledge receivers have to observe these knowledge expressions, listen, read etc. The process of knowledge sharing consists of two processes: first, 'knowledge owners' do an act of 'externalization'. This process of externalization can be in vast different forms; one of the very common and traditional ways is explaining the concept in a lecture, tutorial class or codifying it in an intelligent knowledge system. It also includes any actions performed based on this knowledge. Knowledge externalization can also be an unconscious act; i.e. an act which does not originally target at sharing knowledge. Take for an example, we can learn by observing somebody operate a machine, even if this person is not aware of he is being watched. Most of the times in knowledge sharing, however, have trouble in motivating the knowledge owners to externalize their knowledge in one or various ways. Apart from that, knowledge sharing assumes an act of 'internalization' by those knowledge receivers, by reading books, learning by practices etc. Some barriers, namely, culture, language, social distance, differences in mental or conceptual frames, space and time may cause distortion in the internalization of externalized knowledge [Vriens, (1998)].
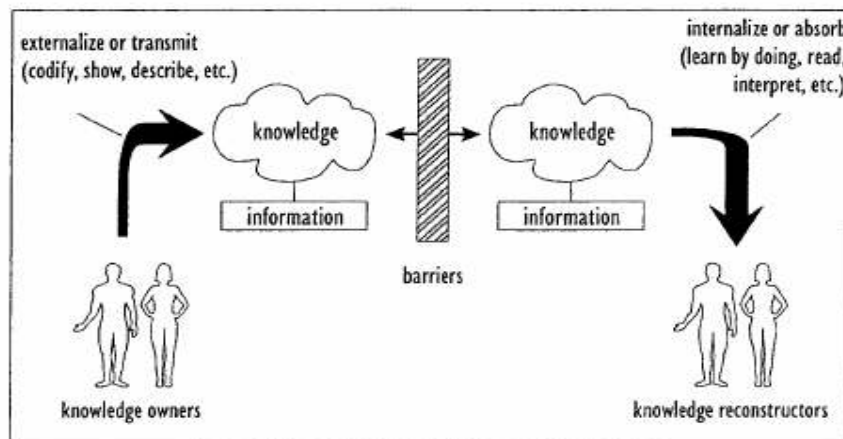

Figure 2. Simplified model of knowledge sharing
Source: [Hendriks, (1999)].

Knowledge sharing is a basic element for individuals in organizations to learn. "People" and "technology is the two major key elements in achieving the goal of effective knowledge sharing tactic. Knowledge sharing consists of three layers: infrastructure, formal rules and infoculture. The first layer, infrastructure, refers to those hardware or software. Knowledge infrastructure can also be interpreted as the knowledge architecture in its physical system. It refers to possible methods which improve knowledge transmission and storage [Dulaimi, (2007)]. Previous research on knowledge management has shown that information technology is often an important knowledge sharing facilitator, knowledge respiratory, internet, intranet, blogs are very good examples. Researchers and practitioners have noted the success of knowledge sharing activities essentially relies on top tier managers to promote knowledge-sharing recently. Furthermore, several indispensable factors have to be considered to ensure a successful knowledge-sharing tactic, for example, it must also go with organization planned targets [Lin and Lee, (2004)]. The second layer, "infostructure", represents the formal rules and regulations which govern the knowledge exchange between the various stakeholders within the network. Knowledge Infostructure are the set of practices which the employees of the companies adopt for exchanging knowledge based on the existing knowledge infrastructure, i.e. the first layer of knowledge sharing. The third layer, infoculture, represents the background knowledge set in social relations adjoining the processes of work group. An openness and trust culture is a significant factor for knowledge sharing in any organisation. To ensure smooth knowledge-sharing within an organisation, a climate of trust in organizations is necessary [Dulaimi, (2007)].

