Dealing with Public Debt Burden

A system dynamics approach to implement sustainable financial policies in the Italian State

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In the last decades in several mature democracies the problem of debt emerged as a violation of intergenerational equal treatment due to high expenditures concentration and dilution of costs by mean of debt creation. So far this issue has been analyzed from a statistical and a socio-economic perspective, which identified the high political interference as the main dysfunction of country debt management. There are no studies which frame the issue by focusing on State institutions as performance-oriented organizations, according to this perspective such organizations have to respect dynamically trade-off between development and the debt reduction through a mix of levers such as: funds acquisition/reduction, interest rate and financial leverage. System dynamics can be successfully used as an instrument to support Government in keeping control over the key variables affecting debt changes and implementing a sustainable policy. In the paper three kinds of policies are recommended: the reduction of expenses and increase of receipts in the short term to drastically reduce the debt amount; the opportunity to exploit the financial leverage in the long term. Such approach implies a change of perspective, looking at Italy as a performance-oriented organization in which a proper financial management serves economic development and not vice versa.

Keywords: Italy; public debt; sustainability, debt/GDP ratio; surplus; risk; financial leverage; system dynamics

Introduction

High public debt has accompanied Italy's history, since the country unification in 1861 (Zamagni 1998). European countries generally used debt to develop infrastructures, to foster economic development and to enhance military power. After the Second World War and especially after 1963 the Italian debt grew significantly showing a different pattern compared to other European countries. Italy experienced high primary deficits (-12.5% in 1981, OECD 2007) but debt increased less because of

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hyperinflation (Istat 2010; Francese and Pace 2008) provoked by the obligation enforced by law, which required the Bank of Italy to buy unsold bonds in the market by printing new money. After 1981, the Bank of Italy was not obliged anymore to the above-mentioned and the debt grew out of control because of the high deficits had to be financed by debt with higher interest rates in order to sell all the public bonds. After 1994, when Italy recorded a debt-to-GDP ratio of 121.8%, in 2007 the debt decreased reaching the threshold of 103.4% of GDP. Finally, in December 2011 the debt of Italy accounted for 120% to GDP, because of high interest rates[1] and the decrease in GDP during the global financial crisis. Today, Italy is the world's third most indebted nation with debt of 1,897 trillion Euros (Banca d'Italia 2011). The debt is more than that of Greece, Portugal, Spain and Ireland combined and accounts to the 20 percent of the Euro zone's public debt.

In the literature many authors argued over time about the national debt presence and its threats for the country's economic development. According to Keynesian economists governments should increase the national debt to stimulate the economy during downturns and retire the debt during business cycle upturns. Debt could be paid by raising taxes, when needed. Otherwise government debt could be reduced through other options such as reducing spending or issuing more money (Buchanam and Wagner 1999).

An alternative point of view is presented by the author of "invisible hand" Adam Smith (1776) who advocates for parsimony in country budgets, which sounds like a prophecy of the current sovereign debt crisis: "Ordinary expense [ought to be] equal to ordinary revenue and it is well if it does not frequently exceed it". According to Smith countries should strive to produce a surplus in order to accumulate it for investment purposes or possible economic recession. Classicist' distinction between ordinary and extraordinary financing sought to differentiate tax financing from debt financing, specifically that in peacetime expenditures were to be financed by taxation and countries should strive to produce surplus to spend during economic recessions. Like Smith other studies focus on social consequences of debt. Eusepi (2008) pointed out that a certain increase in community welfare could be obtained without any postponement of cost generated by debt and so claim for a Paretian distributive policy free of intergenerational externalities.

Oppositely to a Paretian policy the presuppositions of Harvey Road viewing a balanced budget "as an irrelevant dogma leads to the aberrant conclusion that the debt is a problem only for private individuals, never for the government, thus the debt is said to be public because we owe to ourselves" (Eusepi, 2008). In such a way government can perform disappointing promises and roll over repayments commitments indefinitely. Therefore, as Alesina (1988) pointed out, the public debt "is essentially a political problem".

[1] In October 2011 Moody's rated Italy's government bond, ratings has fallen down what produced an increase in Italy's borrowing costs as well.

Andreatta (1973), instead, referred to fiscal policy designed during the end of the 60's: according to author, a mistake made by reformers was "to ask for a socialist expenditures policy without asking for a socialist revenue policy".

Finally many studies have focused on the macroeconomic perspective and on debt reduction policies. Spaventa (1988) conducted an interesting macroeconomic comparative analysis concluding that Italian debt explosion in the 80's was not worse compared to other European countries, what distinguished Italian debt was heavy reliance on short-term debt and remarkable increase in share of debt owned by households. Pagano (1988) instead suggests that cost of debt could be reduced by innovation in debt instruments, while other authors analyze possible target for Italian debt-to-GDP ratio with a small macroeconomic model including variables such as European Central Bank's (ECB) monetary policy, raw material prices, and US GDP growth (Casadio et al. 2012). Further study suggests a surprising way to avoid debt increase for recovering economy in downturns: by using the computer to mark up the size of the account that banks have with Central bank, this would allow for a fast recovering without higher taxes, more debt and inflation (Striner 2010).

As mentioned above, the problem of rising Italian debt has been studied in a macroeconomic, political, socio-economic and fiscal perspective but so far there are no studies considering Italy as an enterprise dynamically facing economic opportunities, budget limitations and external constraints. The system dynamics approach allows for taking into account this perspective supporting management in exploiting key performance variables (Bianchi et al. 2010). The purpose of this paper is to provide dynamic explanation of debt structure and profile to decision makers, in order to support effective policies for the solution of the dynamic problem.

Dynamic problem

Historically debt of Italy has been constantly increasing with oscillating tendency from First World War, depending by economic conjuncture, public expenditures in investments and current expenses, tax and monetary policies.

Since 1998 the majority of European countries (including Italy), has adopted a same monetary policy decided by ECB. This represented the first step towards the common currency of Euro, adopted in 2002. Moreover, the Maastricht agreement set rules about inflation and deficit limits in order to achieve the stability of European Union (Eur-Lex 2012). This obviously represented an important goal in the European Union building process. However, it forced Italy to lose the lever of issuing money, which generates inflation in order to reduce the real value of debt. Such deep change has had repercussions in debt management that call for the identification of new effective strategies to reduce debt, especially in present days of economic downturn. In the

following analysis the period 2000-2010 is taken because of above mentioned changes in financial and monetary policies of Italy.

Figure 1: Debt, GDP and surplus of Italy from 2000 to 2010 (millions €)

National debt of Italy from 2000 to 2010 has increased by around 500 billion of Euros. In the analyzed decade, minimum value of debt-to-GDP ratio was 103.5% in 2007 while maximum has been reached during current economic downturn in 2010 and account 119% of GDP (Istat 2012). Debt of a country could be external or internal, depending on whether a country borrows money from local or foreign authorities. Currently 46% of Italy's debt belongs to Bank of Italy, 10% refers to resident investors and 44% to foreign investors, this means that around 56% of debt is internal and other 44% of debt is external[2] (Banca d'Italia 2012).

The problem of Italy's debt involves many stakeholders. Firstly the Government of Italy as well as its inhabitants: the goal for all nations is financial stability and economic development, for inhabitants of country it is danger raising taxes or lowering expenditure such as education, health service or pension funds. Other concerned stakeholders are financial institutions such as the Bank of Italy, the International Monetary Fund, and the Central Bank as all of them are closely correlated and interdependent.

Dynamic Hypothesis

Hypothesis overview of Italy's public debt

Explaining the national debt of a country seems to be a very difficult and complex task, while a model could exemplify it in a simple way with the simplest version of a country debt model containing one stock and two flows. The debt of a country (stock) is equal to the net accumulation of the debt acquisition and redemption rates. The acquisition rate is an inflow while the redemption rate is an outflow. In other words: the acquisition rate is the new debt caused by a primary deficit and the interest rate in the debt stock, while the redemption rate is the re-payment of debt on its expiration date and is calculated by dividing the debt by its average duration. When the acquisition rate is higher than the redemption rate the debt increases as presented in Figure 2. The debt is reduced when the redemption rate exceeds the acquisition rate except for cases in

[2] For historical composition of debt see relative graph in Appendix C.

which redemption is paid by acquisition of new debts. In order to keep the debt amount under control a surplus production is vital, in fact when surplus increases, debt rises less steady as showed in Figure 1.

Causal Loop Diagram of national debt management

The next figure explains relevant variables, key factors and feedback relationships in country debt management. Starting from a basic feedback structure (debt stock, acquisition and redemption rates) there are two loops: a counteracting loop (C1) and a reinforcing one (R1). The reinforcing loop indicates that the higher the acquisition rate is, the higher the debt becomes and the higher debt determines a higher acquisition rate because of its interest rate. The counteracting loop indicates that the more debt there is the more needs to be paid for (redemption rate), but the more is paid for, the smaller the debt stock will be. Whether there will be an increase or a decrease in the amount of debt depends essentially on which loop described above dominates.

