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THE ANALYSIS AND MODELING OF THE PROFITABILITY FEEDBACK PROCESS – A DYNAMIC MODEL ON PORTUGAL'S NATIONAL ECONOMY

Bianca-Ioana Popescu
Corresponding Author: The Bucharest University of Economic Studies, Romania.
Email: bianca.popescu@gmail.com

Emil Scarlat
The Bucharest University of Economic Studies, Romania. Email: emil_scarlat@csie.ase.ro

Abstract

The aim of the present paper is to underline the influence of the profitability process at macroeconomic level will exert on real economy. Until now relevant literature has been focused on firms, banks and industries but only with the objective of comparing past profitability of the studied entity or comparison to other competitors on the market and with microfoundation calculus - profitability being calculated for a panel of firms in the studied industry. The model of the Profitability Feedback Process is capable of surprising the influences the concept of profitability will have at macroeconomic level as being considered to be one of the auto-regulation processes of a national economy. The simulations have been made on EUROSTAT's official stats of Portugal between 2005 and 2012 annual data and the simulations have revealed robust behavior of the system in relation to the profitability and the economic context and sustain the rationality of our attempt.

Keywords: Cybernetics, Dynamic Model, Feedback Process, Macroeconomy, Profitability, Regulating Process, Investment Decisions, Adjustments and Exclusions

1. Introduction

The general objective of the attempt to build an instrument capable of defining the cybernetic system of the national economy is to find means by which we can simulate the national economy as a whole. This holistic approach of the system of a national economy is considered here to come as an alternative to the neoclassical economic thinking and to offer the possibility of modeling and simulating some of the processes that take place at macroeconomic level. These models, used to capture the feedback processes, would be able to offer parametric control in rder to test and asses the influences of economic policies for macroeconomic governance. In this attempt we will take into consideration the framework in which a national economy is characterized as a complex adaptive system, ruled by its structure of interrelated feedback loops that are forming between the subsystems of the national economy, redefined as it will presented throughout the paper. Between these subsystems a series of feedback processes will be formed and until now there have been described four regulating processes at economic level (Scarlat and Chirita, 2003) between which we will find the Feedback Process of Profitability that will be defined, analyzed and modeled in the present paper.

The presented model and the theoretical framework in which we argue is based on the

real economy, having at its core the production subsystem defined as being the one aggregating each production process of the economy that functions at a specific scale. Each of these scales are considered to be determinant in regard with the quantity of inputs, work force used and even output of the considered production process. In our attempt to build a macroeconomic useful tool, we are to consider these scales at national level being a certain classification on industries, thus when translating the concept of profitability we will have to consider the specifics of the profitability as it is considered now in the specific literature. The scale economies, persistence of profit, the non-convergent ideas regarding the importance of the industry characteristics in regard with firm profitability as we will see later support the theoretical framework in which we argue and come to be the basis for which alternative ways of considering the profitability concept could be of benefit on trying to understand the functioning of a national economy.

Profitability defined as a concept and in relation with the theory of systems will define the ability of the system (i.e. economic system) to return or to generate value compared with the inputs used or relevant associated costs of the processes within the system. Based on this simple definition the model will calculate on the profitability and net profitability of each industry considered. The scales that will determine the output of each industry are in a direct relation with the net profitability - calculated on real data provided by EUROSTAT between 2005 and 2012 on Portugal's national economy, while the most important variables trough which markets are adjusting, the quantities of inventories and price will be endogenous variables evolving interrelated and dependent on the scales of production (i.e. industries on total output), thus net profitability. Built in this manner, the model permits parametric control and contra factual analysis.

2. Micro Foundations – The Basis for Macro – Complexity

Taking into account that we are working in the framework assumption that a system's behavior will be determined more by its internal structure rather than as a reaction to the environment, we will not find abnormal the fact the many studies have reported in regard with profitability that different profit rates of firms will persist even when facing similar external conditions (Jacobsen, 1988). One of the features of a complex system is that its behavior will be determined in time more by the internal structure of the feedback loops in closed boundaries rather than the external shocks (Barlas, 2009). The way the system will react to external impulses is determined in fact but its internal structure and this may be the explanation for which there are many studies on the same aspect that will reveal different results when analyzing the same concepts on different entities. Our argument is that the theory of complexity should be comprised in any attempt of understanding economic systems and processes (*i.e*. firms, banks, industries or national economies).

Industry belonging of firms was to account only for 9 percent of the difference registered between returns of the firms while the effects of the specifics of these firms has been revealed to be around 44 percent (Rumelt, 1991). Other panel data studies, following Rumelt's work have had as central finding the fact that the profitability would not be influenced on the affiliation to one or another industry rather than the effects at firm level (Powell, 1996; McGahan and Porter, 1997; Mauri and Michaels, 1998; Brush *et al.* 1999). On the other hand, taking into account the heterogeneity of the data panels, when leaving out of the study the "dominant value creators and destroyers" it has been showed that for those firms that will not be important players or on the edge of exiting the market, the industry effect will be of more importance than the firm-specific characteristics (Hawawini *et al.* 2003).