As knowledge sharing happens whenever an individual is agreeable to give a helping hand to the others and learn from others, knowledge sharing allows individual to learn in the company and to assimilate the knowledge for applications in a practical way. Therefore, knowledge Sharing and organizational learning are closely connected. The process of knowing, thinking, learning and sharing factors have a reciprocity relationship. On top of that, people within an organization can establish their common understandings mutually via sharing their view, thinking, information and knowledge. Knowledge exchange among folks allows stakeholders to improve their capability and produce new knowledge communally. By sharing with and transferring to others, value of knowledge appreciates. Redundant intermediary channels might lead to incomplete knowledge transfers as quality of knowledge may be distorted, or become less accurate. Organizational members' misunderstanding, ignorance or/and failure to convey the original concept or idea can affect the overall organizational performance. This incomplete knowledge transfer would lead to knowledge decrease ultimately. Knowledge depreciation usually happens when 1) the newly emerged goods and services make the originally old knowledge obsolete 2) workers leave their post before transferring their knowledge; 3) sharing only put into practice for certain individuals or selectively shared to some individual [Yang, (2007)]. In the light of this, rapid knowledge sharing method is necessary. Traditional face-to-face safety knowledge sharing method seems cannot provide the way out for this. Information technology, however, meets the requirement of fast knowledge transfer.

6. Paradigm shift in knowledge sharing

Several key elements are identified in our new technological era: 1) knowledge and digital economy; 2) virtual; 3) internetworked; 4) disinter mediated; 5) convergent; 6) innovative; 7) immediate; 8) global; and 9) discordant. Major alterations in our work environment includes 1) from conventional semiconductor to computer chip technology 2) from analogue to digital; 3) from manual to server computing; 4) from traditional footpath to information superhighway; 6) from disintegrate text, data and image in documents to multimedia; 7) from propriety to open systems; 9) from hand-craft to object computing 10) from graphical user interface to virtual reality and multimedia user interface [Mak, (2001)].

The popularity of World Wide Web (WWW) and Internet have affected all walks of life. Industries are evaluating how to gain benefit with them [Doherty, (1997)]. Organizations and corporations, especially those medium to large size, have been and are taking advantages of these paradigm shifts in technology. Government Bureaus, broadcasting industry, educational organizations (from pre-school to Universities) and even food and beverages companies are moving towards this digital era. The current applications of information technology in the construction industry is, however similar to other industries, piecemeal. Contractors invested in IT mainly to attain the goal of

manpower and costs saving, increasing efficiency and getting more business [Mak, (2001)]. Their uses are mainly focus on daily communication (e.g. bosses send emails to their employee notifying the daily tasks), administration (e.g. transmission of data file) and construction drawing (e.g. AutoCAD drawing).

On construction sites in Hong Kong, construction workforce usually learns safety knowledge from toolbox talks and morning site safety cycles [Choudhry and Fang, (2008)], the major ways in sharing safety knowledge among construction workers is by means of face to face interactions. Although IT is gaining its popularity, knowledge sharing by means of IT is limited. Face-to-face Safety meetings, toolbox talks and morning assembly on-site Green Card training, worker registration training, and on-site induction training remain the major source of safety knowledge [Choudhry and Fang, (2008)].

7. Possible key enabling/emerging technologies in sharing construction safety knowledge with the help of IT

Overcoming geographical constraints and increasing velocity of information transfer and improving task performance are some of the very good examples to show the merits or market information technology to construction companies' senior, persuading to use the "newly" developed tools in sharing the safety knowledge. While many of them can tell the existence of intranet to share information or knowledge and some researchers even equate promoting knowledge sharing with intranet, the potential of IT in supporting knowledge sharing goes beyond intranet usage [Hendriks, (1999)]. Some individuals have already started to share their safety knowledge via Web-based communities, blog, virtual lessons and even online games. Although construction companies in Hong Kong seldom use these methods in knowledge sharing between employees, these examples can provide much insight for safety officers.