The basic feedback structure explains how debt generation normally works but in the case of several countries, among them Italy, the simple feedback structure could be extended with the use of more influential key variables in order to explain the problematic behavior of the exponential rising of Italian debt. In the case of Italy, redemption of debt payment has been done partially by using financial resources generated by the management of country accounts. This implies the existence of another loop weakening the counteracting C1 loop and causing the strong exponential growth of debt as recorded in the past decades. By introducing the variable "redemption not covered by surplus", the R2 loop shows how the acquisition rate increases by that portion of the debt that is not paid-out by the country's own finances.

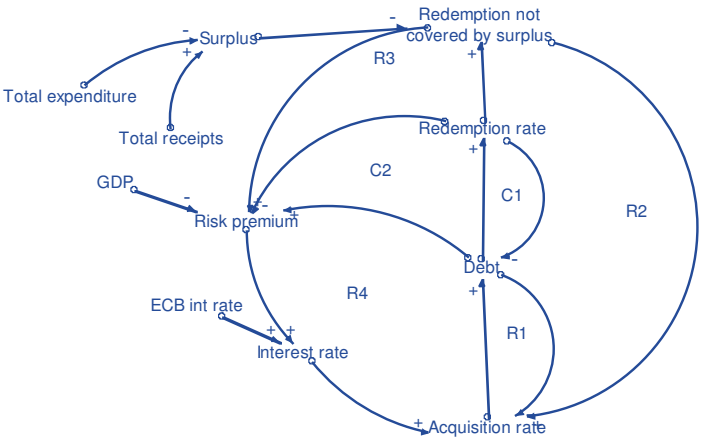

Figure 2: Causal loop diagram of Italy's debt

The present model of Italian debt management also includes the variable risk premium that is the part of interest rate determined by market appreciation of country risk. This represents an absolute novelty according to the survey of scientific studies about country debt topic: the present study considers the interest rate as composed by two different factors: a risk free rate fixed by ECB and a risk premium associated to the country. The bond market decides the size of risk premium because it is the additional yield due to risk that an investor supports with respect to a risk free investment. In common public mental models, risk premium is given by the market and cannot be managed endogenously by the system. This paper shows that proper risk premium can

be affected by internal dynamics of a country's system[3]. Risk premium is not only an endogenous variable affected by the systems behavior over time but, by application of private company's strategies oriented towards a better bank rating, it can "smartly" be managed and kept as low as possible. In the model risk premium is positively affected by GDP growth, political instability and European conjuncture, by the variable 'redemption not covered by surplus' (loop R3) and 'debt amount' (loop R4). The redemption rate oppositely affects the redemption not covered by surplus/redemption rate-ratio and, as a consequence, the risk premium (counteracting loop C2). The final point of both reinforcing loops R3 and R4 is that the interest rate variable is affected by the risk premium, and this proportionally influences the acquisition rate.

In the scenario portrayed above it is important more than ever to record a surplus in country accounts: if the redemption of debt would be covered by a surplus, the acquisition rate will be reduced, resulting in a smaller debt and redemption rate. Moreover a surplus has a double positive effect for the country's economy through weakening the R3 loop by reducing redemption not covered by surplus/redemption rate risk factor[4]. Therefore, oppositely to deficit, when government generates a surplus, the interest rate, acquisition rate, and consequently debt are reduced, which will solve the problem of exponential growth on debt of the Italy enterprise.

Stock and flow diagram of national debt management

The model was built based on literature review and personal experience of the author. The dynamic problem of Italy's public debt could be presented in a simplified stock and flow structure where debt is treated as a stock and its change is influenced by two flows: acquisition and redemption rate. The problematic exponential growth behavior occurs when acquisition rate exceeds redemption rate. In other words, as showed in the CLD diagram in Figure 2, when R1, R2, R3, and R4 loops dominate over the counteracting C1 and C2 loops.

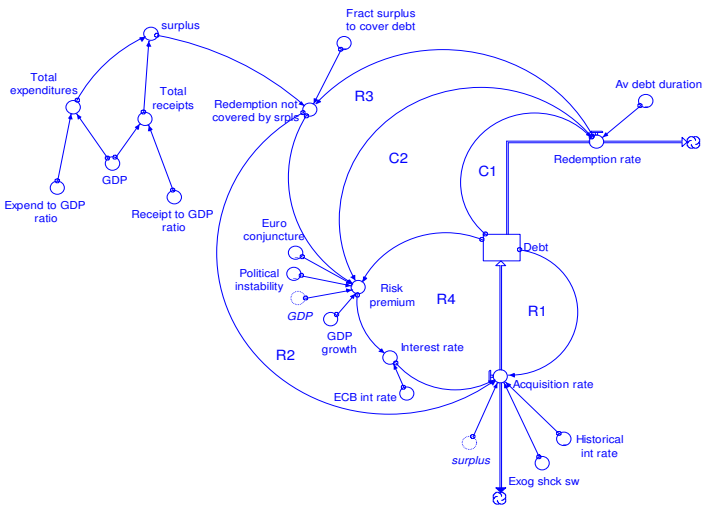

Figure 3: Stock and flow structure for national debt management

The redemption rate outflow is extended by average debt duration and its calculation by its division by debt is presented on Figure 4. Average debt duration from 2000 till 2011 is constantly increasing from 5.8 to 7.0 years and, assuming a stable increasing rate till 2020, it is going to reach probably 7.8 years. The acquisition rate is equal to interest on debt (interest indicated by ECB +

[3] See for demonstration structure-behavior test B shown in the next chapter.
[4] See for demonstration structure-behavior test C shown in the next chapter.

risk premium), new deficits[5], and redemption not covered by the surplus. The variable "redemption not covered by surplus" measures how much debt is not redeemed by liquid assets generated by the State (surplus), and consequently indicates the part of debt redemption that will increase the acquisition rate (reinforcing loop R2). When the country's budget balance is positive (surplus) it means that its receipts are higher than its spending. Vice versa, a negative budget (deficit or in this case negative surplus) means that the country spends more than it earns. The last variable in the basic stock and flow structure is risk premium, which is indicated by the following variables: GDP growth, Euro Conjuncture, Political instability, Redemption rate, Redemption not covered by surplus, and Debt to GDP ratio (the corresponding equations with full model are in Appendix A).

Model analysis

The Italian debt model provided in this paper needs to produce real and predictable behavior. In order to ensure that, model analysis has to be done since only a reliable model in which we have confidence can be used for managing the debt problem and testing the effectiveness of future policies.

Unit consistency test: is used to validate model since a model which has inconsistent units is usually not only trustless but also worthless (Sterman 2000). After careful study of model units it was stated that units used are consistent as presented in Appendix A.

"Face validity" test: the system reflects reality! Debt increases exponentially due to interest rate and since redemption is not being covered by self-financing (surplus) the country has to refinance itself by new public auctions on debt. Portions of debt expire overtime according to the average debt duration. As the country records a surplus the debt grows less or, if surplus exceeds payments for interests, decreases.

Equilibrium shock test: The aim of the equilibrium test is to identify and fix incorrect equations and to better understand the dynamics affecting the debt stock[6] (Ford 2010). The system is in equilibrium when surplus is equal to interests payments, in this case acquisition rate is equal to redemption rate and the debt stock is in equilibrium. In the second equilibrium shock test displayed in graph 2 the system is shocked by setting since 2005 surplus equal to zero, contrary to the first diagram, debt increases more and more because of the interest and the model shows exponential growth, which is the expected behavior.

Extreme conditions test: seeks to identify and fix wrong or incomplete equations (Ford 2010). This test indicates direct influence of surplus and surplus fraction to cover

[5] In the model surplus and deficits are defined by the same variable, in fact surplus could be negative.
[6] For equilibrium shock test see Appendix B.

debt on debt stock[7]. To perform the test, interest rate (risk free rate+ risk premium) has been set at the extreme value equal to zero. In this case debt decreases more/less according to the more/less surplus production and fraction of surplus employed to pay debt at its redemption date. In 2009 debt increases due to primary deficits recorded during last financial crisis.

Reference mode comparison test: To check out the accuracy of the constructed model, the simulation result (blue curve) has been compared to historical debt behavior (red curve). The result corresponds reasonably well as the historical and simulated behaviors are almost placed upon: starting from the same initial value of debt (1.300.269 million of Euro in 2000) the structure developed in the model shows highly similar behavior to the historical debt development from 2000-2010 and the value of stock obtained by simulation at 2010 differs by just 2%.

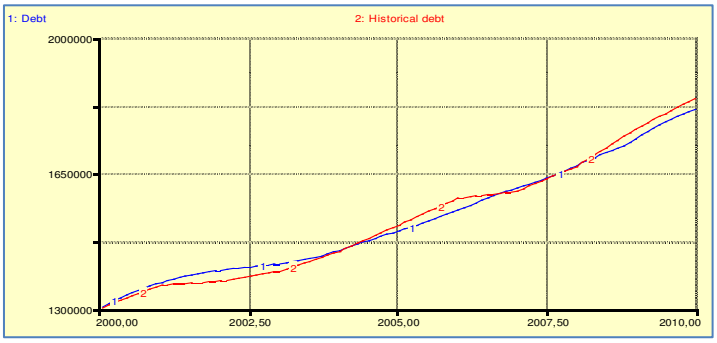

Figure 4: Reference mode comparison test (2000-2010, millions €)

Some points need to be elaborated regarding how this behavior was simulated and reproduced. The actual behavior was reproduced based on historical interest rates and average debt duration. For a better correspondence between simulated and historical debt, the behavior variable "fraction of surplus to cover the debt" was introduced because in reality the country recorded a surplus from 2001 to 2008 that could have been spent in different ways, such as covering debt, making investments, or covering current expenses. The variable was adjusted according to historical debt development.

