MICROECONOMIC CONSIDERATIONS ON A SOUTHERN ITALIAN COMPANY FOR MACROECONOMIC GROWTH

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Summary

The work originates from the strategic guidelines, for the time period 2013 – 2015, suggested to OH S. p. A., a consumer goods distribution Company, located in Southern Italy. The Strategic Planning approach to Company decisions suggests full awareness that Micro and Macro economic factors are interconnected. Euro problematics and related environmental conditions, in which all Italian companies are called to operate, may affect their final results significantly. Relevant space was given to analyse the reasons why these conditions have arisen. These macroeconomic considerations and related uncertainty factors formed the basis to outline possible scenario variabilities which influence the action path, and decision making process. The elaborated scenarios were deemed to require different approaches, but a common strategic factor was found in strengthening the role of the Company related Applied Research Center (*Centro Studi S.r.l.*).*The capacity to lead to innovation generated by this venture established a few years earlier, was considered to be strategically essential to play a proper synergic reaction role in all possible environmental situations envisaged. Then, from analysis of a wide population of case histories , some general principles were defined on how to optimize its role in Microeconomic terms to be of benefit to the Company. After having recognized a similarity in these principles with those enunciated by experimental thermodynamics, from analysis of some thermodynamic processes it was shown how the best approach of industrial applied research and innovation process coincides with the Six Sigma system. As a reference idea proposed by this paper the actual possibility of using these principles in a quantitative way and to improve evaluation tools, optimization and allocation of resources in Macroeconomic terms to benefit all emerges.*

1. INTRODUCTION

The aim of this work is to provide some insights into the strategic planning approach in *OH S.p.A.,* a consumer goods distribution Company, located in Southern Italy, for the time period 2013 – 2015.

Because the objective of strategic work is the one of suggesting proper actions, the planning approach to managing the organization in demanding and critical economical situations, should aim to structure a flexible input tool that is useful for making simple decisions in a complex environment. This subject therefore could be considered of general interest for other Companies, operating in similarly uncertain environmental conditions.

We will give some strategic guidelines, that take these environmental conditions into careful consideration and will show how an open approach to innovation and an Applied Research Center could be an important factor, to react promptly to possible different scenario evolutions as the ones expected for the Euro crisis environment.

2. A BRIEF CULTURAL BACKGROUND

In this session we report some ideas of an eminent economist about the management of a Country during a crisis period, not to judge exactly how it has been managed today, but only to try to understand the current situation, and, above all, to derive useful ideas on possible evolutions, aimed at defining management guidelines for the Company under consideration.

Here are the ideas:

In the course of a conversation on public debt [1], *Ben S. Bernanke*, the chairman of the Federal Reserve, said that the American debt ceiling, put by law, must be considered only of symbolic value and, without details on the interest rate policy applied to this debt, said that the fiscal component is the most important aspect in the hands of those in Government, to increase *GDP*.

As *Keynes* said, the importance of money in its significant attributes *flows from its being a subtle device for linking the present and the future* [2]. The economic crisis of the thirties had suggested to *Keynes* to investigate the laws of economic systems, especially during crisis periods and the sentence above was part of it. Unfortunately, the *Keynes* lesson, reviewed by others, but fundamentally recognized of basic conceptual validity nowadays, is not sufficient to guide important decisions, and the *Euro* situation as well as the situation of others economies, is heavily affected today by monetary problems.

The importance of being aware of these factors in the Strategic Planning process of a Company, becomes more and more relevant with increasing complexity due to globalization of world economies. Unfortunately it is difficult to obtain manageable information and the disputes between Central Banks, Governments and arguments arising between opinion leaders in the press and at academic level, bears witness to the complexity of the task.

A. Dixit [3] outlined the work of *Paul Samuelson* in clarifying some difficulties, coming from the interpretation of *Keynes* ideas, using mathematical language and introducing some similarity [4] between economy and thermodynamics.

According to *Keynes* the expectations are primary drivers of the economy. People's behavior is correlated to their expectations. *George Akerlof, Nobel* prize winner in 2001, reinforced this concept quoting *animal spirits* as mental energies that he suggests should be considered very carefully, to understand the economy [5]. Nobel prize winner *Paul Krugman* in a book edited on the network [7] delivers some *Keynesian* ideas that the *Financial Times* defines as *A thoroughly persuasive polemic against premature fiscal austerity in the wake of a deep recession.* As *Keynes* told us, he says, *austerity must be used during expansive phases of the economy, not during crisis periods and credit restrictions to productive sectors initiate corrosive mechanisms.*

The complexity of establishing common dialogue tools is increased by the apparent confusion between financial and value creation factors, as we can observe also from the so-called Basel 3 [8] agreements. The current approach taken by financial Institutions and Central Banks, has further contributed to increase the critical Sovereign Debt situation, deeply affecting the weaker economies.

The distorted effect in the Euro zone, in our opinion, is not attributable entirely to poor credit risk assessment by the Banks on the loans granted to the economic system, but also to the limited capability of the *ECB* , to contrast financial speculation. Credit tightening and unequal financial conditions are creating financial flows at the expense of potential economic value generation. The latter makes it difficult for many companies to keep their credit rating stable and their capability to respond to an eventual credit crunch. In Microeconomic terms and in our view, value is created and measured in the economic part of the accounts while the financial means side of the Balance Sheet, must be considered mainly of "service" to the Value Creation System and additionally as a risk control tool on the resources employed. By analogy, the present Macroeconomic environment of the Eurozone, and its overall Value Creation Process appears not to be sufficiently protected from the effects of financial distortions.

The result of all these factors considering, in addition, the impossibility, by definition, of the weaker Eurozone countries to defend their own currency in tailored made way has given room to specifically driven financial attacks by international speculation. In the meantime all fiscal mechanisms adopted so far have worsened the situation further, as many Italian economists like *Paolo Savona* [9], *Alberto Bagnai*, *Claudio Borghi Aquilini*, *Sergio Cesaratto*, *Gennaro Zezza*, *Lidia Undiemi*, *Luca Fantacci* [10], acknowledge.

We can conclude by talking about the *Euro*. This currency, defined originally as the great *European House*, has currently created a common house, built, starting from the roof. Many aspects correlated to Money attributes and the Central Bank and Political management have been disregarded. For example, the fact that a currency heavily affects people's behavior and is affected heavily by that behavior has been disregarded. The fact that a currency, managed through inflationary policies causes long term structural behavior different to that currently followed by people living in a low inflation country has been disregarded or not sufficiently considered. The fact that the currency had to be introduced in countries considerably different culturally and behaviourally to each other has been disregarded, i.e. the political aspects of different countries have been disregarded or not sufficiently considered. To assign the Euro, as a common Money, not only the simple role of exchange means, currency unit, and reserve of value, but also the difficult task of playing the role of being a Currency capable of gradually creating a more integrated and politically unified Continent was a costly dream that so far still has to prove to be effective. This was the conclusion of the Strategic Planning Team for the purpose of possible Scenario definition. Following these ideas, we considered that the economic situation, perhaps, would have been better, if different approaches had been followed in the last years, but these considerations do not affect the conclusions and are out of the scope in microeconomic terms of this work and the conceptual elements gathered were considered sufficient to procede.