7.1. Professional web-based communities

Professional web-based communities are developing as an important means of assembling, systematizing and distributing knowledge within an organization. Within these communities, each individual can bring together their own "pieces of knowledge" to fabricate a "pool of knowledge" [Obonyo and Wu, (2008)]. Pooling of knowledge and experiences among group members can provide more options in problems solving [Choudhry and Fang, (2008)]. Web-based sharing knowledge can be treated as a kind of social practice which requires participants to actively engage in the process of creating, communicating and refining knowledge. By way of this medium, people often can build up their social network with similar interests. In the construction industry, social networking can be used to reinforce communication among safety officers and workers intra and inter organizations. To build up a good social network sites for sharing knowledge, or sharing safety knowledge in our case, a user friendly publishing and sharing information is necessary [Obonyo and Wu, (2008)]. Thanks to web servers such as Youtube, video production can be as simple as a mobile phone or camera with video taking fuction, a video can be uploaded within 5 minutes' time. Safety message can be conveyed easily by means of easy sharing tools. Another merit of web-based communities is, while production of video tape is usually limited by geographical location: a safety VHS tape produced in Hong Kong can usually be distributed to workers in Hong Kong only, videos uploaded to communities such as Facebook or Youtube can be viewed by people from all over the world. There are currently 4 community groups in Facebook about construction safety and 3 groups about occupation safety. Group creators and members of the group can share some videos and photos about safety, discuss on discuss board and post the most up-dated information under "wall post".

Table 4. Construction safety groups in Facebook

	Construction safety related group	Origin	Contents	Open Group
1	Construction Safety	Turkey	Basic information, video, wall post, photos	Y
2	Construction jobs - health and safety	London	Basic information, recent news	Y
3	Construction Safety Officers / First Aid Attendants	Vancouver	Basic information, video, wall post, photos, Discussion board, posted items	Y
4	Health and Safety in Construction...Help Lauren With Her Uni Work!	Unknown	Basic information, contact	N

Source: (Facebook, 2008).

Table 5. Construction and occupation safety groups in Facebook

	Occupational safety group	Origin	Contents	Open Group
1	Occupational Health and Safety Management Group	Turkey and Los Angeles	Basic information, contact, photos, videos, discussion board, posted items	Y
2	Occupational Health and Safety	Unknown	Basic information, photos, videos, discussion board, notes, mini-feed	Y
3	Stargazer Safety Kit	U.S.	Basic information, discussion board	Y

Source: (Facebook, 2008).

However, as there are no restrictions on the quality of data which can be posted on web, accuracy of data depends on the one who posts the information, the creators of these communities and the mechanisms of information distribution. Furthermore, the success of information and knowledge sharing depends heavily on "interactivity" [Obonyo and Wu, (2008)], many of these groups on web "die" eventually because the members become inactive as time goes by. With the popularity of web based community, more web-based communities similar to those in Facebook will be set up, free videos and education materials can be obtainable readily on web.

7.2. Intranet

Nowadays, nearly all the medium to large size companies have established their own intranets. Many of these are established to inform or notify the companies' policies, new rules, or even companies' annual dinners etc. Intranets can also be used to up or download information from and to the central databases. This allows members of organizations to share the information rapidly. In order to gain an advantage from Intranet as a device for knowledge sharing, it is crucial that there are more dynamic rather than static information. Moreover, companies have to avoid problems such as information content deficient. In spite all the merits and advantages provided by intranets, intranet practitioners often hold the view that intranet does not meet their expectations [Ingirige and Sexton, (2007)]. In the future, it is likely that there will be more safety information circulated around construction workers on site, as there are more and more mobile phones to provide mail box services to mobile owners.

7.3. Online safety games

Computer or video games which require players play through computer network and internet are online games. Gone are the text-based role playing games, computer games designers nowadays usually design games made up of a virtual world simulating real life environment and science fiction

settings [Weibel *et al.*, (2007)]. Because players can play by themselves or with the other game players and make conversation with others online concurrently, these games attracted much players [Weibel *et al.*, (2007)]. More than 400,000 people play Everquest and around 2000 gamers play the game at the same time at every time slot. In Hong Kong, playing online games have become youngsters and teenagers' 'homework'. According to a research, 48.9 % of the youngsters claim that they play computer games everyday from one to four hours. 63.2% consider themselves as computer games adductors. Although more than 60% of those who play computer games are teenagers between 13-15 years old now [Chen, (2007)], they will become pillars of our society and part of the workforce on sites. While people nowadays mainly focus on negative impacts of online games on adolescent playing, for example, the effects of playing aggressive games and addiction [Griffiths *et al.*, (2004)], provided that we can make good use of computer games in conveying safety message, we can successfully turn what we regards as "bad" into "good". Besides, another major characteristic of computer games is, it can be a good method to promote brand name. Nike, for example, provides online games as one of the method in marketing its products as well as collecting information of players online [Spero and Stone, (2004)]. Though it does not necessary for safety games providers to collect information of the players' online, games providers of online safety games can also be a very good channel in posting their advertisement. Besides, with the help of simple tools such as C++, DarkBASIC Professional, JAVA etc, games writing can be done by many people with certain level of computer knowledge. Table 5 gives some examples for those game providers currently. Most of them are overseas companies. While it is uncommon for those games providers in Hong Kong to provide safety education games, it is foreseeable that there will be more safety games written in Chinese in the future for teaching the practitioners in a more interactive and interesting manner.