Different studies reveal different results but the importance of a research output is the knowledge the results can give if looked from different aspects. Although there will be studies that reveal that when trying to evaluate profitability the bigger system, thus the industry, has little influence, there are other to say the opposite. As we assume complexity, these results are not in fact exhaustive. Each study has made some different initial hypothesis and if taken as all being truth than our single statement on profitability would be that the concept of profitability can be applied in each layer of the economic system – from firms to industry and even a national economy and at each layer the concept will take different forms – from one simple calculus to an entire dynamic model.

Many of the studies have dealt with profitability in the micro from of it and will state that

the determinants of profitability will ultimately be size, market power, debt and liquidity (Goddard *et al*. 2005). Nevertheless, there are studies that emphasize on the fact that the environment in which the companies evolve has an important role in the behavior of profit and thus profitability (Gschwandtner, 2005). Even though we observe a non-convergence in ideas regarding the profitability of companies in regard with the industry, there are studies who reflect on the policy implications and the way in which those can have important effects on aggregate productivity, even making an emphasis on the fact that the financial system would be more efficient in allotting resources based on the companies structure and profitability (Nucci, 2005). It is then even more obvious that on trying to elucidate one problem, the studies on a certain concept or system when going in depth of the problem inevitably will find and include the links and the effect on and from the bigger systems that comprises the one in focus.

3. System Dynamics of the Profitability Process at Macroeconomic Level

In order to make a comprehensive analysis on the way the profitability process works we are to present the framework in which the cybernetic system of the real economy has been defined and explained. The redesign of the subsystems of the national economy has been made in accordance with the objective of understanding of the endogenous processes of auto-regulation that take place into the economy.

3.1. Subsystems of the Real Economy Cybernetic System

The new set of subsystems comprising the national economy, leaving aside economic sectors, have been classified and described by taking into account their functionality and each of them have been described in relation with the other systems putting this way the basis for identifying processes forming in the above layer (*i.e*. at national level). The redesign of the structure of the national economy in the cybernetic approach includes seven cybernetic subsystems, each realizing a series of functions in the national economy. These subsystems have been defined as follows: S1 – the production subsystem; S2 – the aggregated supply – aggregated demand ratio subsystem; S3 – the market of scarce resources subsystem ; S4 – the profitability subsystem; S5 – the subsystem of income formation and distribution; S6 – the subsystem of the financial market; S7 – the subsystem of the capital market (Scarlat and Chirita, 2003).

Each of these subsystems has been developed from the cybernetic systems of the economic sectors as we know them (households, public, private etc.) in relation with aggregated markets (i.e. market for goods and services, the markets for inputs, labor market etc.) by analysis of the flows that enter and leave the sectors. Between each of these relations a series of feedback loops are forming and the subsystems later presented will have in their structure feedback mechanism which are forming on one hand into the interior of the subsystem and others between the subsystems.

From this point on, a descriptive analysis can be made in order to capture the transmission effects that happen at macroeconomic level. We will not try to give a detailed description from bottom to up but rather we are focusing on the feedback processes that happen at macroeconomic level and we will give a presentation on the subsystems of the cybernetic system of the real economy which will always comprise interrelation with the other subsystems as this is an holistic approach to the system of the national economy. We are to give enough information in the attempt to make a comprehensive framework by which the model presented in this paper and the findings to be understood or put through informed questioning. The cybernetic system of the real economy puts at its core the *Production Subsystem (S1*) which comprises the concept of scales of production. That is, we consider that in a period of time, let say a year, different production process from the economy will function at different scales. The scales of production are considered to be the share that a specific process will have in the total national production. Also, the scales of production are dependent on the net profitability associated with the production processes and as the net profitability of one production process will increase the same effect will take place on the scale, thus rising for the profitable production processes and decreasing for the less profitable ones. For those processes that are yet to be innovated or discovered we are to say that their scales of production will be zero until they enter into the production sys-

tem thus decreasing the scales of other production process or even replacing the underperforming ones. Defined as such, the production subsystem is comprised by the scales of tion $S_a, S_b, \ldots$, the intermediate consumption used for each of the production processes, $X_{p1}, X_{p2}, \ldots$, the output realized by each of the process, $Y_{p1}, Y_{p2,} \ldots$, and the number of workers used for the realization of each process, $L_{p1}, L_{p2}, \ldots$. Although comprised by a series of variables, the production subsystem is important by the fact that it has as a resulting variable the total output from the economy, the aggregation of $Y_{p1}, Y_{p2,} \ldots$.