3. A BRIEF ANALYSIS OF THE ENVIRONMENT

Based on the considerations of the previous session, and other related subjects, not reported so as not to make the paper a dull read, three possible scenarios have been imagined for the next years to come:

Scenario A

° *During 2013-2014 the political conditions to eliminate the spread between sovereign debts in the Euro area, do not become a reality. Italy continues to remain in the same situation as today.*

° *Credit to Companies stays blocked and only occasional (uncontrollable) credit windows may open up, but followed by sudden stops afterwards. Opportunist Companies with good financial ratings and technical dialogue with the Banking system may take advantage of it.*

° *Consumption continue to remain stagnant and gap dynamics between staple goods and branded specialty goods increase. Distribution Companies must develop a more precise identity policy to satisfy people living in diverging economic conditions, while on average, there is a tendential decrease in purchasing power.*

° *Medium sized firms/companies may collapse. Small flexible and opportunist ones emerge, as well as structures making proper aggregations.*

° *Structures making aggregations and capable of qualifying their business model may eliminate medium sized companies financially inadequate if dimension and economies of scale become relevant.*

° *During 2015 the critical Euro economy situation continues. Innovative consumer goods distribution companies in Italy or that are capable of aggregation may remain in business independently, but will look for partners and international finance to escape or to find alternatives from what might become an economic ghetto.*

The *scenario* reported above could be the so called *Worst Probable Scenario*, with weak growth and limited possibilities for economic expansion.

Scenario B

° *During 2013, due to the impossibility of political solutions, Italy, after a time period of uncertainty, pushed by social problems, plans to come back to the Lira, as its National currency.*

° *The Currency shock generates a negative economic effect, difficult to be forecasted univocally, but that might be counterbalanced by the will to build new activities after a crisis period (like after a war). Growth could be favoured by an initial inflationary situation (30%?) that might be reasonably expected, but that would be deeply dependent also upon the Euro collapse governmental plans and handling of eventual international agreements.*

° *Companies must be flexible but would also be keen to open new debts and invest in high return activities, possibilities using the new monetary tools made available by the Country and keeping reserves made of strong foreign activities whenever possible as back up.*

° *The growth rate, initially difficult, might rapidly evolve to the range of two digits, as a reaction to inflationary shock and the natural economic tendency to return to new growth after a deep crisis period. Anyhow it is reasonable to expect a lag period before the return to growth and the economy to be stagnant for a technical period that might exceed a three year span.*

In Strategic Planning terms we could define it as *Intermediate but risky Scenario*, because it would envisage limited expansion room for companies in the very short term, with new significant perspectives of expansion reasonably starting only after the considered planning period e.g. 2016.

Scenario C

° *Germany and the other strong economies agree on the political and technical means to prevent the Spread effect on Eurozone sovereign debt. The price to pay could lead to significant transfer of the residual National sovereignty, essentially in the fiscal area.*

The Banks credit mechanism to Italian Companies might begin to work again, but general fiscal difficulties overloading the Country would remain excessive to allow for autonomous recovery.

° *Gradually the strong economies may obtain the control of less efficient organizations through their companies. These acquisitions might be selective and Italian companies would only remain so by improving their standards of competitiveness.*

° *Consumption does not decrease further, but does not increase either, if the country system does not innovate itself rapidly. This stagnation might be gradually mitigated by the ability of the Country to export and improve the Balance of Payments.*

It could be the so called *Best but less probable Scenario*, for what concerns Italy. We would pay strongly for the period after '68, i.e. almost 50 years of progressive disqualification, both cultural and educational, especially heavy in some areas affecting the economy. We, for sure, have some cultural excellence, but the average current level, has decreased significantly in recent years. A strong ability to react by the Italian people would be necessary. This cultural and behavioural upgrade must be considered as a really achievable goal in our country but it would probably take a 10-year period to bring it to reality and to rebalance economic gaps. As matter of fact Italy needs to consider "anyhow" the latter as an obliged task to achieve a safer and wealthier economic future because emerging economies and particularly the Asian ones are raising the level to which to tend to be competitive referring to these aspects further. In addition, without the improper spread burden, the general competitivity of our Continent could be improved as the Eurozone could finally begin to work for the member countries as an actual and worldwide significant "optimal currency area" as it was intended to be: a geographical region in which it would maximize economic efficiency to share a single currency. The compromises are difficult but as *Giuseppe Guarino* [11] says, there are too many interests that make it difficult to cancel the Euro venture and even if *Paolo Savona* [9], fundamentally suggests as technically preferable for Italy to abandon the Euro and to return rapidly to a national currency, he recognizes the role that could be played by this complex factor to lead to an evolution of the agreements, capable of making the Euro a better monetary tool.

4. STRATEGIC GUIDELINES FOR *OH S. p. A.*

We will describe, in this session, the strategic guidelines suggested to our Company, related to the three different scenarios presented above.

Scenario A (*the most probable*)

° To be a company that makes aggregations, but with a precise constraint as internal strategic covenant: Net Financial Debt/ EBIDTA< 2,5 where **EBITDA** stands for *Earnings Before Interest, Taxes, Depreciation and Amortization.*

° In this context the capability of generating monetary *cash flow* is of strategic importance. The monetary *cash flow* also becomes a *key performance indicator* to prevent treasury problems.

° It is assumed that the medium term indebtment capacity cannot be precisely planned in a situation where short term Central and therefore Interbank rates are kept lower than the rate of inflation. We must assume that a longer term financial risk should be evaluated on the amount of structural floating rate debt carried on.

° Without bank finance, the company must be able to plan and rely on its own resources, cash flow synergies and capability to generate value.

Scenario B (*Medium probable, risky, full of threats and opportunities*)

° The *key strategic Indicator* becomes, in this case, operating flexibility and realization velocity in aggregation processes and, above all, the ability to take opportunities, not only in the national environment. The vital threats in this scenario could be not only in the way one operates, but also in lost opportunities.

Scenario C (*scarcely probable, but more favorable at level of company risk*)

° A good financial rating, a good company reputation and good business relations, not only in Italy, but also throughout Europe and World will be necessary.

A common characteristic of all the scenarios considered is to rely, above all, on the value, coming from an intelligent use of resources. To this purpose the scientific methodology must be assumed as the benchmark to refer to constantly.

Keeping in mind this basic idea, and for this reason, a strategic guideline, in absolute terms, must be the *exploitation of the Centro Studi* [12], that, founded some years ago, must become more and more the pivot, around which to build future know-how. In a time period where financial resources are scarce, the choice to invest in intelligence could result in the most intelligent strategy.

In *OH* Group investment has taken place since 2005, but since 2008 a well planned activities management project has started. One of the initial activities was the recruitment of qualified resources; then,the deployment of activities can be distinguished in three periods

2005 - 2008: *the processes were studied and main control tools identified and designed*
2009 - 2011: *a number of tools were introduced and the culture diffused*
2012 – *on going: some key applied research projects have been started*

The aim of the *applied research projects* is to obtain a number of solutions to optimize the value chain, by operating in a proper way in the different conditions we will encounter.