7.4. Virtual classrooms

Given the widespread use of the Internet and the boom in Website design, it is predictable that Web-based lessons in HTML will become one of the major medium in online learning. With the help of Operating system (e.g. LINUX Redhat), web server (e.g. Apache), system database (e.g. MySQL) and programming knowledge (e.g. JAVA and PHP) (Sun *et al.*, 2008), virtual lessons of construction safety can become reality.

As part of mandatory requirements by the regulations in Hong Kong, all the contractors need to provide safety education to their employees. Face-to-face construction safety lessons are one of the most common methods to covey the safety knowledge. Yet, as the costs of finding suitable candidate in teaching the safety course is high, these lessons can only be carried out at certain period of time. Another problem is, these construction companies need to spare some spaces to hold these courses. In view of high labour costs and limited space in construction sites, safety lessons can not be held so frequently. Besides, some work on sites is so special and unique that general safety courses cannot meet the need of these workers.

Distant learning, from this perspective, provides a good solution to the problems aforementioned. Besides, learning companions can also form some Internet-based interactive learning groups. The emergence of these virtual lessons helps us to switch the traditional classroom into global learning group. On top of the aforementioned merit, there are three potential educational advantages: 1) unlimited learners at the same time, 2) asynchronous learning and 3) the application of global resources, course instructors or even learners can upload any new information to the website at any time and in any place [Sun *et al.*, (2008)]. Table 5 below shows some of the private companies which provide multimedia/online courses. Most of the safety training course providers in Hong Kong provide face-to-face training only. Few or even none of them provide long distance. In some of the developed countries, such as US, multimedia and virtual learning is very common. As some of the workers in Hong Kong only work for a few days in a week, it is highly unlikely that they will be able to have some specific course for them. These virtual lessons can provide them up-to-date knowledge. Besides, it is also possible that they can re-read the course again when they forget.

Table 6. Local and overseas private companies which provide services on safety trening

Company	Source of information	Originaity	Face-to-face safety course	Multimeidia/ online safety course	Games
The Workplace Safety Store	The Workplace Safety Store (2008)	Texas, US	X	X	
Safety Video Direct	Safety Video Direct (2007)	Alabama, US		X	X
National Safety Compliance	National Safety Compliance (2008)	Washington, US		X	X
Pure Safety	Pure Safety (2008)	Hilliald, US		X	
Compliance Consultant	Compliance Consultant (2008)	Georgia, US	X		
Omni Safety	Omni Safety (2008)	Not mentioned	X		
KHK Management Consultants Limited	KHK Management Consultants Limited (2008)	Hong Kong	X		
Hong Kong Human Resources Limited	Hong Kong Human Resources Limited (2008)	Hong Kong	X	X	
Hong Kong Safety Training Centre	Hong Kong Safety Training Centre (2008)	Hong Kong	X		
The Hong Kong Safety Training Association	The Hong Kong Safety Training Association (2008)	Hong Kong	X		
Industrial Technology Consultant Limited	Industrial Technology Consultant Limited (2008)	Hong Kong	X		

7.5. Blog

Blog, a new term which only appears in these few years, one can hardly find the meaning in traditional dictionary. It generally refers to a shared on-line journal where people can post diary entries about their personal experiences and hobbies [The free dictionary, (2008)]. Young people always write their blog to share their thinking and viewpoints on blog websites such as Xanga, Yahoo, MSN Space etc. Some of the young academic researchers also write their own blog to share their academic research on web. Other blog writers can choose to subscribe others' blog entry and read it via email, e.g. Blog of KK [KK, (2008)]. Writing and posting a blog message can be completed within a very short time. Yet, readers from all over the world can get access to the information simply by clicking into the website. Blog subscribers can also leave comments and ask the blog owners questions. There is already some private individuals' share their knowledge on safety on blog, such as the one illustrates in Figure 7. Similar concept can be applied in some construction companies for informing their employees about safety courses, toolbox talks etc.