The Aggregated Supply – Aggregated Demand Ratio Subsystem (S2) is the one concerned with the general equilibrium on the Market for Goods and Services. This subsystem is formed by the fluxes that interact between the households and private sectors in relation with the market for goods and services. In the detailed description of the subsystem, beside the variables introduced to capture the relation of the later mentioned economic sectors with the market a series of auxiliary variables are introduced in order to highlight feedback loops that are forming with the other subsystems. Beside the variables comprised by S1, S2 comprises the aggregated,D, formed by the aggregation of intermediate consumption, public consumption, G, and final consumption, C. The aggregated demand will influence the auxiliary variables, the real stocks (i.e. inventories) formed into the economy,J , and the considered variable of wanted stocks , $\bar{J}$. The latter two variables will influence what we will call the excess of wanted stocks, $(\bar{J} - J)$, a signal variable by which it can be recognized a disequilibrium on the market for goods and services. For a $(\bar{J} - J) > 0$, the market will register an excess of demand while for $(\bar{J} - J) < 0$ an deficit of demand. Both situations represent a signal and will introduce transmission effects into the feedback mechanisms within the process of aggregate supply – aggregate demand equilibrium which assures the continuum of the regulating processes that take place at macroeconomic level. The subsystem comprises in its structure two interrelated feedback loops whom effects of transmission are as follows:

$$D \to \bar{J} \to (\bar{J} - J) \to S_a, S_b, \ldots \to X \to D$$
$$J \to \bar{J} \to (\bar{J} - J) \to S_a, S_b, \ldots \to Y \to J$$

Both feedback loops have the functionality of shortening the gap between the supply and demand on the market for goods and services.

The third subsystems, the *Subsystem of The Market of Scarce Resources (S3)* until now has been referred only to the specifics of the labor market and the way labor is used throughout the economy. Resources entering the production subsystem are generally treated similar to the products and services traded on the market for goods and services but these type of products are destined to be for productive consumption. This is why, in the framework of a national economy, the demand of inputs is given by all the economic sectors that have production activities (i.e. private sector, public sector and foreign sector). Assuming that the household sector owns the factors of production, the supply of inputs will be attributed largely to the households sector, public sector for resources that are publicly owned and the external sector for imported inputs in the economy. The interaction of these sectors with the markets for inputs is similar with the one described for S1 and the feedback mechanism of adjusting to equilibrium will behave as already described. The price on the market of inputs is formed in the same conditions as it is formed on the market for goods and services. Yet, this price is dependent, besides the supply and demand on the market, also by the scarcity of the traded resources.

Given the characteristics of today's global economic environment, we believe that it is important to capture some of the strategic resources of a national economy – labor, energy, capital. Labor, of course, as it has an important dependence on population growth and the educational system of a nation, it is most important in our attempt of building an integrated model of a national economy. Capital must be included in such an attempt in order to introduce effects that take place on the financial markets, even though real economy although generating the most part of the financial fluxes. Capital and energy will be taken into account only as a measure of giving a developing perspective of the idea and model presented in this paper.

The Profitability Subsystem (S4) acts as a selection mechanism in the economy. This

mechanism is linked to S2 and S3 having an influence on the aggregate supply and demand of goods and services and also to the allocative mechanism of the labor market. Production Net Profitability has influence on the intensity (scales) of the production process and through it to other production processes in the economy. This mechanism favors production processes with high net profitability, increasing their scale in relation to other processes less profitable. The profitability subsystem will be treated in a more detailed fashion later in the paper as it is the core of the subject. *The Subsystem of Income Formation and Distribution (S5),* it is the subsystem that assures the distribution of financial flows within the economy making the link between the monetary economy and the real economy (Popescu *et al.* 2015).