We suggest something in line with a recent observation of the *U.K.* Prime Minister Cameron to *OH S. p. A.* who, in a meeting held in Davos [13], expressed some doubts on the real will and convenience of the United Kingdom to continue to be part of the European Community, for a basic reason, that he expressed in this way: *Europe is being outcompeted, out-invested, out-innovated. And it is time to make the European Union an engine for growth, not a source of cost for business*

By means of the *Centro Studi*, even a medium sized Company, like *OH S. p. A.* can generate growth with its own resources, using relatively low price methodologies, that require the use of the scientific methods and a proper organization, i.e. with a well organized research approach which, today, in Italy, no appreciable investments have been made .

We have been convinced by some outstanding results, already achieved in this organization, that the importance of innovation increases a lot during crisis time periods, contrary to current opinion, that, otherwise, considers to be a luxury.

Some time ago, one of the authors of this paper was delivering a lesson on the regression technique. As an example of application and to explain the effect of an independent variable (*advertising investment*) on the dependent variable (*sales*), he presented some real data on a certain product, sold by a Company. He showed the graph reported in figure 1.

One of the Company top managers, after deep reflection, said: I believe that the things are just the opposite of what you are saying; the truth is that if we increase sales, we obtain money to invest in advertising.

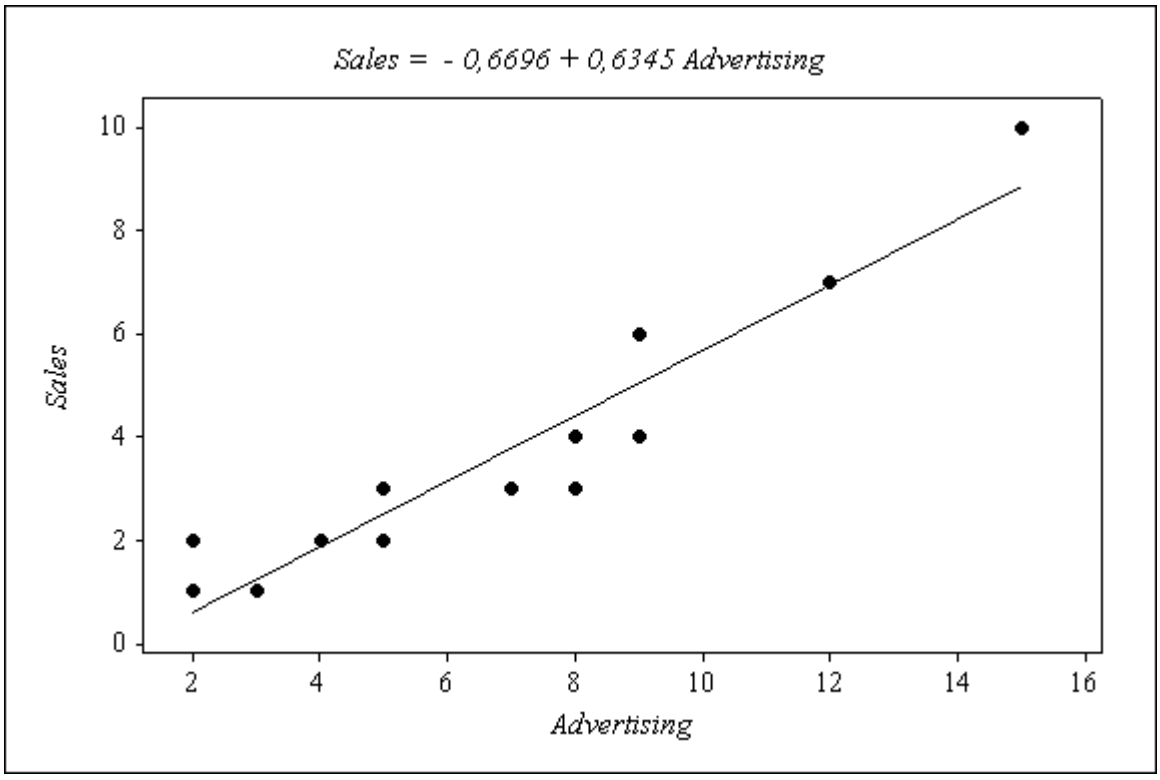

Fig.1: Data show that sales increase with the increase of advertising.

Coming back to applied research, the same thing seems to happen in Italy; if one is good at his job, he will have , few resources to be spent also in research as recognition!

We suggest that *OH S. p. A.* uses applied research as an independent variable, to affect the final results and not vice versa.

Further, we have been convinced by facts, that even with few people, well assembled and well oriented to a unique purpose, brain energy is not cumulative but multiplicative.

We also propose that they give a title to these actions, like *Global Process Development*, meaning that everything has to be developed in a finalized way, using all the tools and methodologies considered to be the most appropriate to the situation under study.

5. ANALYSIS OF THE CLASSICAL INNOVATION TRANSFER PROCESS IN A COMPANY; AN ANALOGICAL MODEL

Once decided that the *Centro Studi* must be an important component of the strategic guidelines of *O.H. S. p. A*, for the reasons outlined in the previous session, that can be further synthesized, saying that an Applied Research organization is necessary, where there are problems or where one would like to improve its performance, we want now to give some insight into how research should be done in an industrial environment, in order to achieve the best possible results.

The analysis started by analyzing a great number of industrial cases, determining some common basis, and reaching a preliminary conclusion: innovative Companies, or even the departments in a same innovative Company, can be clustered essentially, into two basic categories:

Category ***SID***
Successfully **I**nnovative, with some **D**ifficulties in standardizing the results obtained
Category ***SIE***
Successful **I**nnovative, where standardizing the results obtained is **E**asy

In order to understand the reason for this difference, attention has been paid to the peculiarity of a generic process, starting from a proposition of *Henry Poincare* (1854 – 1912), who said:

Because we cannot give a general definition of Energy, the principle of conservation of Energy simply means that something is in place that remains constant (in every physical process). Well, whatever the information of future experiments will be, we know in advance that something will remain constant and that we can call Energy.

Assuming that an *innovation process* is a process, that must be governed, after all, by the same principle illustrated by *Poincare*, we have concentrated our attention on the *energetic aspects* of a process, in general, and because these aspects have been deeply treated in the theory of thermodynamics, mainly in those processes transforming heat in mechanical work, we have thought it worthwhile to study those processes in depth, to take useful suggestions from them, and apply the results obtained there to our case.

All the formulae used below are reported in appendix 2.

To establish a sound analogy, we started from figure 2, where mechanical work is generated by the expansion of a gas, in two different conditions. In the condition a) the gas expands slowly at the same temperature, maintained by a heat source; in the case b) the gas expands, starting from temperature *T*, but it isolated during expansion.