8. Who moved my cheese? The major barriers to resist change

It is nature of human beings to resist change. The extent of resistance differs from people to people [Davis and Songer, (2008)]. By the time the new wave of information technology comes, construction practitioners or even the high level managerial people resist or refuse to bring about any

changes to their current system. Although there are getting more and more people attain the basic knowledge of information technology, including those who are in pre-school education and primary school, application of IT on construction safety knowledge or information transmission is limited. There are many reasons why people resist change. These include lack of inertia, misunderstanding, fear of poor outcome and failure. In view of resistance to change, some authors suggest various solutions to overcome these, e.g. education, coercion, political support, manipulation and discussion (Table 6).

Table 7. The possible causes and strategies in resistance to change

	Kreitner (1992)	Griffin (1993)	Aldag & Stearns (1991)	Schremerhorn (1989)	Dubrin & Ireland (1993)
Causes of resistance					
Surprise	X				
Inertia	X				
Misunderstanding	X	X	X	X	
Emotional side effects	X	X	X	X	
Lack of trust	X	X	X	X	
Fear of failure	X				X
Personal conflicts	X	X	X	X	
Poor training	X				
Threat to job status or security	X	X	X	X	X
Workgroup breakup	X	X	X	X	
Fear of poor outcome					X
faults of change					X
Uncertainty		X	X	X	
Strategies for overcoming					
Education	X	X	X	X	
Participation	X	X	X	X	X
Facilitation	X	X	X	X	
Negotiation	X	X	X	X	X
Manipulation	X	X	X	X	X
Coercion	X	X	X	X	
Discussion					X
Financial benefits					X
Political support					X

Source: [Dent and Goldberg, (1999)].

9. Traditional motivation theories

Motivation refers to encouragement, direction and pushiness behavior. Motivation theory has a root on Adam Smith's basic postulation that all humans are selfish and are trying to do the work subject to the constraints they face [Li, (2006)]. The diagram below shed light on the importance of motivation factors in knowledge sharing by means of information technology.
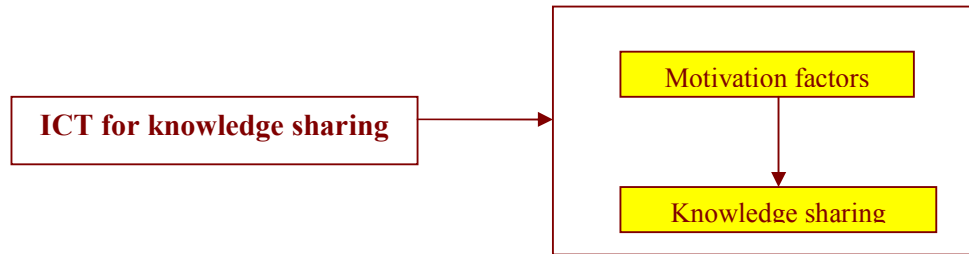
Figure 3. Motivation in knowledge sharing by means of information technology

Source: [Hendriks, (1999)]

9.1 Theory X

Based on the rudimentary assumption that men are not self motivated, Douglas McGregor's Theory X suggest that men have to be directed, forced and threatened with penalty for achieving certain organizational objectives [Li and Poon, (2007)]. McGreqor points out 2 distinctive assumptions made by the manager on human behavior by Theory X and Theory Y. Nevertheless, some researchers concede that minimal supervision is sufficient to ensure the organization members do what they should do [Morden, (1995)]. Subject to regulations, human can exercise discretion [Cooper and Phillips, (1997), Morden, (1995)], punishment and fine are peripheral means to achieve goals set by organizations only [Stroh, (2005)]. Moreover, some authors opine that disciplinary actions tend to be ineffective because either of delay or its mild nature [Peters, (1991)].