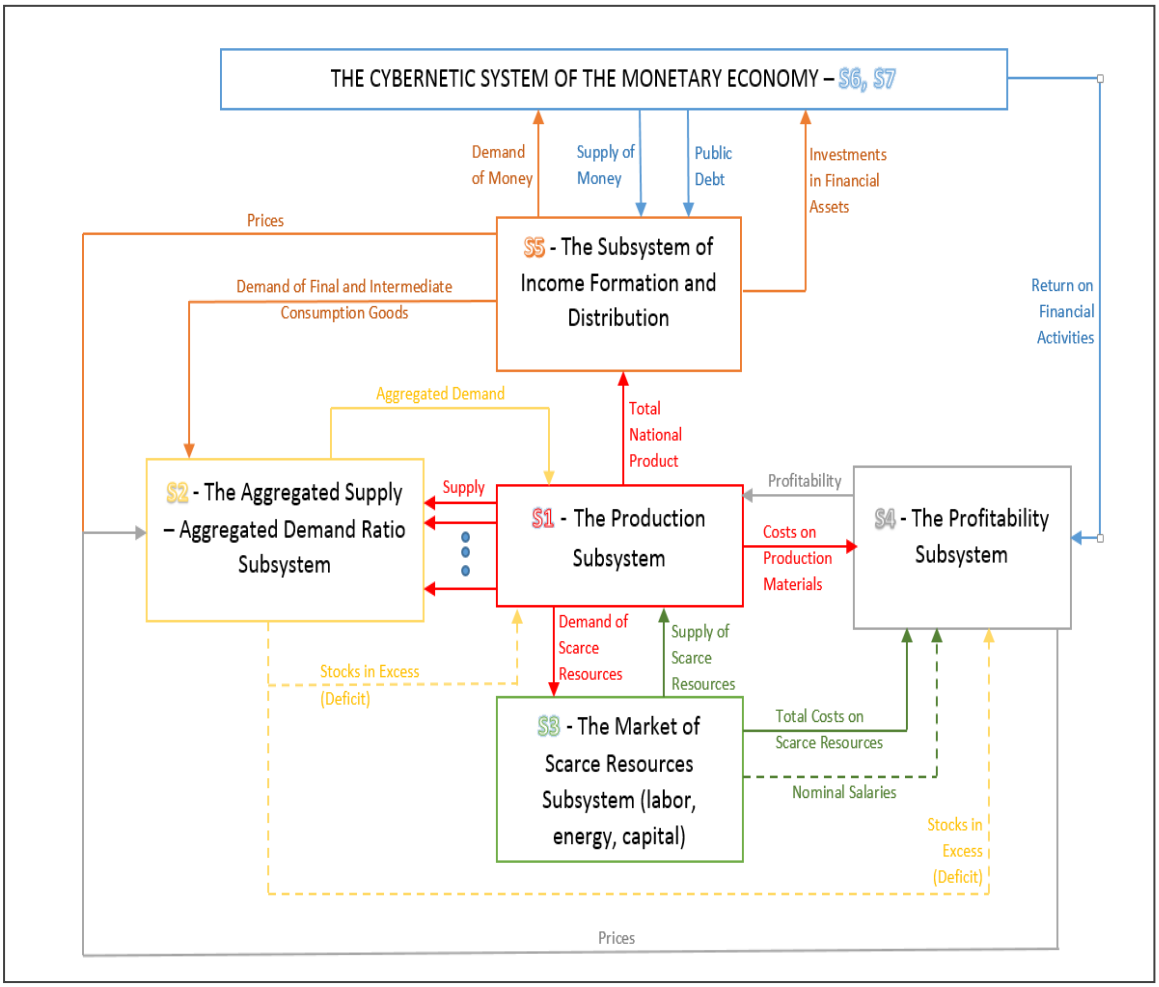

Figure 1.The Cybernetic System of the Real Economy

Figure 1 reveals the relationships that are forming between the five subsystems of the real economy and the way the subsystems are interacting by creating a series of flows between them. This approach permits the identification of feedback processes that happen at macroeconomic level. Until now, there have been identified four fundamental feedback processes. *The Feedback Process of Equilibrium Adjustment on The Market for Goods and Services*, formed between subsystems S_1, S_2, S_4, S_5, *The Feedback Process of Scarce Resources Allocation*-formed between S_2, S_4 and S_3, *The Feedback Process of Disposable Income Allocation* forming between S_1, S_2, S_4 and $S_5$and *The Feedback Process of Assuring Profitability* formed between S_1, S_2 and S_4 (Popescu *et al.* 2015).

3.2. The Profitability Subsystem – Bottom-Up Analysis

Until now it has not been taken into consideration the influence on the real economy exerted by the ratio of nominal selling prices of products on all the markets for goods and services from the economy and the nominal costs of the inputs that were used for obtaining these products. This ratio, one of the most important from economy, is defining what we call the production profitability. Let us define the profitability of the functioning of a production process at unit scale and in one point in time. The difference between the income realized by selling the output of the process and the cost of the production inputs will be the brut profit associated with the production process in focus.

One production process is able to get an output of different products and if we are to consider big data we are not farfetched in considering models that include information of market prices for each product, for each input of factor of production and the quantities on each product. Considering all these information then the brut profit obtained following the production process in one unit of time would be:

$$\pi_p(t+1) = P_{ap}(t+1)\cdot Y_{ap} + P_b(t+1)\cdot Y_{bp} + \cdots - \left[P_{ia}(t)\cdot X_{ja}(t) + P_{ib}(t)\cdot X_{jb}(t) + \cdots\right] - \left[W_{ia}(t)\cdot L_{ja}(t) + W_{ib}(t)\cdot L_{jb}(t)\right]$$

where, P_{ap}, P_{bp}, … are the market prices for the products delivered by process p; Y_{ap}, Y_{bp}, are the quantities of product a resulted from process p; X_{ja}, X_{jb}, are the intermediate products or inputs used in the process p associated with each product $a, b,$ … while P_{ia}, P_{ib}, … can be the exact prices for each X_{ja}, X_{jb}, … combination with j form 1 to n, m,… number of inputs used for product a, b,… in process p. Or for ease of implementation, P_{ia}, P_{ib}, … can be an average of the cost on inputs for each product. In an integrated database, these type of information can be taken with ease from each producer due to the accounting framework in which they report.