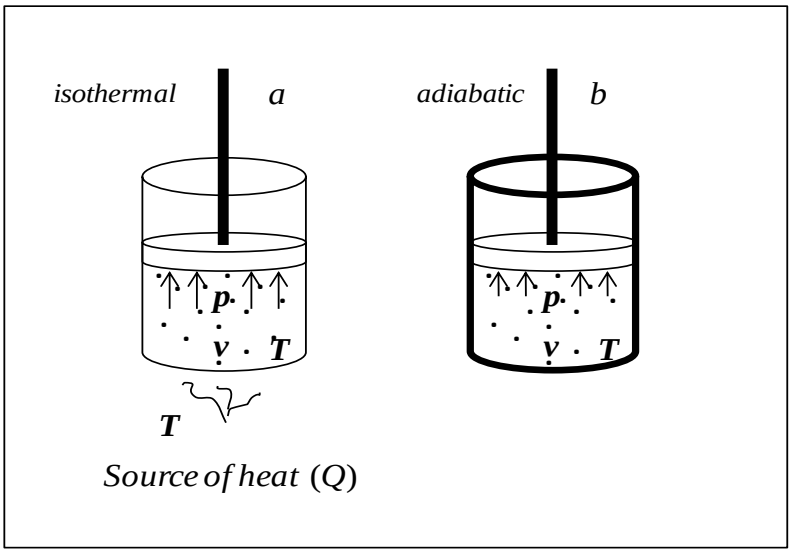

Fig.2: The gas in the vessels, when expanding, generates mechanical work

The gas in the vessel has an internal energy, say *U*. When a quantity of heat *Q* is applied to the gas, it expands and makes mechanical work, say *W*. The first thermodynamic principle establishes that, in general:

$$dU = dQ - dW \qquad (1)$$

that means: an infinitesimal quantity of heat dQ transferred to a system is used by the system, to make work, if it is possible, plus to increase its internal energy.

If the system indicated in figure 2 is correct , and we suppose that the expansion is occurring very slowly, we know that:

case a) the gas remains at the same temperature, during expansion, due to the effect of the heat coming from the source at the same temperature. It starts from a volume V_1 and arrives at a volume V_2; consequently, the pressure, according to the law of perfect gases, changes during expansion in such a way, to satisfy, the equation: $pv = constant$ in every status. Hence, according to the equation (1), because $dU = 0$, we can write:

$$dQ = dW$$

and during expansion from volume V_1 to volume V_2, the following equation does hold:

$$Q = W = \int_{V_1}^{V_2} pdv = \int_{V_1}^{V_2} \frac{nRT}{v} dv = nRT ln\left(\frac{V_2}{V_1}\right)$$

being $n,\ R$, respectively, the numbers of moles of gas in the vessel and the universal gas constant.

case b) the transformation is called adiabatic expansion, and no heat exchange occurs, during expansion. In this case the temperature decreases during the gas expansion, and, according to the equation (1) the obtainable work is given by the formula:

$$W = -U = \int_{V_1}^{V_2} pdv = \frac{p_1 V_1}{\gamma - 1}\left[1 - \left(\frac{V_2}{V_1}\right)^{1-\gamma}\right]$$

where γ is the ratio between specific heats, $c_p,\ c_v$.

Total mechanical work produced by a system, that starts in the way *a*) and continues according to the way *b*), is given by the area under the curves of figure 3.

For example, expansion of a mole of a diatomic gas, maintained at a fixed temperature of 0°C, (273° K), from 3 liters to 10 liters, isothermally, and from 10 liters to 15 liters adiabatically, will generate total mechanical work, given by:

$$W = 8{,}31 \cdot 273 \cdot ln\left(\frac{10}{3}\right) + ((226863 \cdot 0{,}01)/0{,}4) \cdot \left[1 - \left(\frac{0{,}015}{0{,}010}\right)^{-0{,}4}\right] = 2{,}73 \cdot 10^3 + 0{,}85 \cdot 10^3$$
$$= 3{,}58 \cdot 10^3\ [Joule]$$

obtained by inserting the proper numbers into the formulae of the works, given above, and keeping in mind that:

$$p_2 = 226.863\ [N/m^2],\ v_2 = 0{,}01[m^3], v_3 = 0{,}015\ [m^3], 1-\gamma = -0{,}4$$

(the value of p_2 comes from the equation $pv = nRT$ and - 0,4 from the hypothesis of a diatomic gas, being in this case, $\gamma = 7/5$).

Having said these things, we can assume that an innovation process in a Company behaves in the same way; in fact:

A person or a group of people provide a solution for a problem or an idea for an improvement (*heat source at temperature T)*; a group of people absorb this energy, to apply the solution (*the gas into the vessel*) and generate application (*work from gas expansion)*.

In general, this work is obtained, in the first phase, in conjunction with the people that provided the solution; in this way the energetic level of these people is maintained at a constant level, (*temperature in an isothermal transformation)*, and in the second phase by these people while working alone (*adiabatic transformation)*. In this second phase, the work generally is accompanied by decreasing internal energy, because people start to forget the rationale of a solution, (*temperature decreases);* the solution is applied in practice; the amount the solution is really applied is not completely deployed (*total mechanical work given by the area under the* transformation curves).

Graphically, the situation reproduces figure 3.

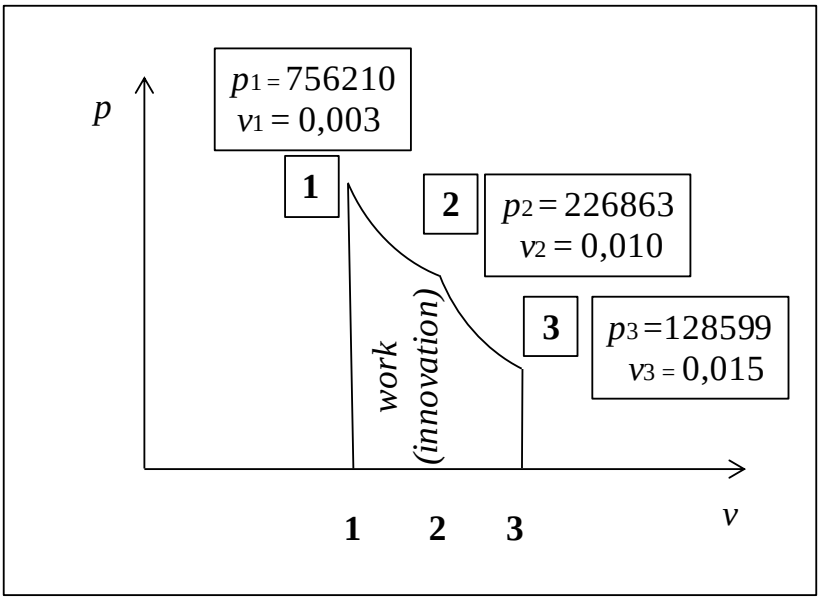

Fig.3: The area under the curves is the amount of mechanical work from a system operating from 1 to 2 isothermally and from 2 to 3 adiabatically

Some considerations, coming from these analyses:

1) Obtainable work is proportional to heat source temperature (*level of research*)

2) The process of transferring solutions into practice gives results, always worse than those obtainable, if they were applied directly from the heat source, without any intermediate gas (*directly from research, without other people*)

3) Active work (*the part of the solution that is really implemented*) is less than that obtainable with a unique isothermal transformation (*working with the originator of a solution until complete transfer into practice)*

4) Active work changes with the type of gas used (*the part of a solution really implemented depends on the level of people*)

5) Pressure decays while increasing volume, at a different rate, in the two parts of expansion, isothermal and adiabatic (*people's motivation* (pressure), *while transferring the results to operating people* (volume) *decreases during this task*, for two reasons, 1) *because they are not fully able to understand the rationale of the proposed solution*, and 2) *because they start to forget the know – how transferred to them in the first phase)*

.

All these considerations can be summarized by means of a unique function, say *E*, called *Enthalpy*, that indicates the energy that can be exchanged by a system with the environment.

Its formal definition is:

$$E = U + pV$$

where *U* is the internal energy of a system and *p* and *V* are the pressure and volume in which the system operates.