Parameter sensitivity test: values of interest rate and total public expenditures are used[8] to test parameter sensitivity. The interest rate from 2003 was increased by 5% and the country expenditures were reduced by 200 billion of Euro from 2006. Simulated debt increased more from 2003 as a result of the higher interest rate and decreases in 2006 because of the reduction in spending, it increases again till 2009 by setting fractional surplus to cover debt redemption equal to zero.

Structure/behavior test: it shows how each feedback loop operates creating endogenous variation of the debt stock. The purpose of analysis is to isolate effects of some feedback loops in order to validate its single influence on debt stock.

[7] Extreme conditions test is presented in Appendix B.
[8] For parameter sensitivity test see Appendix B.

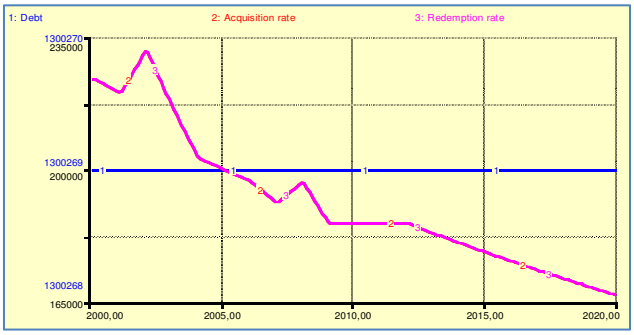

Figure 5: Structure-behavior test A (2000-2020, millions €)

a) When R1, R3, R4, C2 loops are removed acquisition rate equals redemption rate, because the values of inflow and outflow depend on average debt duration and decreases when debt duration increases. In other words, by cutting the loops and setting the surplus (deficit) variable to zero we see that the C1 and R2 loops have the same strength. The graph represents the behavior explained above: redemption rate is equal to acquisition rate and then debt is stable.

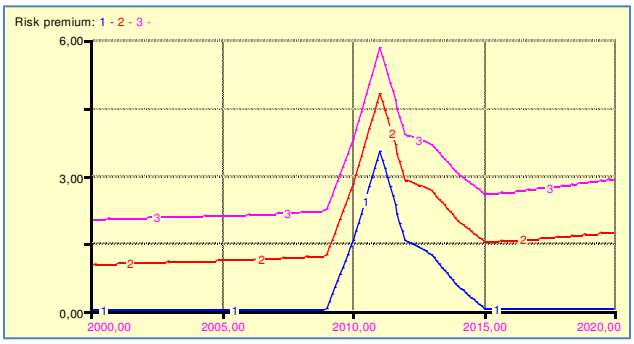

Figure 6: Structure-behavior test B (2000-2020, in %)

b) Risk premium is an endogenous variable influenced by the R3, R4 and C2 feedback loops. The first curve represents the risk premium influenced by Political instability, GDP growth, and European economic conjuncture. The second curve includes additional risk due to the R4 loop in other words the part of risk related to Debt-to-GDP ratio. The third risk premium curve combines the strength of the R4 and C2 loops influencing risk due to redemption not covered by surplus-to-redemption rate ratio.

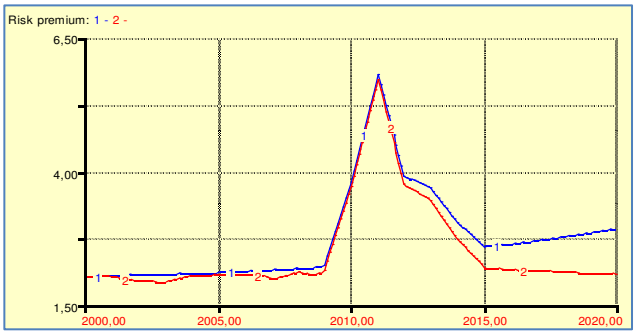

Figure 7: Structure-behavior test C (2000-2020, in %)

c) Including the effect of surplus spent for covering debt, the risk premium is reduced because surplus operates by weakening the R3 reinforcing loop, specifically by reducing redemption not covered by surplus-to-redemption rate risk factor.

Policy design and implementation

Designing a policy response for Italian debt problem means seeking and implementing strategies in order to reach the desired stock amount starting from critical actual level. In case of Italian debt this operation implies a weakening of reinforcing loop causing exponential growth in debt amount and a strengthening of the counteracting ones (Sterman, 2000; Ford, 2010).

Surplus production, as showed by model analysis, has a positive effect not only in weakening reinforcing loop of new debt acquisition for debt not paid by self-finance but also in reduction of the interest rate. Moreover, interest rate could be decreased by an active management of risk factors affecting it. This requires a shift from a passive mental attitude that rating is assigned from outside to an active one which would promote operating in advance for obtaining the best possible rating value.

Based on the information discussed above, one can easily argue that a good policy has to produce a surplus before interest at least to the level of the debt costs. It is also evident that if the surplus produced will be even higher debt will be reduced overtime because there will be a fraction of debt redemption paid by self-finance and not by new debt acquisition.

Policies design and implementation 1 and 2

The first two policies provided in this paper seek to control two groups of factors that influence a surplus and consequently the debt: total expenditures and total receipts. Surplus could be reached in two ways: reducing expenses and/or increasing receipts, it has been excluded in advance the possibility to reduce public services to citizens. For the purpose of this paper it is assumed that policies lowering the expenditures will be implemented in 2013 while actions in terms of changes in taxation methods will take place in the end of 2012[9].

The first group of short term policies, as showed in the graph below, demonstrates an absolute necessity to reduce public expenses - currently Italy is the European country with the highest level of general administrative public expenses[10] (Eurostat 2011). Deeper analysis of all advisable policies is presented below.

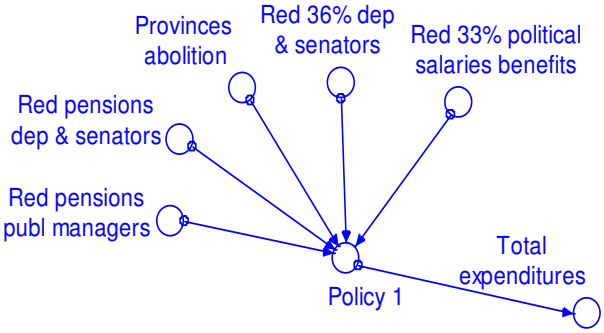

Figure 8: Expenditures saving policies

a) Abolition of provinces: Historically administrative division in Italy includes: central government, regional governments, provinces, and municipalities. Currently in Italy there are 110 provinces. Functions of provinces include local infrastructural and budgetary planning, such as provincial roads maintenance.

The cost assigned to the administration of provinces accounts over 17 billion Euros: 18.3% for workforce salaries; 22.3% for investments on previously mentioned responsibilities and the remaining 59.4% are unspecified (consumption of goods and services, real estate costs and other unindicted; Eurispes 2007).

[9] For policies regarding changes in taxation an earlier date of implementation has been predicted . In Italy laws by decrees, necessary to implement this kind of policies, are operative from the date of issue.
[10] In 2009 the value was the 9% to GDP while the European average was 6.2%.

Redistributing 59.4% of unspecified spending and delivered responsibilities undertaken by regional institutions, including local infrastructural planning, provincial roads maintenance and provision of local police, could save approximately 10.6 billion of Euros. In fact, removing provincial divisions is one on the least harmful policies to society, since current employees would be only moved to other administrative institutions. However, this would allow an elimination of unspecified spending that provincial governments are currently receiving.

b) Abolition of 36.5% of Parliament members: National Parliament of Italy has 945 elected members that consist the Chamber of Deputies (630 members) and the Senate of the Republic (315 members). In 2010, the former Prime Minister Berlusconi has seek to reduce parliament by 70% but this initiative was perceived as too radical and unrealistic. However, reducing Parliament by 36.5% would result in 3.5 billion of Euro savings. An alternative way of achieving a desired outcome might be a public referendum[11] allowing popular decision to become effective as soon as the 2013.

c) Introducing a reduction of 33% in salaries and benefits of politicians: In Italy costs of politicians' expenses are 24 billion of Euros. These include benefits such as housing, travel costs, salaries, cars, hairs stylists, and similar while average net salary per politician already is approximately 12,000 Euro/month.