What is of importance to us is the fact the brut profit will take into account when determining the income the present period $t+1$ while when determining costs it will related with one period before, that is, t and the inputs will be evaluated at the market price from the t period, as well as the work force labor that will be evaluated at the rates of the nominal wages from period t. It is then important to introduce in any modeling instrument time delays between interdependent variables in order to capture the effects of price and price change.

Due to the natural gap between the realization of one product and the moment in which the selling of the product produces income value, the companies that incorporate the process of production they either cannot have the disposable liquidity for the acquisition of the necessary input factors and to pay for the work force they implied in the process or even if they have these liquidity we have to assume the fact that the choice of investing in process p has an opportunity cost and that is the interest on the deposit market. Either way, when determining the net profitability associated with the production process p we are to assume the exclusion of the real costs on the interest of the opportunity cost of the deposit interest, we will denote the interest (credit or loan) being the interest associated with the process p, i_p^* and we will consider it being an exogenous variable for the model.

We will be able then to determine the net profit associated with the process p as being:

$$\bar{\pi}_p(t+1) = P_{ap}(t+1)\cdot Y_{ap} + P_b(t+1)\cdot Y_{bp} + \cdots - \left(1+i_p^*\right)\left\{\left[P_{ia}(t)\cdot X_{ja}(t) + P_{ib}(t)\cdot X_{jb}(t) + \cdots\right] + \left[W_{ia}(t)\cdot L_{ja}(t) + W_{ib}(t)\cdot L_{jb}(t)\right]\right\}$$

It is important to mention than on aggregated analysis and implementation of a model, when determining the profitability of an industry for example it is necessary to introduce into the model the level of taxation on the specific industry taking into account the fact that economic policies can control the national economy depending on the general objective, thus encouraging the development of certain areas of importance in relation to the strategic economic develop-

ment of each country.

One important aspect of the way in which the profitability is evaluated is the fact that if we are to have specific data on the volume of the coefficients of inputs and output of one certain production process, such as the intermediate consumption, volume of work force used and the quantities on output, then the brut and also the net profitability will be dependent strictly on the ratios between the prices on the input market and the prices on the market for goods and services and on the changes registered on these prices.

Some observations can be made in regard with the dependencies of the profitability on prices. The present theory will consider state-dependent prices that will change based on the changes in the economic environment, thus in the market. As we are going to implement the model on aggregate level then we are going to imply on the stickiness of prices of going upwards and the down stickiness of wages. From the work on models of state-dependent prices we are to take into consideration that "time-dependent models have been appropriately criticized for treating the pattern of price adjustment as exogenous" (Dotsey *et al.* 1999) and this is why find support to determine price endogenously as being the resulting variable of the feedback process of profitability at macroeconomic level. In that sense, if the level of wages will be lower we will register a higher profitability and on the other hand at a given rate of nominal wages then, on average, high prices will deliver higher profitability. On aggregate level, the effects of rising prices can be annulled by the fact that even though the rise will produce high profitability on a process, the same rise can produce a decrease on the process that uses the products produced by the first process. But what is more important is that the profitability is not sole dependent on the level of prices but also by the rate on which prices change. The difference mentioned before between t and $t+1$ can determine a rise, if prices go up or a decrease, if prices go down, in profitability. It is then easily perceived that the rate of price inflation will determine higher profitability on short run. On the long run price inflation will determine also a price inflation on the inputs market and also pressures on the wages to be risen. Moreover, at these balancing effects a rise in the interest levels will be registered on credit.

4. A Dynamic Model for the Profitability Feedback Process

As argued before, when studying any economic process we are to understand we are dealing with complex adaptive systems and the best method by which we can capture nonlinear behavior over time is the method of system dynamics developed by Jay Forrester. The dynamical model associated with the Feedback Process of Assuring Profitability at macroeconomic level was implemented in STELLA 9.1.4. Modeling and Simulation Software. The software was constructed following the Jay Forrester's view on system dynamics and permits the construction of the model by defining the relationships that are forming between state variables, flows and auxiliary variables. The model benefits also by the introduction of delays. The data used for initializing the state variables were the official statistics of Portugal for year 2005. Production Scales were classified in accordance with the EUROSTAT NACE 10 classification on industries sectors for Portugal's GDP by industry.

4.1. Dynamical Ecuations and Implementation

As it can be seen in Figure 2, the considered state variables of the model are D, the aggregated demand on the market for goods and services, $Real\ Stock$, representing the level of real inventories formed within the economy at each point in time (i.e. *dt* step), the total output realized internally, Y and the $Price$, considered in the model as index and to be compared with the Consumer Price Index.