This equation, with reference to our vessels, says that the *Enthalpy* of this system equates the internal energy of the system plus the pressure within the vessel containing the gas. Hence, the *Enthalpy* variation of a system, during a transformation, may be an indicator of the attitude of the system to maintain the ability to exchange energy after transformation.

Let us continue examining the transformation taking place in our vessel, when a first phase is isothermal and a second one is adiabatic, in a sequence. We can write the *Enthalpy* values in each status:

$$E_1 = U_1 + p_1 v_1$$

$$E_2 = U_2 + p_2 v_2$$

$$E_3 = U_3 + p_3 v_3$$

and make the difference $E_3 - E_1$. We obtain:

$$E_3 - E_1 = (E_3 - E_2) + (E_2 - E_1)$$

that, because $(E_2 - E_1) = 0$, gives:

$$E_3 - E_1 = -340\ Joule$$

Being:

the Enthalpy at the end of a transformation process is ?the energy transferable by the system, to the environment

this last equation says that at the end of this process, the attitude to transfer energy has decayed by about 10%.

At this point the process is not ended. We will re-examine it, now, in a more complete form. Let us consider, to this purpose, and again, the actors and its evolution.

The actors are:

Top Management - **0**
Applied research people (*Heat source*, Q_1, at T_1 temperature) - **1**
Process Engineering people (*Fluid in the vessel*) - **2**
Production (in a late sense) people (*Volume of vessel*) - **3**
The process evolves as follows:

In a first phase **1** transfers to **3**, working together to **2**, high level *know – how* (Q_1, *isothermally, temperature* T_1); the motivation of **2** decreases a bit during this process (*pressure decays*); in a second phase **2** *(the fluid)* works alone to involve **3** *(volume)* in applying the solution, starting to produce effects (*adiabatic transformation, motivation decays rapidly)*; in a third phase **3** starts to come back to the previous operating procedures, wasting know – how (Q_2 wasted at lower temperature (know – how), while **2** tries to resist , increasing motivation; until a fourth phase, where the motivation increases more and more, thinking about new projects; this behavior increase the contraction of **3**.

Which is the final result? What has been the role of top management ?

The final result is that, when the innovation has been transferred, even with a loss of enthalpy, as described above, the situation can worsen additionally, because the operating people tend to return to the initial equilibrium status.

Hence, learning from the behavior of the *Carnot* thermodynamic cycle shown in figure 4, that, in terms of process yield, provides us with the equation:

$$innovation\ yield = 1 - \frac{T_1}{T_2}$$

we can conclude that the final results depend on the ratio of the know – how levels between research and production people, and that a significant part of the energy, put into the system by research people, is inevitably lost.

What is the lesson learned?

That an innovation process, in order to be efficient, requires many activities, after the theoretical results of research have been obtained. The internal organization, the top management – **0** support, as well as the attitude of process people themselves , can change the situation dramatically. In any case, it is impossible to obtain a 100% yield in a classical organizational model.

We have described a situation and found a basic principle, based on the observation of very numerous situations really experienced in the industrial environment, following the same logical path of that followed by physicists, when they established the thermo dynamic principles.

6. ANALYSIS OF THE INNOVATION TRANSFER PROCESS IN A SIX SIGMA ENVIRONMENT; AN ANALOGICAL MODEL

The *Six Sigma* methodology [14] dramatically changes the situation illustrated above. This system, in fact, staying on the thermodynamics analogy, is designed in such a way to obtain an isobaric transformation, like that reported in figure 5.

We can illustrate such a process, before explaining the analogy.

Defining:

$W = active\ work$
$Q_{isobaric} = heat\ transfered\ into\ the\ system$
$U = internal\ energy\ of\ the\ system$
$c_p = specific\ heat\ at\ constant\ pressure$
$R = universal\ constant\ of\ gases$

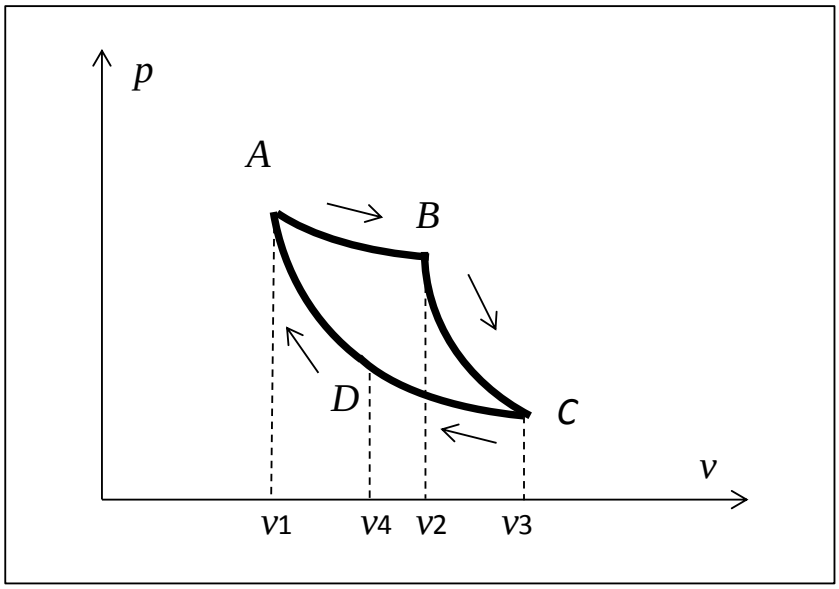

Fig.4: A classical innovation transfer process is similar to a Carnot thermodynamic cycle. The yield depends on the ratio between the levels of applied research to that of production people

one can write:

$$Q_{isobaric} = \frac{c_p W}{R} = \frac{\frac{7}{2}RW}{R} = \frac{7}{2}p(V_2 - V_1) = 3{,}5 \cdot 756210 \cdot (0{,}015 - 0{,}003) = 31760\ J$$

$$W = 756210 \cdot (0{,}015 - 0{,}003) = 9074J$$

$$\Delta U = Q - W = 31760 - 9074 = 22686J$$

If we now compare, , the two situations in figures 3 (*transfer of research results into practice, according to standard Company behavior*) and 5 (*transfer of research results into practice, according to Six Sigma methodology*), we can summarize the results in figure 6: (the numbers in this figure are clearly indicative, and can be used for comparing two different situations).

Once anticipated that the *Six Sigma* approach can provide us with more useful final results, we must give some justifications of this proposition.

Then, why would the *Six Sigma* system permit an innovation transferring process, corresponding to an isobaric transformation?

Really, it depends on the philosophy on which the system is built, that has completely changed the approach to the improvement, as we can realize, also with the help of figure 7.