Reducing spending by 33% would save 8.23 billion of Euros (Il Giornale 2011). This could be difficult to implement because of the lack of political will and well established traditions of benefits associated with political duties. However, given an average wage in Italy, that currently is 1,407 Euro/month, this seems only fair and legitimate for the public to require.

d) Reduction of pensions for current and former deputies and senators: in Italy pension is proportioned to the amount of pension contributions paid by workers during the whole working period. However this is only true for common citizens but not for deputies and senators that are allowed to apply for pension as soon as the end of five years mandate. Designed policy provides a suggestion to abolish this exception and apply same conditions for the entire population of workers independently on their obtained job profile. In 2009 total cost of retirement benefits for deputies and senators was 219.4 million of Euro, while yearly contribution paid was only 17 million Euro (Il Giornale 2011). Consequentially, this burden contributes to the budget deficit and to the ever growing debt. Introduction of this policy is expected to save approximately 202.4 million of Euro per year. However, in order to implement this policy a public referendum should take place which would allow an effective application of changes as soon as 2013.

e) Reduction of pensions for public managers: similarly to the deputies and senators public managers are also exempted from general retirement benefits system's rules. An interesting cost breakdown analysis conducted by INPDAP[12] in 2011 has

[11] In Italy, in accordance with Constitution, referendum proposal could be submitted by a minimum number of 500,000 people.

[12] Istituto Nazionale di Previdenza Dipendenti delle Amministrazioni Pubbliche.

shown that total amount of pensions paid to this specific workers' category is 30,000 million of Euro per year. This implies that only by applying a pension threshold of 5,000 Euros per manager/month the country could save 9,800 billion of Euro per year.

Government receipts are mostly generated through taxation and management of public properties. As a result, policies presented in this paper seek do not harm society by increasing taxation but suggest less upsetting measures of managing public finances that are listed in the figure 14.

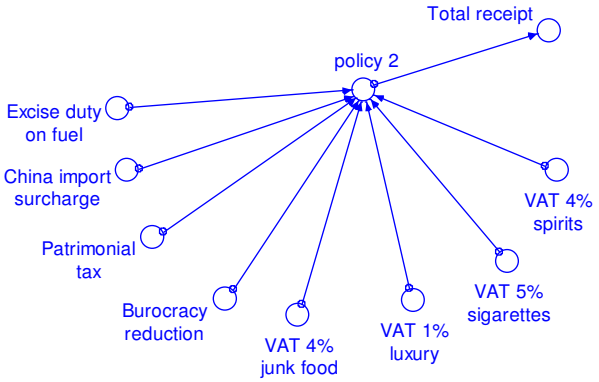

Figure 9: Policies for increasing receipts

a) China import surcharge: China's yearly export to Italy accounts for 28,790 million of Euro (Ministero dello Sviluppo economico 2011). Based on such information, the proposed policy seeks to increase taxes applied to this segment of export by 2%, namely raising taxes on imported Chinese goods from 10% to 12% of import value. As a result, the implementation of mentioned measure would generate 576 million of Euro receipts per year. However, one has to be cautions regarding the policies and regulations applied to international trade, particularly those that are subjected to free trade agreements with WTO and the EU. Moreover, the above mentioned policy would introduce a raise in demand for domestic production and import from other EU countries, hence fostering common European interest.

b) Patrimonial tax: In Italy patrimonial tax is a subject to the real estate property. Normally patrimonial tax is applied only on the second or further real estate properties while up until 1997 patrimonial tax applied to all real estate equally. Based on historical experience and the fact that current value of residential real estate properties in Italy accounts for 6,244,000 million Euro (Sole 24 Ore 2010), the suggested taxation policy is to add an additional tax rate of 0.15% on every segment worth 100,000 Euros market value . In other words, additional 150 Euros would be added on every piece of 100,000 Euros worth estate. It is expected that this measure could generate an increase of 9,366 million Euros in receipts. Patrimonial tax would be paid by owners and subjected to the principle of *higher tax according to higher marginal richness*. It is necessary to note that decisions that are needed to put the mentioned measure in effect would require strong political will and dedication since this policy implies a rather inconvenient changes to the people owning more than one piece of real estate. However, given an extremely concerning situation of public finances drastic measures have to be undertaken in order to avoid even worse scenario in the future.

c) Reduction of bureaucracy: In 2011 in the Index of Economic Freedom Italy was ranked 87th due to an excessive state interventionism. In manufacturing and service sectors enterprises obtain over 16,629 million Euros of costs created by inefficient bureaucracy (Confartigianato 2010). Most the time these costs appear due to long time

for authorizations, fiscal compliance, delayed payments from public administration and similar. By eliminating these inefficiencies it would be possible to collect additional receipts worth 5,820 million of Euro from taxation of higher enterprises' profits, without considering a higher international investment appeal of Italy that will be generate even higher taxes. Initially some people employed in Public administration might lose their jobs but new job opportunities will soon arise as companies will save money for future development.

d) Increase in VAT of specific goods: It should concerns "junk food" (+4%)[13], cigarettes (4.5%)[14] and spirits (4%)[15]. This policy is socially desirable to reduce consumption in detrimental goods to health. Eventually, a VAT increase of 1% in luxury goods[16] seems to be a reasonable policy as these goods are not sensitive to small price variations. These policies will bring to Treasury additional receipts for 2,442 million of Euro.

e) Excise duty on fuel: In 2011 total fuel consumption in Italy reached 40 billion of liters (Unione Petrolifera 2012). This means that by applying an additional excise duty of 1 euro cent per liter, the country should increase receipts of 400 million euro per year. Policy implementation will be quite easy and without great harm for whole population.

About Policies 1 and 2 effectiveness

The short term policies described above are finalized to the surplus production in order to weaken the vicious effects produced by reinforcing loops R2 and R3 (green marked) influencing the exponential growth in debt.

Specifically, as shown in figure 10, the additional surplus reduces the value of "redemption not covered by surplus". This causes the weakening of R2 with less acquisition rate, less debt, less redemption rate, and eventually less redemption not covered by surplus. It is important to observe that the reinforcing loop R2 is responsible of the partial o total neutralization of the C1 counteracting loop.

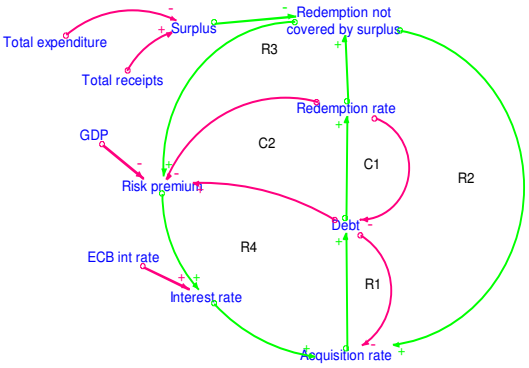

Figure 10: Positive effects of surplus in R2 and R3 loops (green marked)

[13] Yearly receipt from increase in "junk food" VAT policy is 39 million of euro, this has been calculated on sales of Mc Donald and Burger King in 2010 (984 million of euro). Sources: Sole24ore, 2011; Beverfood, 2011.

[14] According to British American Tobacco Italia in 2010 it has been registered 17 billion euro of cigarettes' sales, policy will increase VAT from actual 16.5% to 21% bringing to government new receipt for 765 million of euro.

[15] In 2010 in Italy sales of spirits reached 1.2 billion of euro (food.net 2011), by applying an additional 4% VAT government will increase receipt for 48 million of euro.

[16] According to Bain & company in 2010 in Italy sales of luxury goods achieved 159 billion of euro.

A decrease in "redemption not covered by surplus" also provokes a weakening of "R3 loop", which is responsible of a higher risk premium and thus a higher cost of the debt: less redemption not covered by surplus lead to less risk premium, less debt, less redemption rate, and less "redemption not covered by surplus".
In the short term the weakening of both R2 and R3 produces a decrease in debt. In the long term also the reinforcing loop R4 is weakened, due to a lower Debt-to-GDP risk factor. This allows a reduction in the risk premium, acquisition rate and in the debt stock.
The fulfillment of policies described above depends by several factors, first of all the political will to solve the problem, thus it is correct hypothesizing different levels of policies fulfillment, hereafter named policies effectiveness scenarios. In the case of 100% effectiveness scenario the policies recommended above may create an additional surplus of 40,084 million of Euro per year.

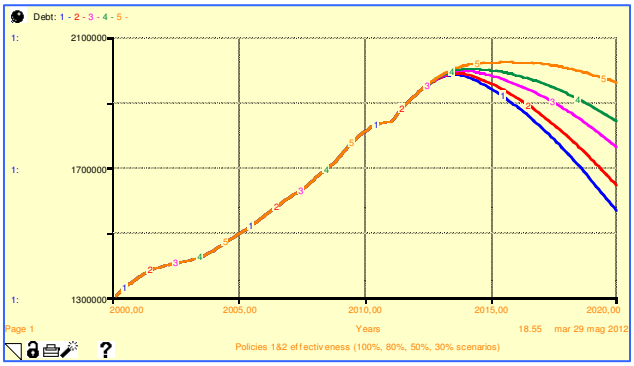

Figure 11: policies effectiveness in different scenarios, values in millions €

Figure 11 shows results for four different scenarios about policy effectiveness: a) 100% effectiveness, blue line; b) 80% effectiveness, red line; c) 50% effectiveness, pink line; d) 30% effectiveness, green line; e) 0% maintaining the *status quo,* orange line. However, in this last scenario debt decreases because of lower risk factors affecting interest rate on debt such as "European conjuncture" and "political instability", both described above.
Instead, Figure 12 compares debt stock and GDP in the case of a policy effectiveness of 80%. Good results will be reached after just eight years starting from the actual economic downturn: debt may account for 1,644 billion of Euro. With an expected average growth in GDP of 1.5% from 2013 to 2020 it will be possible to achieve a debt to GDP ratio of 103.3%, thus reducing the gap from the psychological threshold of 100%.