In the light of Theory X, the major motivation in adopting IT for safety knowledge comes from the high penalty in accidents. Fixed costs, e.g. purchasing safety games and interactive training costs, are very low when we compared to the high compensation costs paid by the contractors and possible ban of tendering which lead to wind up of the companies and workers' lost of jobs. This is also one of the reasons why some innovative safety management systems, such as Zero Accident Activities (KYT), site safety cycle etc are "imported" from Japan.

9.2 Theory Y

In stark contrast, however, Theory Y represents another polar hypothesis about human behavior. Followers of theory Y trust men and have confident that they are responsible. Provided a suitable working environment, workers can reach the goal set by the companies. Theory Y followers consider human beings need to work and treat like a precious member in the society [Kock, (2005)]. Trust is the fundamental requirement for communication, open and communal learning. Trustful human relationship also helps generates a strong cooperative power within the company [Rogers, (1995)] so as establishing an IT knowledge sharing platform

Nevertheless, Theory X and Y, represent two completely different scenarios which neither of them represent the real situation well , it is more likely to fiind an amalgamation of the two [Li, 2006)].

9.3 Reinforcement theory

Psychologists B.F. Skinner contends that human behaviors are directly related to the results of their acts. By applying reinforcement, people's behaviors will change [Courtland *et al.*, (1993)]. Monetary incentives, such as cash allowance, increase in salary and non-monetary incentives such as being named Achiever of the week can motivate or positively reinforce employees to do good work [Davidsom and Griffin, (2006)]. By offering pleasant consequence, positive reinforcement can motivate people to do the work. Usually, there are too few winners in any incentive programs, distrust and corruption among members of organization can lead to much greater concern. Moreover, monetary incentives can be costly and useful in short term only. It is quite often that they do not encourage long-term improvements [Li, (2006)]. Successful positive reinforcement strategy, therefore, can also motivate safety officers or workers with computer knowledge to share their safety knowledge by means of IT.

Sometimes, employees will do work in one way because they know that if they do in another way, they will be have negative consequences. In this way, their behaviors are reinforced by avoidance learning [Courtland *et al.*, (1993)]. Negative reinforcement, however, can offset positive punishment reinforcement. Sometimes, positive value of co-workers are so great which lead the workers to accept punishment instead [Schermerhoen *et al.*, (2003)]. In other to achieve some of the companies' objectives and implements new innovative policies, newly implemented policies usually associated with penalities for those violators.

9.4 Hierarchy of needs theory

According to Maslow's theory, men are motivated by five classes of needs: 1) Physiological (e.g. shelter, hunger, sex thirst and other bodily needs), 2) safety (e.g. security, protection from emotional and physical harm), 3) social (e.g. belongingness acceptance, affection and friendship), 4) esteem (e.g. internal esteem factors, for instance, self-respect, autonomy, and achievement; and external esteem factors, for instance, recognition, status, and attention), 5) self-actualization (e.g. the drive to become what one is capable of becoming; includes growth, achieving one's potential, and self-fulfillment) (Kim, 2008).

Although needs theory has been heavily criticized, for instance, 1) its strict assumption on hierarchy in needs, 2) fails to explain how behavior can be affected within the hierarchy, 3) its weak empirical foundation (e.g. Maccoby, 1988), it still proves its value at the present moment. Maslow's theory indicates that motivation for knowledge work comes from his three highest hierarchical levels. Needs theory imply that knowledge owners do not have the motivation to share what they know by information technology because such actions will not lead them to earn more money or improve their relationhips with their colleagues? Their motivation, however, mainly comes from their want to attain self-actualization [Hendriks, (1999)].

Figure 4. Maslow's needs theory (Kim, 2008).