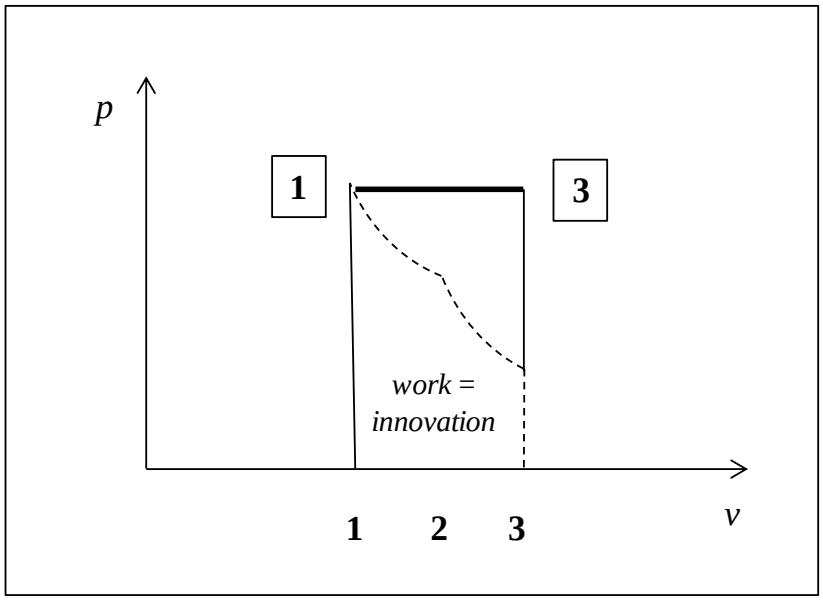

Fig.5: Transformation at constant pressure. To accomplish the work, more heat than that required by a isothermal is required. In this case, 3970 versus 919 Joule. The internal Energy increases by 1789 joule ($\Delta U = (Q - W) = 3970 - 2181$)

Methodology for transfering the results of the research into practice	*Requested energy*	*Results deployment*	*Enthalpy variation*
Standard	*2731*	*3580*	*-340*
Six Sigma	*31760*	*9074*	*+ 22686*

Fig.6: Comparison among the main indicators of the process of transferring the results of a research into practice, with two methodologies

Looking at the steps of figure 7, related to the classical organization, one can understand the reasons for decay. The decay of the implementation level of the solutions provided by the research people, as well as a partial return to the initial situation, are almost inevitable. The scarce involvement of the management worsens the result of the entire process further.

The situation belonging to the *Six Sigma* approach is completely different. Here, the management forces the objective, empower people towards the objective, ask people, not only to prove that they have reached the objective, but also that, once reached, the process will stay on the new conditions with time.

In terms of thermodynamic analogy, the process evolves like an isobaric process, because the motivation level of all the involved people is forced to remain constant from the beginning to the

end. The quality of the result depends, as in the case of thermodynamics, only on the level of applied research.

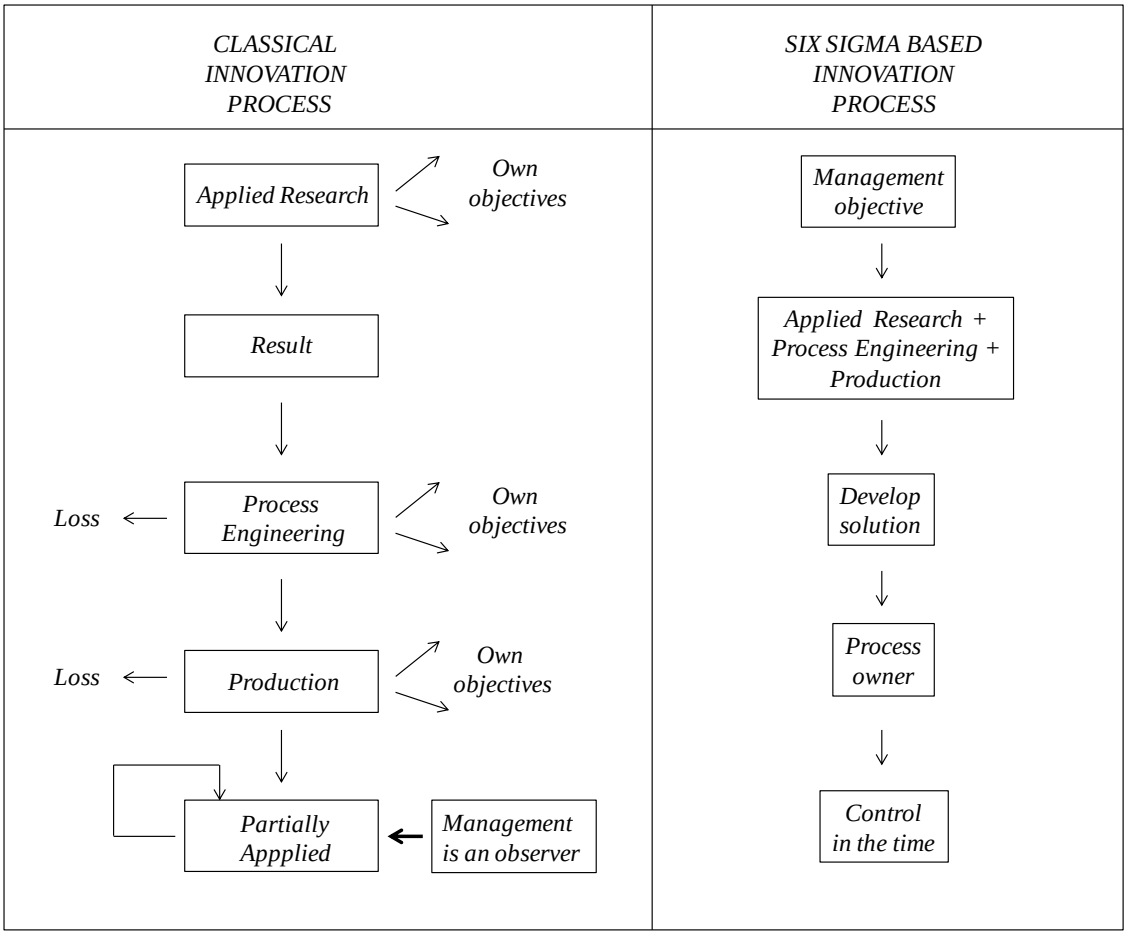

Fig.7: Comparison between a classic and a Six Sigma based innovation process

7. MICROECONOMIC CONSIDERATIONS

This work has been an attempt to provide the Company to which we refer, with some guidelines, that are useful to define the best strategic behavior for the next 3 years. To this purpose we have, firstly, analyzed the economic and financial environment in which all Italian companies are operating today, obtaining, in conclusion, three possible scenarios, with an estimate of occurrence probability, for each of which a specific behavior is suggested to the Company.

In spite of uncertainty, deriving by the fact that, after all, we do not know, at the moment, which one will occur, a basic behavior, common to all scenarios, has been identified; it consists in strengthening the applied research organization of the company, that is has been in place for a few years, but that could be a powerful response to the different scenarios, if sufficiently empowered.

Once this principle was established, we studied the most useful way to make research, and reached the conclusion that a *Six Sigma* approach would be the best solution, in an industrial environment; this conclusion was reached, in a sense, indirectly, through 5 steps.

In a *first step*, we analyzed hundreds of case histories about the process of transferring research results into practice, and arrived at the conclusion that they can clustered in two categories; those, where the results of research are applied only partially and usually for a limited period of time and those, really in a more limited amount, where implementation is complete;

In a *second step* we analyzed the thermodynamic processes of heat transformation into mechanical work, and recalled the different aspects;

In a *third step* we built an analogical model between the two kinds of processes;

In a *forth step* we analyzed the conditions that optimize the yield in thermodynamics;

and, finally

In a *fifth step*, we derived from these conditions, through the analogical model, similar conditions in our case, arriving to the conclusion that a *Six Sigma* based approach corresponds to an isobaric transformation, that is able to provide a great amount of usable energy, that, in our case, means a high level of implementation of research results. This brings to a high probability of increasing the economic value generated with a relevant very acceptable financial risk on Company resources allocated to research and, more generally, innovation properly managed and controlled.