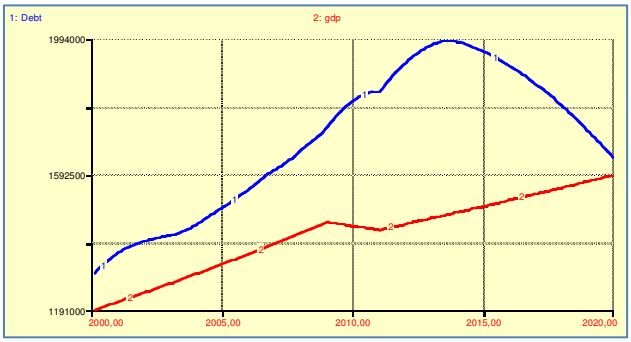

Figure 12: Debt & GDP – Policy effectiveness 80%, values in millions €

A policy effectiveness of 80% may sound too optimistic, especially in light of austerity measures requiring a political will. However, policies adopted by the Italian government since November 2011 for the debt reduction imply, compared to the second policy recommended above, higher sacrifices to citizens without appreciable results: this is the case of the increase of 12.5% (0.12 euro) of the excise duty per fuel liter. As a

consequence the consumption of fuel dropped of 10.5% in the first four months of 2012 (Unione Petrolifera 2012).
Figure 13 shows different values of Debt to GDP ratio in 2020 and 2030 according to the effectiveness scenarios of policy 1 and 2. It is very difficult to predict an approximate level of the ratio for 2030 since that value depends on not predictable variables on the long term such as GDP growth, free risk interest rate, and risk factors affecting the risk premium on interest rate such as political instability and European conjuncture.
The scenarios for 2020 and 2030 are thus based on the following assumptions: average GDP growth of 1.5% (1,794 billion of Euro in 2030, +16.9% from 2007), the ECB risk free rate steady after 2020 at 2%, stable level of risk factors after 2020 (average value of 1.5%), constant Expenditure to GDP and Receipt to GDP ratios.

Policy effectiveness	Debt to GDP ratio in 2020	Debt to GDP ratio in 2030
100%	98,4%	22,2%
80%	103,3%	36,2%
50%	110,8%	57,6%
30%	115,8%	72,2%
0%	123,3%	94,6%

Figure 13: Debt to GDP scenario in 2020 and 2030 according to different levels of policies effectiveness

Towards a new way of managing public debt: the opportunity to exploit the financial leverage in the long term management of debt

Adopting a business-like perspective, which often lacks in political debt management, it is possible to look at Italy as an enterprise whose revenues are represented by receipts, and costs by expenditures. Difference by revenues and costs can be referred to surplus/deficit result. In the specific case of public organization, under the same fiscal leverage condition (stable receipt-to-GDP ratio), an increase in GDP means proportional increase in revenues. A loss has to be covered with new liquid assets, i.e. new debt. Instead, profits could be employed either in reducing debt, as demonstrated by the effectiveness of the policies described above, or in new profitable investment that, in the future, will produce adequate cash flows to pay interests and redeem debt. The distinction between a profitable and not profitable investment depends on interest rate on debt: a profitable investment is mainly marked out from its capability to create a positive difference between the yield generated and cost of interest payable on debt for the same amount and the same period of time.

The model has been then extended by public investment activity: in real public finance management it happens that surplus could be either used to redeem debt or invested, or it can be spent in current expenses. A novelty introduced by this paper is that this relationship has been examined in a quantitative way in order to provide a useful tool for understanding and managing country finances.

The third policy thus consists in the possibility to accumulate surplus and invest it in profitable projects starting from the strategic decision of which investments are most productive compared to the alternative uses of capital. In this case, private company strategic management can be of great help for public administration in the use of financial leverage: to be convenient, the new public investments should produce a yearly net income margin that exceeds the expected interest rate that the State will must to pay on the debt.

At this point a further explanation is needed. In private organizations the financial leverage concerns the possibility to acquire new debt when interest rate on it is lower than new investment profitability. However, in the case analyzed, Italian State cannot acquire new debt, and thus the implementation of financial leverage concerns the sole possibility to postpone debt redemption when interest rate on debt is lower than public investment profitability. As a consequence, if in private organization financial leverage strategy concerns the possibility to borrow, in the case of Italy's debt which is already borrowed the strategy could only consist in deciding when to invest surplus postponing the debt redemption. Test B in the next paragraph demonstrates how financial leverage is not always convenient: in 2012-2013 period, for instance, the interest expected on debt (synthesizing the market appreciation of risk how explained by figure 6) is higher than investment productivity, and debt redemption will be the best choice.

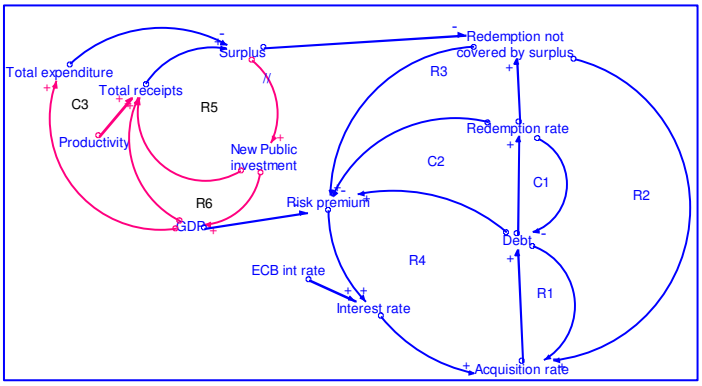

Figure 14: Causal loop diagram incorporating third policy

The policy, therefore, introduces three main loops in the model structure that reproduce the Italian government debt. These loops are highlighted in red in the casual loop and stock and flow diagrams illustrated in this page.

The reinforcing loop R5 shows how surplus could be invested in a good and profitable investment, this generates more future receipts caused by its cash flows (investment stock multiplied by investment productivity) and consequently more future surplus. The reinforcing loop R6 demonstrates that public investments (in this case financed with surplus) generates more receipt by investment suppliers taxation and more future surplus. Surplus can be employed to pay debt or reinvest again (repeating the sequences of loops R5 and R6). However, the strength of the loops R5 and R6 is counteracted by loop C3 which explains how, keeping constant in the budget "public expenditure-to-GDP" ratio, an increase in GDP, due to new public investment financed by surplus, leads to higher public services to citizens.

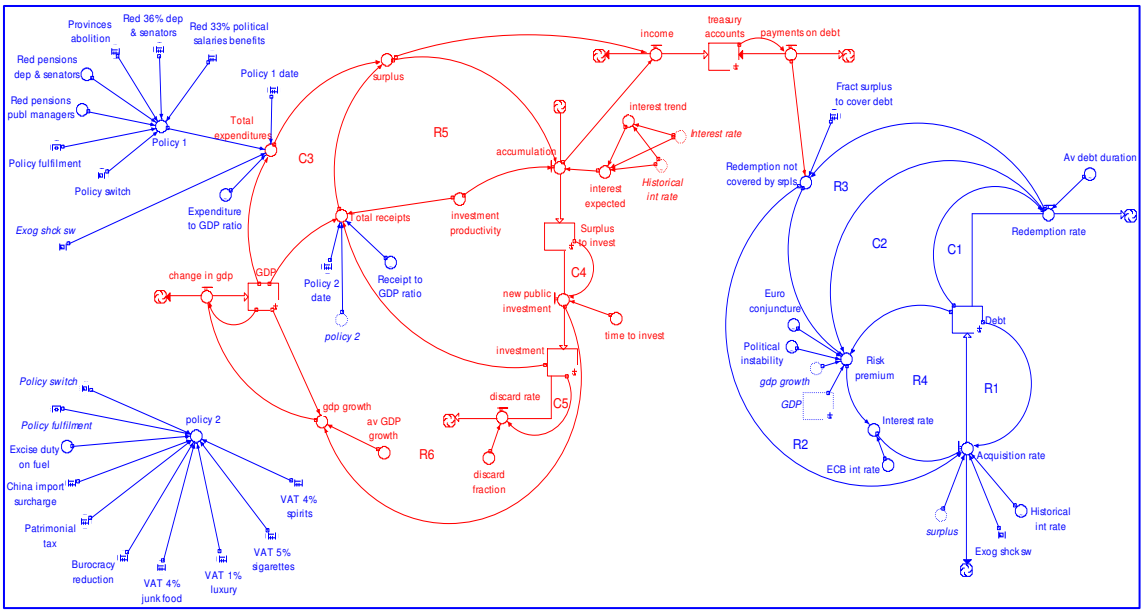

Figure 15: Stock and flow diagram incorporating third policy

The policy recommended would act a revolution in situation of bad public financial management: in several countries such as Italy public debt has been generated exclusively by deficit in the unproductive current expenses, it was the case of high public administrative expenses and of an inefficient public healthcare. This implies that public administration should turn the attention from a financial accounting perspective to a business planning one, understanding that "public enterprises" have to respect the same economic and budgeting constraints as private firms (Sorci 1995).