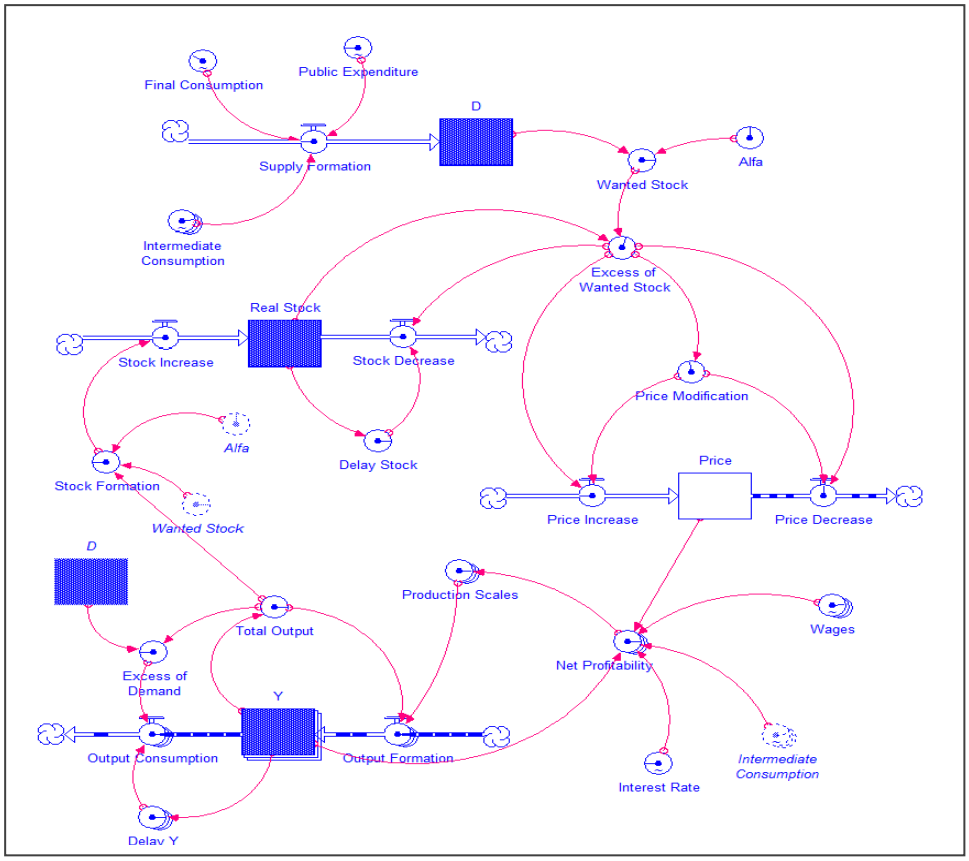

Figure 2.Stock – Flow Diagram Implemented in STELLA 9.1.4 for the Model

The equations of the model were introduced using the baseline theory presented earlier in the paper but also by implementation needs for some of the outflows. The dynamical equations are transformed by the software and use as an integration method the Euler's method as the model uses built in logical functions IF – THEN – ELSE and the method is set to be more reliable than the implemented Runge – Kutta methods.

The equations [1] to [4] represent the dynamical equations transformed by the software for the state variables and the sub points (a) represent the inflows for the state variables while (b) represents the outflows.

$$D(t) = D(t - dt) + (Demand\_Formation) * dt \quad (1)$$

$$Demand\_Formation = ARRAYSUM(Intermediate\_Consumption[*]) + Final\_Consumption + Public\_Expenditure \quad (1a)$$

$$Price(t) = Price(t - dt) + (Price\_Increase - Price\_Decrease) * dt \quad (2)$$

$$Price\_Increase = IF\ Excess\_of\_Wanted\_Stock > 0\ THEN\ Price\_Modification\ ELSE\ 0 \quad (2a)$$

$$Price\_Decrease = IF\ Excess\_of\_Wanted\_Stock < 0\ THEN\ (-Price\_Modification)\ ELSE\ 0 \quad (2b)$$

For the real inventories and for the total output we have introduced an outflow representing the level of the state variables from a previous period, a *dt* step using the built-in delay function. This was done with the assumption that if the wanted inventories of the producer

sector are higher than the actual inventories then it is fair to assume that the producers will use all the inventories formed in the previous period. The variable $Delay\_Stock$ from Equation [3b] represents the level of the inventories in the previous period, the level of the variable $Real\_Stock$ at the previous *dt* step.

The same assumption was made for the construction of the outflow for the output Y as seen in Equation [4b] where if the market registers on excess of demand then it is fair to assume that the total output from the previous period will be consumed entirely. The variable $Delay\_Y$ was calculated to be the value of Y in the previous *dt* step.

$$Real\_Stock(t) = Real\_Stock(t - dt) + (Stock\_Increase - Stock\_Decrease) * dt \quad (3)$$

$$Stock\_Increase = IF\ Stock\_Formation > 0\ THEN\ Stock\_Formation\ ELSE\ 0 \quad (3a)$$

$$Stock\_Decrease = IF\ Excess\_of\_Wanted\_Stock > 0\ THEN\ Delay\_Stock\ ELSE\ 0 \quad (3b)$$

$$Y[Output](t) = Y[Output](t - dt) + (Output\_Formation[Output] - Output\_Consumption[Output]) * dt \quad (4)$$

$$Output\_Formation[Output] = Production\_Scales[Output] * Total\_Output \quad (4a)$$

$$Output\_Consumption[Output] = IF\ Excess\_of\_\_Demand < 0\ THEN\ Delay\_Y[Output]\ ELSE\ 0 \quad (4b)$$