9.5 Herzberg's two factor theory

Herzberg's (1968) two-factor theory is based on two different groups of factors: motivation and hygiene. Hygiene factors motivate people firstly in a negative way. Generally, they do not motivate people when they are present, however, absence of them will lead to dissatisfaction and a decreased motivation. These factors include Salary, working conditions, status and interpersonal relations. On the other hand, presence of motivator factors lead to an increase both in motivation and satisfaction. These include challenge of work, promotion opportunities, sense of achievement, job done recognition, sense of responsibility and operational autonomy [Hendriks, (1999)]. We almost turn to motivation factors automatically, instead of hygiene factors when we intend to look for the reasons why people want to share knowledge by means of information technology. Bonuses (either in monetary or non-monetary terms) or penalties, for example, may lead to a rise in the use of knowledge sharing by information technology. Yet they are not likely to lead to an increased motivation for knowledge sharing by IT. When hygiene factors are absent, knowledge sharing by means of information technology may be frustrated. Yet it is not very likely that they will lead to a rise in sharing knowledge motivation. The six factors identified as motivators by Herzberg also appear to be elements which trigger knowledge sharing by information technology, such as blog, intranet, web-based communities etc.

10. Foreseen industrial impacts and conclusion

High accidents rates in construction industry are often regarded as a hard nut to crack. While there are more and more people who know information technology well, application on sharing safety knowledge is limited in Hong Kong's construction industry. Sharing knowledge by this method can increase the interactivity of the knowledge assimilation process and make the whole process livelier. Moreover, with the help of information technology, it can share the safety knowledge among construction practitioners from all over the world in a faster way. To motivate construction practitioners to share their safety knowledge by means of IT, Theory X, Y, reinforcement, two-factors theory and needs' theory have been examined and are summarised in Table 10. With better understanding on motivation theories, companies know better how to implement a successful knowledge sharing platform with the help of IT. It is expected that the construction accident rates will further decrease.

Table 7. Compare and contrast different theories in achieving the goal of motivating members of organizations in sharing safety knowledge by means of IT (note that Theory X and positive reinforcement theories with "*"indicate that people are motivated because they are afraid of *lower* achievement, salary etc).

Can the following theory motivate members of the companies to share their safety knowledge by IT?	Theory X	Theory Y	Reinforcement theory (+)	Reinforcement theory (-)	Hierarchy of needs	Two factor theory
Punishment	Yes	No	No	Yes	No	No
Trust	Yes*	Yes	Yes	Yes*	No	No
salary	Yes*	No	Yes	Yes*	Yes	No
status	Yes*	No	Yes	Yes*	No	No
Interpersonal relationships	Yes*	No	Yes	Yes*	Yes	No
challenge of work	Yes*	No	Yes	Yes*	No	Yes
promotional opportunities	Yes*	No	Yes	Yes*	No	Yes
achievement	Yes*	No	Yes	Yes*	No	Yes
recognition of job done	Yes*	No	Yes	Yes*	No	Yes
sense of responsibility	Yes*	No	Yes	Yes*	No	Yes
desire for operational autonomy	Yes*	No	Yes	Yes*	No	Yes
Self actualization	Yes*	No	Yes	Yes*	Yes	No

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MOBILE AGENTS MODELING AND THEIR USE TO KNOWLEDGE REPRESENTATION AND PROCESSING

Book Review

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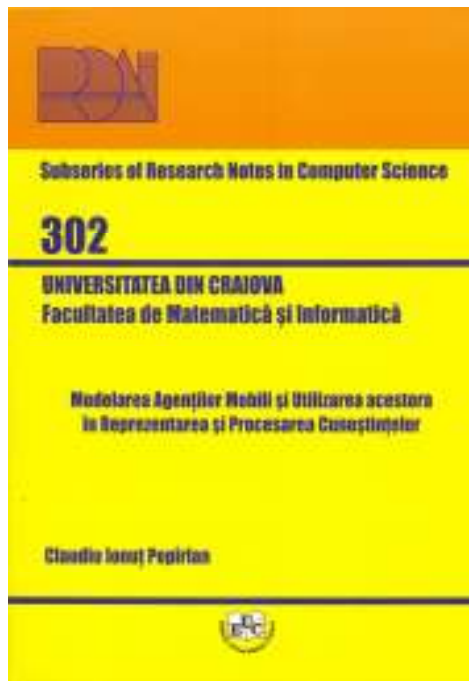
T*he* term of *Agent* appears in the mid-50s, being proposed by two researchers at MIT, first John McCarthy and then Oliver Selfridge and research in the field know two important stages of development. First started in 1977 and has considered agents act on symbolic reasoning. The second began in the '90s and studied mainly typology of agents and how they can collaborate in the network. There are many applications of mobile agents: monitoring computing resources, information retrieval in client-server architecture, computer network management, electronic commerce, problems authentication, information security and many others.