Structure-behavior tests for financial leverage policy

The following tests concerns the running of the three main loops introduced in the model structure by the third policy design.

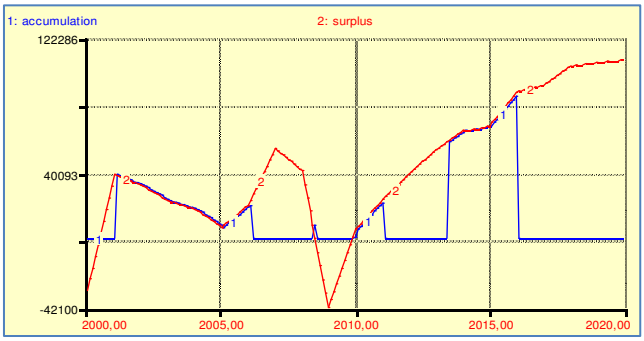

Figure 16: Policy Structure-behavior test A (2000-2020, mln €)

a) Once surplus it has been produced, the model now includes strategic decision either to pay debt redemption or to accumulate for investment. When it is more convenient to invest accumulation is equal to surplus (coincidence of red and blue lines) otherwise it is zero.

b) Convenience depends essentially by comparison between interest expected on debt (appearing in figure 17 as a discontinuous function due to combination of risk free interest rate and risk factor behaviors) and public investment expected

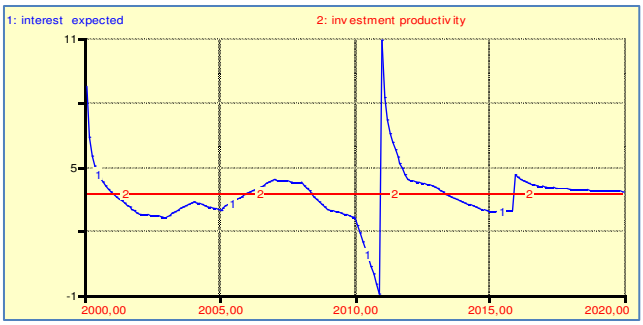

Figure 17: Policy structure-behavior test B (2000-2020, in %)

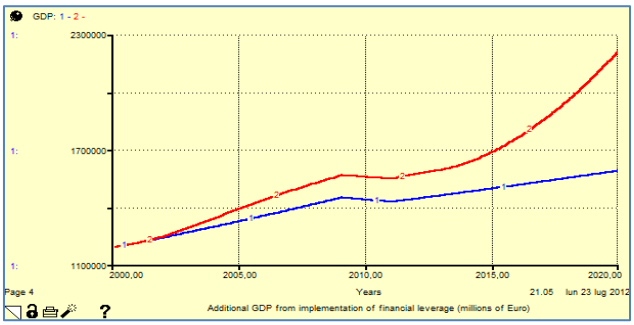

Figure 18: Policy structure-behavior test C (2000-2020, mln €)

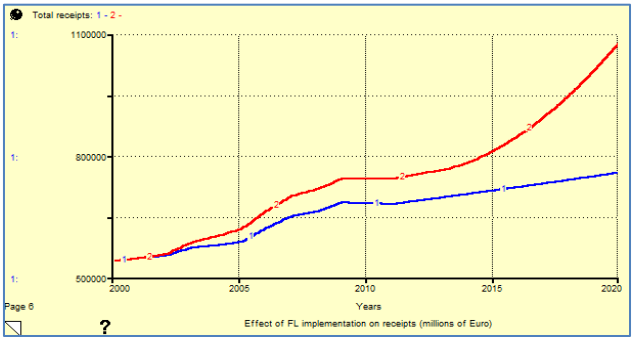

Figure 19: Policy structure-behavior test D (2000-2020, mln €)

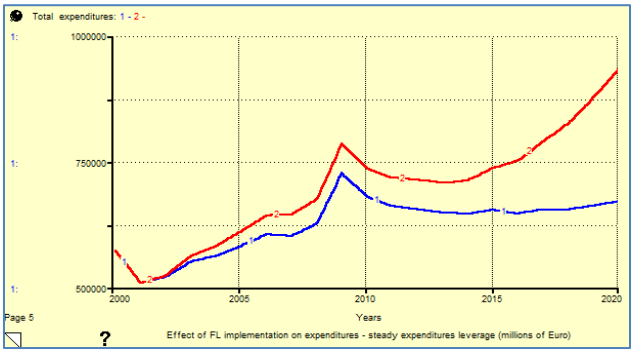

Figure 20 Policy Structure-behavior test E (2000-2020, mln €)

productivity (set in the model at 4% for a better comparison with the interest rate), anytime this is higher than expected interest, investing will be the best choice.

c) Once the decision to invest the surplus has been taken, profitable public investment will have positive effects on GDP (loop R6). The blue line shows expected development in GDP without any additional investment, the red line shows GDP behavior in case of additional public investment. This test shows how the model endogenously avoids the use of the financial leverage from 2008 to 2012 due to deficits in the country's balances. This explains how in this period, in absence of financial leverage effect, the curves for GDP (Fig 18), receipts (Fig 19), and expenditures (Fig 20) are parallel, while those for surplus (Fig 21) are overlapping.

d) Profitable public investments produce GDP as well as an increase in receipts by supplier taxation and cash flows generated by investment, consequently generating a higher future surplus (loop R5). The red line (Fig 19) includes additional amounts from receipts generated by profitable public investments at a constant tax leverage.

e) When keeping stable expenditures to GDP ratio, an increase in GDP obtained by new public profitable investment means more services to citizens (C3 loop). The red line (Fig 20) shows public expenditure behavior generated by additional public investments.

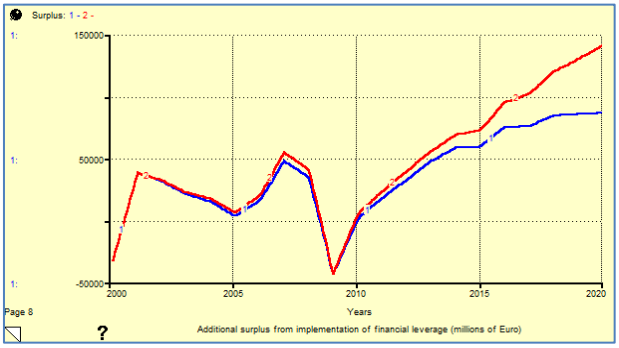

Figure 21 Policy Structure-behavior test F (2000-2020, mln €)

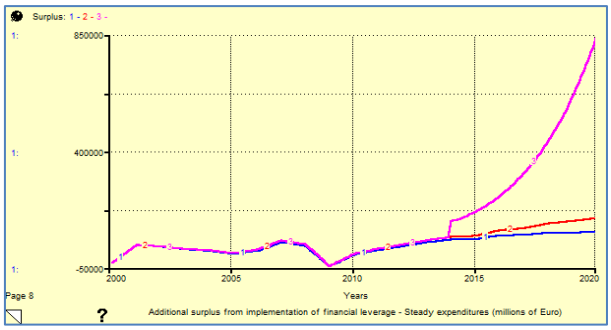

Figure 22 Policy Structure-behavior test G (2000-2020, millions €)

f) The use of financial leverage eventually leads to an "amplification" of surplus production in country budgets. The red line (Fig 21) shows how much additional surplus is generated due to this amplification when keeping the public expenditure leverage constant (Expenditure-to-GDP ratio).

g) The amplification effect described above is even higher (Fig 22) if, instead of a constant expenditure leverage, Italy keeps the amount of public expenditures predicted for 2012 constant, in absolute terms.

In conclusion, the decision to invest surplus in public investments which yield high earnings could be a useful way to increase financial disposal for paying debt. The model shows at its basis a management model of private organizations by replying, in public administration, the use of financial leverage: if public investments' yearly productivity is higher than expected interest rate surplus could be invested in order to pay interests on debt with cash flows generated by investments.

Conclusions and implication for further research

Debt is substantially a huge burden on Italian citizens who advocate for a fast and effective solution for its reduction. On the other hand this public interest to the reduction is contrasting with government's short term oriented management: one can trace the causes of this in the political risk to take "unpopular" decision (such as a tax increase), in the short legislature period not allowing to evaluate long term performance of a government, in the lack of mid-term goals, and in a low disclosure about performance reached.

This paper has outlined how system dynamics could be successful applied to public debt problem: it can foster the decision makers awareness about dynamics that influence debt and about levers contributing to its reduction. The system dynamic approach also allows decision makers to translate into figures the effects of planned policies and to validate them. The system dynamics model provide a useful and objective tool for debt management, by showing and improving limits of the current policy makers mental model.

Short term policies recommended in the paper are effective and operate a "Paretian redistribution" of sacrifices to reduce public debt by asking more from those who

“weigh” more on country expenditures. The use of financial leverage demonstrates how proven success of the implementation in private firms can be replied to change management models in the public administration; moreover, it outlines the absolute necessity to “subject” the public organizations to the same budget constraint of private firms and to enhance the use of planning tools such as the business plan.