8. CONCLUSIVE EXTENSION OF THESE CONCEPTS TO HELP TO ACHIEVE MACROECONOMIC GROWTH

We feel that all the consideration we have done so far, could be applied, in a sense, also to the macro economy. We may be in condition to treat this subject in a future paper in more depth. For now, we point out some general possible guidelines. The processes from which we start are those related to money management, balance of payments and related subjects, like effects of Euro agreements and Italian debt. These effects are in fact the ones that we considered affected our own original field of Planning and Microeconomic interest more.

Even if at this stage of the development of the work idea, we consider that it would be interesting to examine possible Macroeconomic extensions of the concepts we have brought forward, with application to our Microeconomic environment and strategic planning, we do not forget that our expertise is not specific. Anyhow, Micro and Macro Economy are two sides of the same coin and, at the end the day, Economy is one comprehensive entity.

According to The American Heritage Dictionary the generic definition of Economy is quoted as *the careful, or thrifty management of resources*. The dynamics of exchange factors and therefore Supply and Demand are the classic ones associated to possible Growth of an Economy and therefore leading the Consumer Goods market trend, the one that we are interested in specifically to forecast, in relation to the company. Recalling *Samuelson's* analogy then [4], we have carried out specific studies, for internal use, that in our vision has brought us to a more clear path of decision making , and possibly, to a more extended matter of quantitative analysis using these concepts.

As a result, we consider that also qualitative concepts concerning *animal spirits* influence, outlined by *Keines* and *Akerlof* , may find a way to achieve and define quantitative functions on this thermodynamic path of analogy. In fact, from our findings, it has become clear that if we do not add motivation to the people we have not sufficient Enthalpy or "attitude to exchange energy". Economy is based on exchanges and the Value Creation Process cannot be taken and defined only on *hard concepts* basis, we should start thinking also of *soft* ones: of a psychological nature[15]. It is a true factor in the Strategic Planning of Human Resources, it is a definite problem in the allocation of entrepreneurial financial resources and risk evaluation.

Behavioural finance tries to explain why market participants make systematic errors. From the bibliographic material connected to Thesis preparation, supported by the Centro Studi , we had the chance to consider a paper [16] and to make it in relation to our company treasury decision process. Also in this case, we considered that overconfidence and overestimation are *soft* factors that need to be considered.

The *soft part* of Value Creation Processes, the ones that in our opinion would complete the *Economic Thermodynamic variables* picture, is something that has to do with culture, formation, information, motivation and environmental influence. In the case of the innovation process, our one treated in this paper, we have seen example factors influencing the Enthalpy variation or the

Entropy of the system itself. We consider that these findings might be generally and extensively applied.

The dramatic problem posed to the scientific work of Economists nowadays, is linked to the fact that continuous growth in a finite and globalized world, brings about pressuring problems of system change. In our view, it might be advisable also to introduce new factors to describe and analyze the increasing complexity arising in the exchange process of resources, tangible and intangibles between countries and within them.

On one hand, we must assume that tangible resources, and the so called basic ones, cannot grow up in unlimited way unless we enlarge our economic territory outside our world. On the other hand, even without considering space adventure, we should not pose limits on our capacity to innovate, generate services and intangibles with economic value. To both authors of this paper, in debted for their Managerial training to a Multinational Company like 3M, that has made Innovation and Quality a true element for excellence, it remains well clear that it is not only a matter of talking about the economic value of intangibles in Technology, Quality and Innovation, as was usually done decades ago**[**17] **[**18] **[**19] **[**20].

It seems now necessary, for economic purposes, to become acquainted on how to describe and evaluate also the Enthalpy and Entropy variation, being developed in the system. in which Technology, Quality and Innovation are part and determine behaviour.

The apparent complexity of introducing Enthalpy analysis in both sides of the Supply and Demand, value and money exchange dynamics, might be also considered.

However, within the scope of this work and with the aim of contributing to concepts to help to achieve Macroeconomic growth, we prefer to direct our suggestion on application of today's Eurozone and the Italian Debt problem and only to make some initial considerations on it.

Equilibrium is one of the most important concepts and situations in the study of thermodynamics. Trying to understand the equilibrium conditions taking place in the Euro crisis, we have attempted for our limited purposes, to consider the links between key aggregates of accounts of the total economy and balance of payments flows italicized **[**21] in the following equations:

GDP = C + G + I + *X–M*

(*X–M* = balance on goods and services in the balance of payments)

CAB = *X – M + NY+NCT*

GNDY = C + G + I + *CAB*

GNDY – C – G = S

S = I + *CAB*

S – I = *CAB*

S – I + NKT – NPNNA = *CAB* + *NKT–NPNNA* = NFI

(*NKT – NPNNA* = balance on the capital account of the balance of payments) and were:

C = private consumption expenditure

G = government consumption expenditure

I = gross domestic investment

S = gross saving

X = exports of goods and services

M = imports of goods and services

NY = net income from abroad

GDP = gross domestic product

GNDY = gross national disposable income

CAB = current account balance in the balance of payments

NCT = net current transfers

NKT = net capital transfers

NPNNA = net purchases of non produced, non financial assets

NFI = net foreign investment or net lending/net borrowing vis-à-vis the rest of the world

This apparently comprehensive but complex picture is actually leading to very different conclusions and arguments, on the future of the current crisis , between Economists, Central Banks, and Governments . For the limited scope in our work, the main aim was to understand in an informed way where the present situation may lead us as a Country, and therefore to derive prospective elements for Strategic Planning purposes. Anyhow, we also tried to find, within the scope of this paper, if we could understand more within these algebraically summarized quantities and mathematic expressions, looking at the picture by utilizing also a manageable Thermodynamic conceptual approach.

The allocation of debt resources and the equilibrium conditions which drive the economy, probably might be better established and managed by adding intangible variables to the picture, like the one of the latent "motivation to innovate" that we are here proving to be a significant influential factor in qualifying our action on the supply side. We have to keep in mind anyhow that it is the demand side that can tell whether the innovation is successful or not, in creating real economic value **[**15]. Therefore all our innovation decision and process is run with precise attention to the input information and subsequent feedback from the demand side. Furthermore, the Enthalpy value of resource allocation could take advantage of the six sigma approach type for defining and comparing the amount of Entropy that the economic system is accumulating compared to other ones, investing the similar amount of resources. The number and relevance of the intellectual property belonging to a Nation and its development, is not perceivable in this data, while at Microeconomic, Company level, this factor is becoming more and more a key factor to be explained and represented in the Balance of Payments, together with elements pertaining to the quality of the relation maintained with the territory and environment.

We also noticed that the statistical discrepancies, otherwise known as errors and omissions, in the Balance of Payments, are a possible source of significant information.