The equations of the auxiliary variables used in the model are Equations [5] – [8]. The production scales represent are dependent of the net profitability and they are calculated as being the share of the profitability of the considered sector of industry in the aggregated profitability. The label Output used throughout the equations of the model represents the set of the 12 industries – Agriculture, forestry and fishing, Industry, Manufacturing, Electricity and Gas, Construction, Trade and Services, IT&C, Financial and Insurance Activities, Real Estate Activities, Professional, scientific and technical activities, Public Services, Arts Entertainment and Recreation.

$$Production\_Scales[Output] = Net\_Profitability[Output]/ARRAYSUM(Net\_Profitability[*]) \quad (5)$$

$$Net\_Profitability[Output] = Price * Y[Output] - (1 + Interest\_Rate) * DELAY(Price, 1) * Intermediate\_\_Consumption[Output] - Wages[Output] \quad (6)$$

$$Price\_Modification = 0.005 * DELAY(Excess\_of\_Wanted\_Stock, 1) \quad (7)$$

$$Stock\_Formation = -(DELAY(Total\_Output, 1) - 1/Alfa * Wanted\_Stock) \quad (8)$$

The exogenous variables of the model are the$Final_Consumption$,$Intermediate\_Consumption$, $Interest\_Rate$ and $Wages$. Their values represent real data collected from the official statistics of Portugal as they are published on EUROSTAT. Each of them was introduced as graphical functions of time. The intermediate consumption and wages were introduced using the same division by industry sectors, using the Output label presented earlier.

4.2. Model Simulation and Validation

A series of simulations have been run on the model associated with the Profitability Feedback Process on Portugal's statistics from 2005 to 2011. The comparison of the behaviour of the

model with the real evolution of the state variables has led to the conclusion that the model associated with the feedback process of assuring profitability is able to produce behaviour of the net profitabilities associated with the sectors considered in accordance with the economic reality. The simulated period is comprised by the years previous to the economic crisis from 2008 and the years of recovery and we can say that the model displays a predictive behaviour in relation with the economic events from the studied period. Thus the conceptual validation of the model (Pace, 2004), lays in the fact that the simulated data underlines a predictive reaction of the net profitability of each industry, the modeled concept in the presented model being the way in which the economy assures profitability as auto-regulating process.

The calibration of the parameters was realised by multiple simulation taking into account the evolution of the endogenous variables, $Price$, Y, $Net_Profitability$and $Real\_Stock$. Simulations with different thresholds of the parameter Alfa can produce distortions in the results. The presented model and the ones associated with the other regulation feedback processes that happen at macroeconomic level are built in the manner of representing the structures of an integrated system of modeling a national economy.

This is why we are not to compare the simulated values of the state variables with the official statistics but rather focus on analysing the behaviour over time. We function under the assumption that as soon as each of the models is built and passes the conceptual validation then it is fair to proceed with their integration and seek for generating data series close to statistical data. Nevertheless, the model has shown predictive behavior by using the parameters estimated for Portugal in the same period that were used in the simulation of the model associated with the Feedback Process of Formation and Allocation of Disposable Income run in the aggregated accounts of Portugal between 2005 and 2012 (Popescu *et al.* 2015).

5. Conclusion

In each of the simulated cases the behavior displayed by profitability associated with each industry is in accordance with real data, profitability growing or maintain a balanced route until around year 2008 and then descending quickly until a certain level.

Even though at this stage we will relate more on the behaviour in time of the variables, the simulations of the model has displayed some of the problems of Portugal's economy during the years of crisis. Net Profitability being much more influenced on some of the sectors considered while other displayed stable behaviour or even slight growth as seen in Figure 3.