The model illustrates the “objective” dysfunctions hampering a sustainable management of debt, and it could be extended by further studies analyzing the “subjective” dysfunction due not to an incorrect management model but to the decisional process conducted by decision takers: this means to evaluate how an ineffective policy design results from a hurried and misleading needs analysis, from the interferences of several group of interest not coinciding with the public one, and from the lack of feedback analysis of policies adopted in the past.

Finally, further studies could investigate the implementation of periodic reports of specific areas of public administration so as to increase the disclosure to the public as well as it happens for listed companies in respect of investors. These reports should also indicate the degree of achievement in progress of long-term goals. This would promote a proper and honest administration of politicians by providing to citizens an evaluation tool for their actions.

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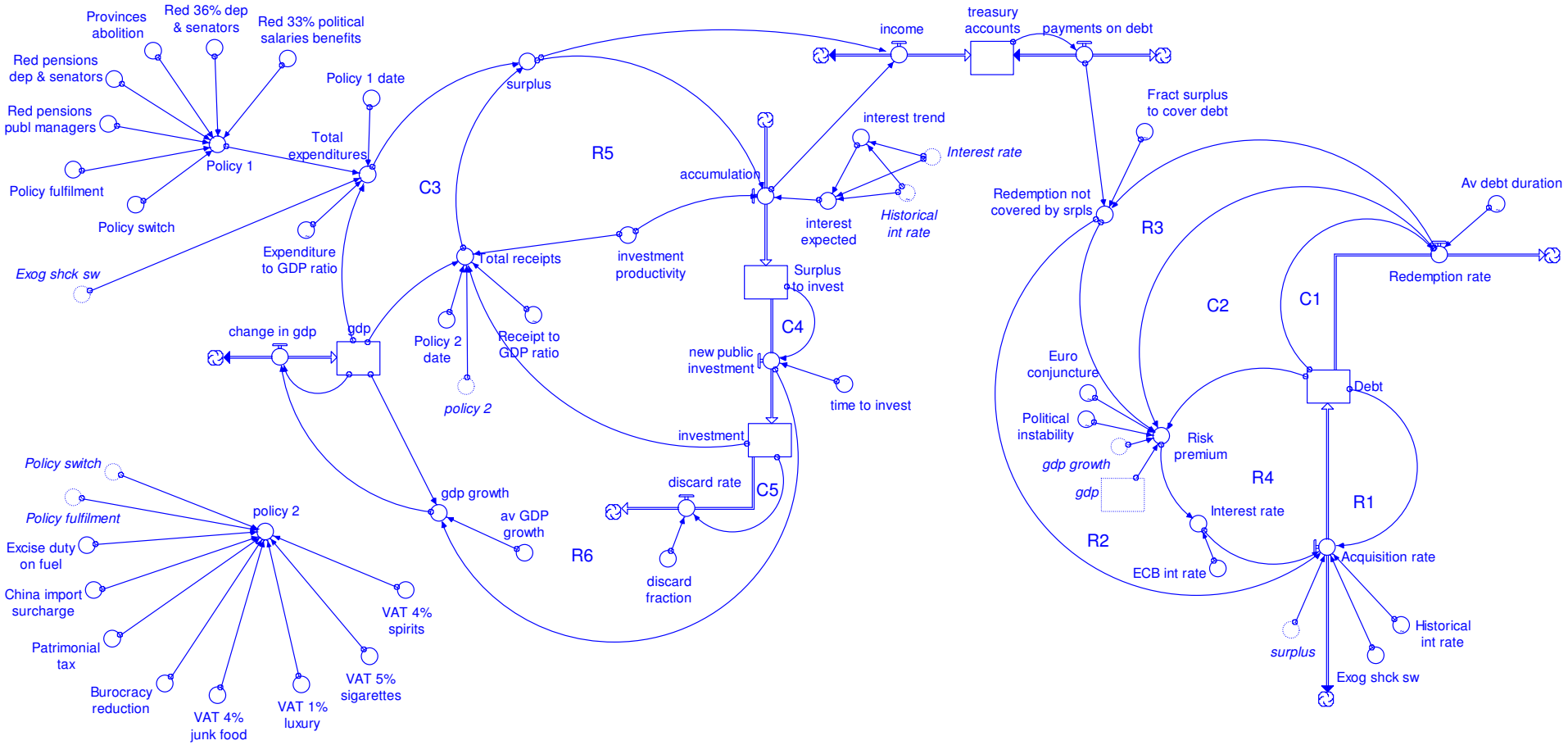
Appendix A: List of Equations and Documentation

Debt(t) = Debt(t - dt) + (Acquisition_rate - Redemption_rate) * dt
INIT Debt = 1300269
{Million of Euro}
INFLOWS:
Acquisition_rate = -
MIN(surplus,0)+Debt*((Historical_int_rate+Interest_rate)/100+step(5/100,2003)*Exog_shck_s
w)+Redemption_not_covered_by_srpls
{Million of Euro/year}
OUTFLOWS:
Redemption_rate = Debt/Av_debt_duration
{Million of Euro/year}
gdp(t) = gdp(t - dt) + (change_in_gdp) * dt
INIT gdp = 1191000
{Million of Euro}
INFLOWS:
change_in_gdp = gdp*gdp_growth
{Million of Euro/year}
investment(t) = investment(t - dt) + (new_public_investment - discard_rate) * dt
INIT investment = 5
{Million of Euro}
INFLOWS:
new_public_investment = Surplus_to_invest/time_to_invest
{Million of Euro/year}
OUTFLOWS:
discard_rate = investment*discard_fraction
{Million of Euro/year}
Surplus_to_invest(t) = Surplus_to_invest(t - dt) + (accumulation - new_public_investment) * dt
INIT Surplus_to_invest = 0
{Million of Euro}
INFLOWS:
accumulation = 0+STEP((IF (investment_productivity>(interest__expected)) THEN
(max(surplus,0)) ELSE 0), 2020)
{Million of Euro/year}
OUTFLOWS:
new_public_investment = Surplus_to_invest/time_to_invest
{Million of Euro/year}
treasury_accounts(t) = treasury_accounts(t - dt) + (income - payments_on_debt) * dt
INIT treasury_accounts = 0
{Million of Euro}
INFLOWS:
income = surplus-accumulation
{Million of Euro/year}
OUTFLOWS:
payments_on_debt = treasury_accounts
{Million of Euro/year}
av_GDP_growth = 0.02+step(-0.025,2009)+step(0.015,2013)
{Million of Euro/100/year}
Burocracy_reduction = 16629*0.35

{Million of Euro}
China_import_surcharge = 28790*0.02
{Million of Euro}
discard_fraction = 0.03
{Million of Euro/100/year}
ECB_int_rate = 1.0+step(1.25,2016)
{Million of Euro/100/year}
Exog_shck_sw = 0
gdp_growth = av_GDP_growth+new_public_investment/gdp
{Million of Euro/100/year}
Interest_rate = 0+STEP(ECB_int_rate+Risk_premium,2011)
{Million of Euro/100/year}
interest_trend = TREND((Interest_rate+Historical_int_rate),1,4)
{Million of Euro/100/year}
interest__expected = Interest_rate+Historical_int_rate+interest_trend
{Million of Euro/100/year}
investment_productivity = 4
{Million of Euro/100/year}
Patrimonial_tax = 6244000*0.0015
{Million of Euro}
Policy_1 =
(Reduction_36%_deputies_&_senators+Provinces_abolition+Red_33%_political_salaries_bene
fits)*Policy_switch*Policy_fulfilment
{Million of Euro}
Policy_1_date = 2013
policy_2 =
(China_import_surcharge+Patrimonial_tax+Burocracy_reduction+VAT_1%_luxury+VAT_4%
_junk_food+VAT_4%_spirits+VAT_5%_sigarettes)*Policy_switch*Policy_fulfilment
{Million of Euro}
Policy_2_date = 2012
Policy_fulfilment = 0
Policy_switch = 0
Provinces_abolition = 10700
{Million of Euro}
Redemption_not_covered_by_srpls = Redemption_rate-
(max(payments_on_debt,0)*Fract_surplus_to_cover_debt)
{Million of Euro}
Reduction_36%_deputies_&_senators = 3500
{Million of Euro}
Red_33%_political_salaries_benefits = 8230
{Million of Euro}
Risk_premium = Political_instability+(0.5+Debt/GDP-0.6)+(0.02-
gdp_growth)+(Redemption_not_covered_by_srpls/Redemption_rate)+Euro_conjuncture
{Million of Euro/100/year}
surplus = Total_receipts-Total__expenditures
{Million of Euro}
time_to_invest = 2
{year}
Total_receipts =
gdp*Receipt_to_GDP_ratio/100+investment*investment_productivity/100+STEP(policy_2,Poli
cy_2_date)
{Million of Euro}