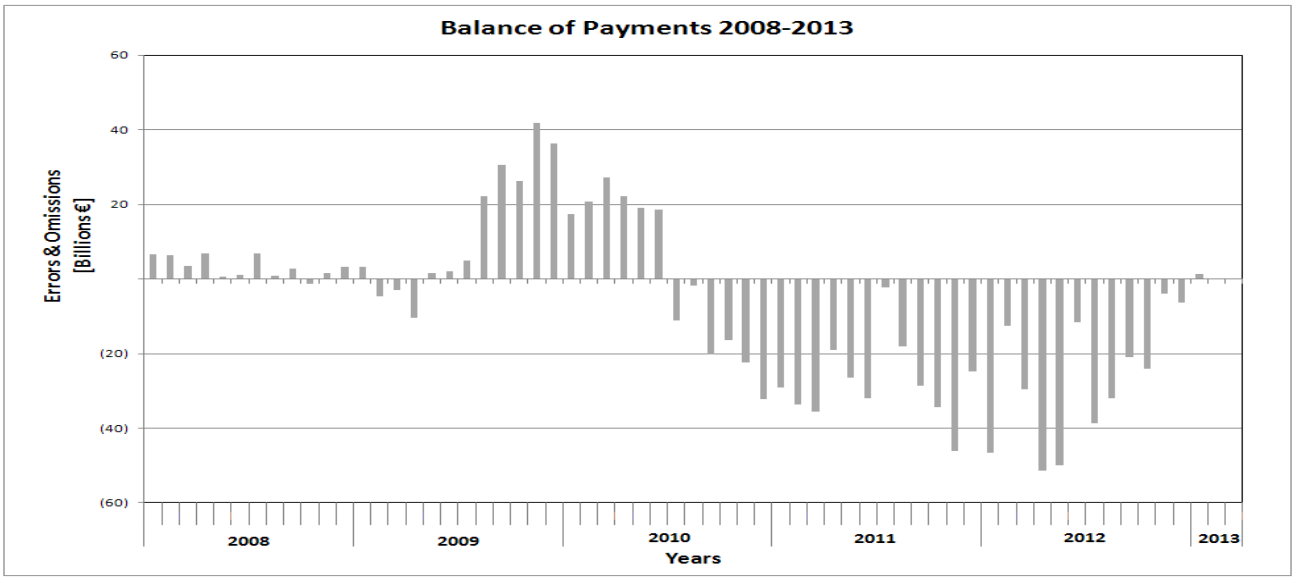

Fig.8: Pattern assumed by the Errors & Omissions reported in the Balance of Payments of Italy, Trailing Twelve Months (TTM) data [22]

At first glance the pattern is clearly not of random and systematic error origin. We have seen anyhow that the usually accepted and simple way to look at these discrepancies leads to their omission and to write :

$$CAB + (TNK - NPNNA) = -CF$$ where : CF = Financial Account balance

The picture is complex and we do not wish to enter into specific detail but from previous considerations made so far we deem that it might be a good idea to explore a function to take in account the soft elements that enter into, balancing item errors and omissions. So far the elements examined are considered mainly financial technical elements like international financial adjustment elements, e.g. rate of exchange but are not studying or defining factors like confidence, motivation, information, that are considered part of the *Economic Thermodynamic variables* to be considered in the value creation process, specifically in the case of innovation, and that we are outlining in our paper analogy.

Without going into figures and only to mention the elements from their remarkable work *L.Eyraud* and *A.Weber* **[**20] outline clearly that in the present conditions of high debt fiscal tightening makes the actual effect on Debt/GDP ratio very questionable. In reality in the three year period the reported simulations assume a negative effect that may fade away within five years.

Returning to the Balance of Payments Manual cited before and recalling *Bernanke* concepts **[**1] expressed in a comparable high Debt/GDP ratio situation, we consider that the present Eurozone system seems to lack the proper tools to evaluate the effects of economic "motivation" in Thermodynamic Equilibrium terms.

Looking from The Strategic Planning Side, we would see as a first priority problem for Italy 2013-2015, to face the Balance of Payments and not only the one of Debt/GDP ratio. The negative effect on internal demand due to fiscal Tightening does not appear on first glance, to increase the Enthalpy level of our economy.

We should leave anyhow to other more qualified and specialized economists to debate and explore the subject more in depth. We mentioned that, from our point of view, at Micro level, we suggested a Strategic Plan guideline of careful investment and innovation policy for OH SpA 2013-2015, based on this Macroeconomic info, cutting severely what is considered to be an Entropic allocation of resources. We recommended that they insist on Company Process qualification and development

and to invest in personnel qualification to achieve a sufficiently Enthalpy oriented, *Economic Thermodynamic* "motivation" factor.

Based on the requests coming from our centre-south Territory, internally defined as the *core geographic area*, the one where the Entrepreneurs and most of our People and Customers live and were born, we decided as the Centro Studi Board and with the active consent and support of OH Spa Entrepreneurs, to promote and to create in collaboration with others, a Foundation that could be a synergic factor to achieve excellence in Applied Research, for young local talent willing and capable to accept the challenges that this requires. The need of a Foundation alongside the Centro Studi is clearly explainable considering that the Centro Studi is a Private Company with precise Value Creation goals and for the benefit of the present shareholders.

The Foundation promotion would allow us to contribute free from constraints of intellectual property protection that is very often present in the Centro Studi, and to contribute to a new organization with specific goals to operate in the interests of the Territory, without posing precise boarders to this geographic concept.

We would also be very happy to bring within the scopes of the constituting Applied Research Foundation international cooperation opportunities of Economic Studies on Macroeconomic developments and particularly, we would be very happy to have the chance to support or collaborate on further findings on *Thermodynamic* concept applications, on Economic Applied Research and Studies.

APPENDIX 1

Definitions:

$n = number\ of\ moles$
$Q = transfered\ heat\ [Joule]$
$T = source\ temperature\ [°K]$
$R = constant\ of\ gases:\ 8{,}31\ [J/°K]$
$v = [m^3]$
$p = [N/m^2]$
$c_p = specific\ heat\ at\ constant\ pressure$
$c_v = specific\ heat\ at\ constant\ volume;\ c_v = \frac{3}{2}R, c_v = \frac{5}{2}R, for\ a\ gas\ monoatomic\ and\ diatomic, respectively$
$c_p - c_v = R$
$\gamma = \frac{c_p}{c_v}$
$U = internal\ energy = \frac{3}{2} \cdot n \cdot R \cdot T\ [J]$
$E = U + pv\ [J]$
$W = mechanical\ work\ [J]$

$1^{th}\ principle:\ dU = dQ - dW$
$2^{nd}\ principle: if\ T_2 < T_1, then\ heat\ cannotbe\ transfered\ from\ source\ 2\ to\ source\ 1$

MECHANICAL WORK

Isothermal transformation

$$W = nRTln\frac{v_2}{v_1}$$

Adiabatic transformation

$$W = \frac{p_1 v_1}{\gamma - 1}\left[1 - \left(\frac{v_2}{v_1}\right)^{1-\gamma}\right]$$

Isobaric transformation

$$W = p(v_2 - v_1)$$

Carnot cycle

$$W = nRT_1 ln\frac{v_2}{v_1} + nRT_2 ln\frac{v_4}{v_3}$$

(*see figure* 4)

HEAT FROM THE SOURCE

Isothermal transformation

$$Q = nRT ln\frac{v_2}{v_1}$$

Adiabatic transformation

$$Q = 0$$

Isobaric transformation

$$Q = c_p p(v_2 - v_1)/R$$

Carnot cycle

$$Q = nRT_1 ln\frac{v_2}{v_1}$$

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