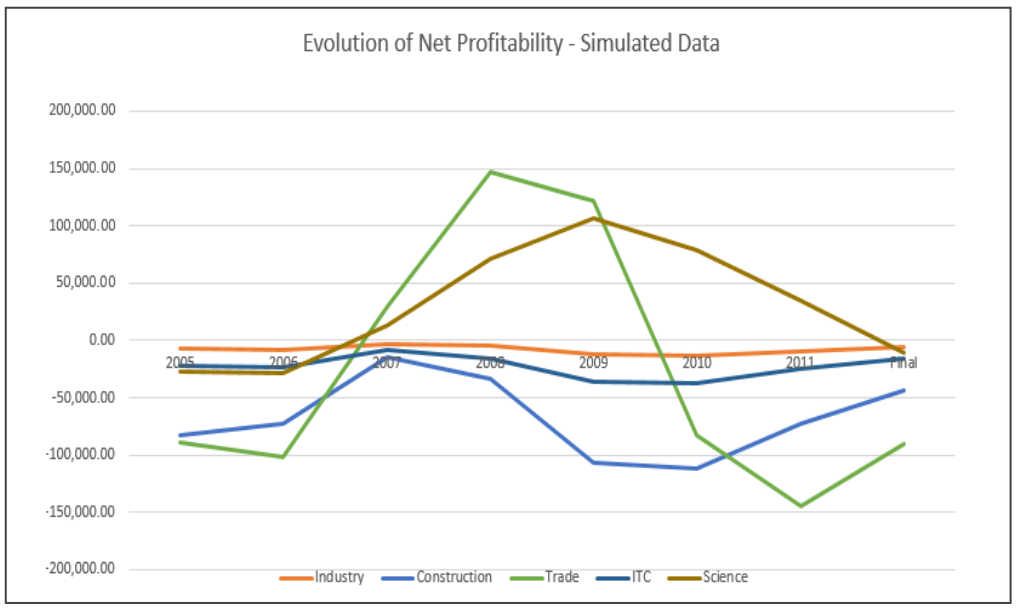

Figure 3. Generated Chart for Simulated Data on Net Profitability

The most affected areas of the 12 considered, displayed by the model were, Manufacturing, Construction and Trade. The most responsive sectors to the economic crisis are Manufacturing and trade as those sectors are the most connected with market changes. Industry is supported most by the public expenditure while the IT&C industry functions on a growth pattern because of rapid innovation. All of sectors will display the start of the recovering period in the second quarter of 2009.

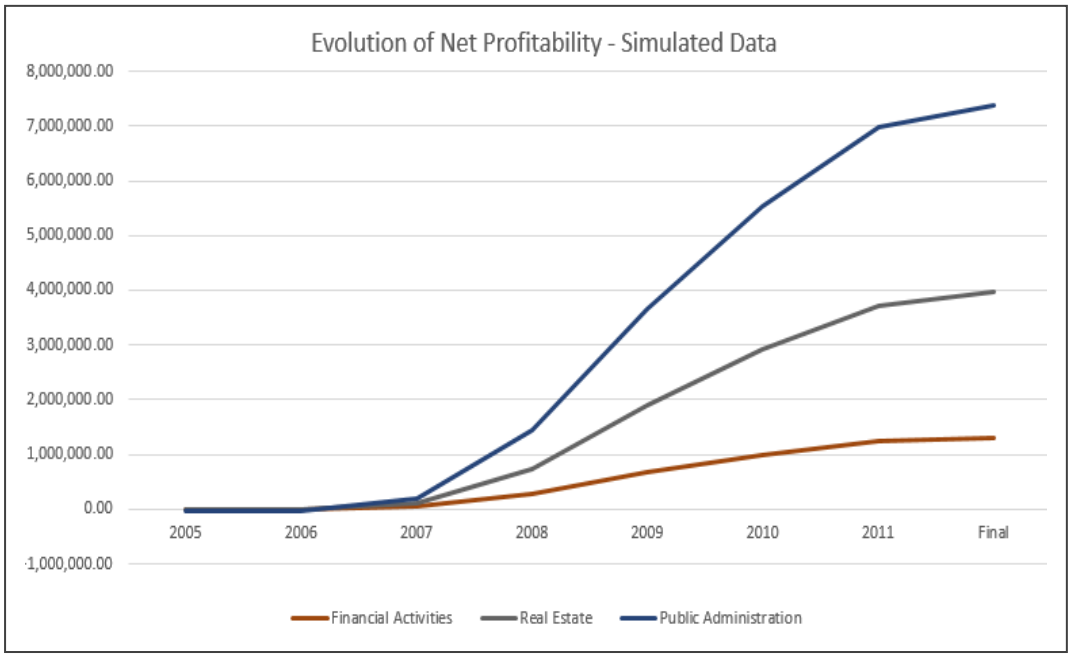

Figure 4. Generated Chart for Simulated Data on Net Profitability

The sole sectors displaying slow growth are Agriculture, Real Estate, Financial Services Sectors and Public Administration. Each of these sectors has specific characteristics that may give an explanation for the fact that even though they will register stagnation until 2008 in terms of profitability, in the next period the associated profitability will grow. For example, as Portugal has implanted the directives of European Union, the government has taken important measures cutting back on the public wages and public sector pensions, a fact that in terms of aggregated productivity of the public sector will be translated in growth as shown in Figure 4. Real Estate, as defined by NACE 10 will be comprised by buying and selling, renting and all connected activities. The crisis has been translated in most important cities of Portugal in terms of real estate as being the industry to acquire most of the foreign capital. The real estate industry has registered a drop in prices but it has brought foreign investors capable of buying real estate properties and with the torment happening in north of Africa, Portugal has become more attractive for the countries with economic potential – UK, Germany, Austria (Oxlade, 2014).

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