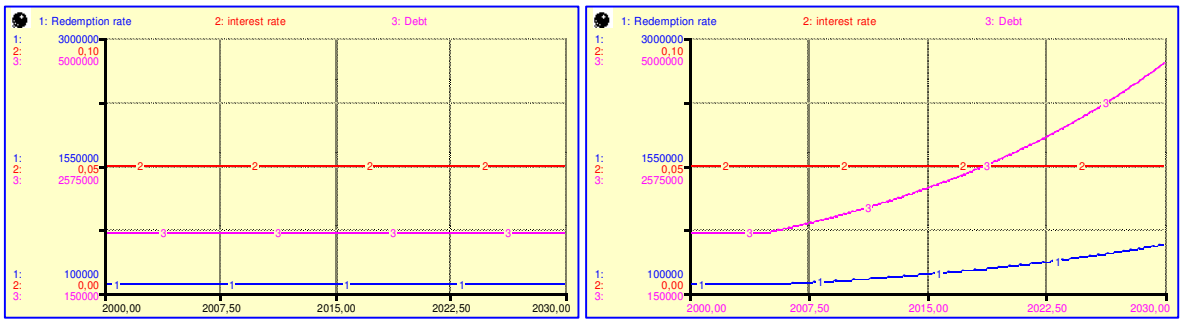
Total__expenditures = Expenditure_to_GDP_ratio/100*gdp-
step(200000,2006)*Exog_shck_sw-step(Policy_1,Policy_1_date)
{Million of Euro}
VAT_1%_luxury = 159000*0.01
{Million of Euro}
VAT_4%_junk_food = 984*0.04
{Million of Euro}
VAT_4%_spirits = 1200*0.04
{Million of Euro}
VAT_5%_sigarettes = 17000*0.045
{Million of Euro}
Av_debt_duration = GRAPH(TIME)
(2000, 5.80), (2001, 5.90), (2002, 5.60), (2003, 6.00), (2004, 6.40), (2005, 6.50), (2006, 6.60),
(2007, 6.80), (2008, 6.60), (2009, 7.00), (2010, 7.00), (2011, 7.00), (2012, 7.00), (2013, 7.10),
(2014, 7.20), (2015, 7.30), (2016, 7.40), (2017, 7.50), (2018, 7.60), (2019, 7.70), (2020, 7.80)
Euro_conjuncture = GRAPH(TIME)
(2000, 0.00), (2001, 0.00), (2002, 0.00), (2003, 0.00), (2004, 0.00), (2005, 0.00), (2006, 0.00),
(2007, 0.00), (2008, 0.00), (2009, 0.00), (2010, 0.5), (2011, 1.50), (2012, 1.00), (2013, 0.7),
(2014, 0.5), (2015, 0.00), (2016, 0.00), (2017, 0.00), (2018, 0.00), (2019, 0.00), (2020, 0.00)
Expenditure_to_GDP_ratio = GRAPH(TIME)
(2000, 48.1), (2001, 41.8), (2002, 41.9), (2003, 43.4), (2004, 43.3), (2005, 43.9), (2006, 44.6),
(2007, 43.4), (2008, 44.2), (2009, 50.2), (2010, 47.4), (2011, 46.4), (2012, 45.4), (2013, 44.4),
(2014, 43.7), (2015, 43.7), (2016, 42.7), (2017, 42.7), (2018, 42.2), (2019, 42.2), (2020, 42.2)
Fract_surplus_to_cover_debt = GRAPH(TIME)
(2000, 1.00), (2001, 1.00), (2002, 1.00), (2003, 1.00), (2004, 0.00), (2005, 0.00), (2006, 0.00),
(2007, 1.00), (2008, 0.00), (2009, 1.00), (2010, 1.00), (2011, 1.00), (2012, 1.00), (2013, 1.00),
(2014, 1.00), (2015, 1.00), (2016, 1.00), (2017, 1.00), (2018, 1.00), (2019, 1.00), (2020, 1.00)
Historical_debt = GRAPH(TIME)
(2000, 1.3e+006), (2001, 1.4e+006), (2002, 1.4e+006), (2003, 1.4e+006), (2004, 1.4e+006),
(2005, 1.5e+006), (2006, 1.6e+006), (2007, 1.6e+006), (2008, 1.7e+006), (2009, 1.8e+006),
(2010, 1.8e+006)
Historical_int_rate = GRAPH(TIME)
(2000, 4.79), (2001, 3.90), (2002, 3.14), (2003, 2.96), (2004, 3.56), (2005, 3.27), (2006, 3.92),
(2007, 4.54), (2008, 4.49), (2009, 3.38), (2010, 2.99), (2011, 0.00), (2012, 0.00), (2013, 0.00),
(2014, 0.00), (2015, 0.00), (2016, 0.00), (2017, 0.00), (2018, 0.00), (2019, 0.00), (2020, 0.00)
Political_instability = GRAPH(TIME)
(2000, 0.00), (2001, 0.00), (2002, 0.00), (2003, 0.00), (2004, 0.00), (2005, 0.00), (2006, 0.00),
(2007, 0.00), (2008, 0.00), (2009, 0.00), (2010, 1.00), (2011, 2.00), (2012, 0.5), (2013, 0.5),
(2014, 0.00), (2015, 0.00), (2016, 0.00), (2017, 0.00), (2018, 0.00), (2019, 0.00), (2020, 0.00)
Receipt_to_GDP_ratio = GRAPH(TIME)
(2000, 45.4), (2001, 45.0), (2002, 44.5), (2003, 45.1), (2004, 44.5), (2005, 44.2), (2006, 45.8),
(2007, 46.9), (2008, 46.7), (2009, 47.2), (2010, 47.5), (2011, 47.7), (2012, 47.7), (2013, 47.7),
(2014, 47.7), (2015, 47.7), (2016, 47.7), (2017, 47.7), (2018, 47.7), (2019, 47.7), (2020, 47.7)

Full stock and flow diagram

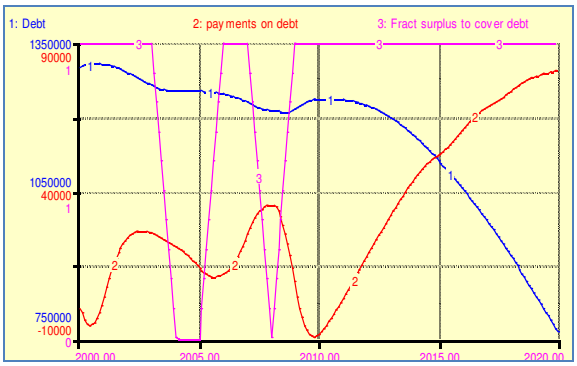


Appendix B: Model Tests

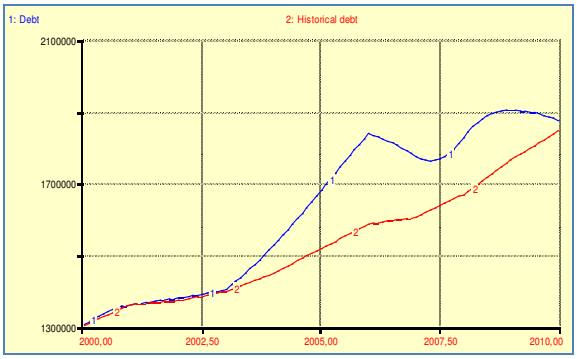
Equilibrium shock test 1 & 2



Extreme condition test

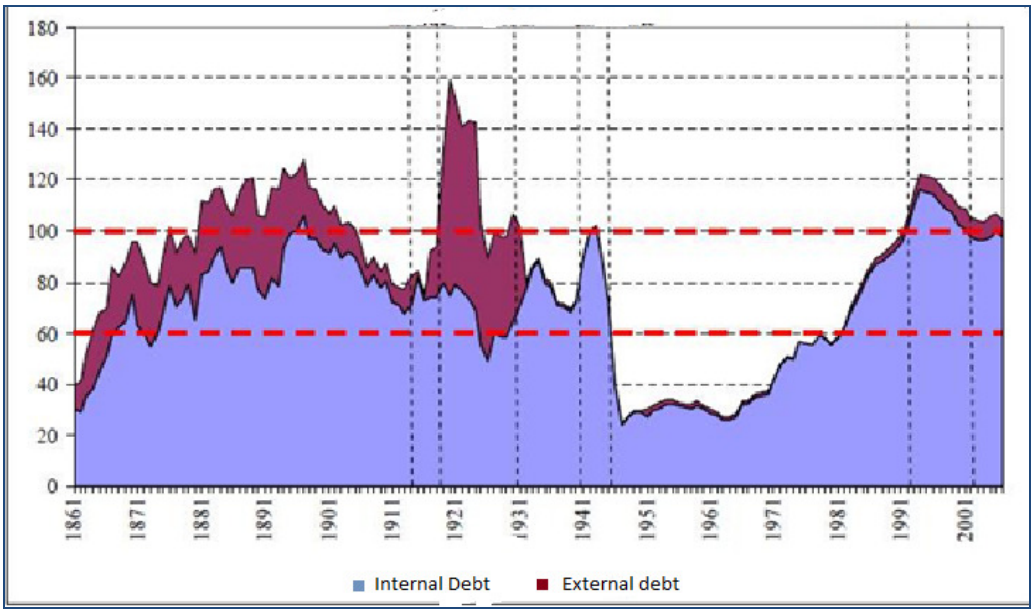


Parameters sensitivity test



Appendix C:

Internal and external Italy's debt (in % of GDP) from 1861 to 2001. Source: Bank of Italy



Italy's public debt from 1861 (in millions of euro). Source Bank of Italy