The research proposed in this volume can be placed in a common area of the mathematics and informatics. First, in this book it is integrated the concept of mobile agent in an algebraic environment of knowledge representation and processing, which is obtained using some concepts of universal algebra. In this work is studied the mathematical formalism for knowledge representation and processing using the inheritance concept and the result of this approach is materialized in a proper view on the formal description of the multi-agent systems. This approach will lead to a simple and concise theory with applications in various areas: transportation, medicines, Internet, economics, e-learning, etc. That explains the connection with the mathematical field.

In terms of informatics, here are distinguished several areas of research from the volume that are closely related: defining a model of multi-agent system - which involves important notions of Artificial Intelligence, programming mobile agents - which is a relatively new field in computer science, the implementation of mobile agents using the latest software technology (Java 2 Standard Edition, Java 2 Enterprise Edition, Aglets, Middleware Applications / Server: Java Servlets).

Author deals with an original subject, an important element: the development and formalization of new methods for representation of knowledge in mobile agents' vision.

In *Mobile Agents Modeling and Their Use to Knowledge Representation and Processing*, Claudiu Ionuț Popîrlan proposes a knowledge representation model based on inheritance and studies calculability response function for the proposed model. A mobile agent is defined as a software program that can be dispatched from one computer to another, in order to action and interact with another agent. They are not fixed where the system has started to run the program, but can move on different machines in the network. Thus, the system becomes very flexible because the calculations can be made on any machine, through the agents, which can move in order to obtain the resources and values necessary for completing the tasks. The system is able to process the knowledge bases distributed on its servers. For this purpose, there are Query Mobile-Agents (QMA) that are visiting one at a time, all or parts of these servers from whom they require a certain information, that corresponds to the user requirements for whom they work. When an agent totally accumulates the answers for the user's interrogations, it returns and transmits the results.

Following the performed research in the mathematical context of multi-agent system for knowledge representation and processing, is presented the model of knowledge representation based on the inheritance mechanism, named inheritance knowledge base.

A separate section of the book is the result of an ample scientific approach which implements the multi-agent system, defined in previous section, with support provided by the Java programming language and Aglets development package from the IBM Company. Thus is created a toolkit, named MAKPT (Mobile Agents Knowledge Processing Toolkit), which uses mobile agents to process knowledge bases. This toolkit is described from the implementation's perspective and three examples of testing are presented. The important criteria of the application have been considered the easy implementation, functionality and a good running time. A very good computational time has been obtained per each system execution and sophisticated knowledge bases have been represented and processed without increasing the file size.

In the context of using the proposed multi-agent system in the real world problems with experimental results analysis are discussed several aspects. There are presented two usage cases for initial different configurations of the multi-agent system:

▪ Knowledge processing represented by a tree level structure (which is commonly used in knowledge modeling for complex mechanisms assembling). This case describes some experiments for the situation of two agents engaged together in assembling a bicycle from its parts scattered inside a garage. It is proposed an optimization algorithm for mobile agents transfer through the network;

▪ Numerical knowledge representation for 3D surfaces deformation modeling. This case describe some experiments for a 3D elastic model (sailing ship), represented with particles connected with elastic springs. The multi-agent system is used to extract the forces information (internal and external forces) and to change the elastic properties of the model, for a better representation and visualization.

The book is based on a literature to date and reflect the author's research experience. It is a useful tool for those interested in issues of mobile agents and can be found in use, even, and specialists in the field - who can find new ideas.

In conclusion, the volume presented by Claudiu Ionuț Popîrlan is particularly meritorious, treats a subject of great current and broad interest, the obtained results are mathematically based and experimentally demonstrated, representing the original contribution in developing the proposed multi-agent system and using it in the real world problems.