How the Italian "SIR" will change taxpayer's choices? The role of Fiscal Administration.

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ABSTRACT

There is a deep change in the Italian Audit mechanism. "SIR" is the acronym of "Synthetic Index of Reliability" and it is the new compliance method that will substitute Business Sector Analyses (in Italy called "Studi di Settore", SdS). The research goal is to study how SIR will change the Taxpayers (TPs) behaviour, and how this new instrument gives to the Fiscal Administration a chance to increase the cooperative tax compliance in Italy. Specifically, the paper will prove that the new SIR is able to discourage TPs from underreporting the declared inputs and, at the same time, to encourage them to declare more turnover as possible. This effect is obtained if we pay attention to the structure of the new Synthetic Index: managing the index architecture, Fiscal Administration will be able to maximize the tax compliance incentives in Italy. This paper has three aims: first of all, to construct a model for this new administrative framework. Secondly, to compare the new SIR with the old SdS, looking at the TPs behaviour. Finally to provide some policy indications for the Tax Agency, in order of maximize future compliance.

Keywords: Tax evasion, Tax Compliance, Audit.

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How the Italian "SIR" will change taxpayer's choices? The role of Fiscal Administration.

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August 1, 2017

Abstract

There is a deep change in the Italian Audit mechanism. "SIR" is the acronym of "Synthetic Index of Reliability" and it is the new compliance method that will substitute Business Sector Analyses (in Italy called "Studi di Settore", SdS). The research goal is to study how SIR will change the Taxpayers (TPs) behaviour, and how this new instrument gives to the Fiscal Administration a chance to increase the cooperative tax compliance in Italy. Specifically, the paper will prove that the new SIR is able to discourage TPs from underreporting the declared inputs and, at the same time, to encourage them to declare more turnover as possible. This effect is obtained if we pay attention to the structure of the new Synthetic Index: managing the index architecture, Fiscal Administration will be able to maximize the tax compliance incentives in Italy. This paper has three aims: first of all, to construct a model for this new administrative framework. Secondly, to compare the new SIR with the old SdS, looking at the taxpayer's behaviour. Finally to provide some policy indications for the Tax Agency, in order of maximize future compliance.

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"No overall modeling framework can be expected to offer an all-encompassing story of the compliance problem, although particular models can provide particular economic insights that illuminate particular aspects of the compliance problem, allowing a piecemeal appreciacion of Tax Administration."

Frank Cowell, "Carrots and Sticks in Enforcements" (2004)

1 Introduction.

It is well known that Italian shadow economy is at the top level of OECD countries. Some evidences (Schneider and Williams, 2013) explain that, looking at 21 OECD countries, the Italian overall shadow economy in 2012 was equal to 21.6% as percentage of national income, comparing to the 13.3% of Germany, 10.8% of France, 19.2% and 19.4% of Spain and Portugal. These discrepancies were growing during the great recession: Italian Giovannini's commission (MEF, 2016) explains how the estimated tax gap in Italy was close to 100 billions of Euro in 2013, with a 25% growth rate in front of 2008 (in which was close to 80). These evidences are the proof that the standard instruments to fight tax evasion are no longer effective, and a new interaction between the Italian Tax Agency and TPs is needed. It is also well known that the Italian large tax evasion is connected with a peculiar industrial system, composed by a huge number of small and micro-scale firms: the national Italian institute of Statistics (ISTAT, 2016) says that in 2014 the number of small and micro-scale business activities was 4.065.829, the 95.4% of the total firms[1], and for this reason the Italian Tax Administration, since 1998, has adopted a specific scheme of Audit, SdS, to fight tax evasion[2]. The challenge for the Italian Tax Administration was to have an efficient and credible Audit in a fiscal system in which there are millions of firms, and in which the probability to be audited is very low (Bosi, P., Guerra, M.C. 2016). For this reason, SdS represented a method to compute a "presumptive" level of turnover, based essentially on estimated "average" parameters multiplied by the TPs input's values. If the turnover reported in the fiscal declaration was higher than the presumptive one, the taxpayer was not auditable, while if it was lower, taxpayer had the chance to declare an higher level of turnover to close the gap[3], or to accept the possibility to be audited. This mechanism had the goal to stimulate cooperative compliance, but there were some crucial critics: one for all, the fact that there was a strong incentive to underreport input variables to have a lower level of presumptive turnover. Santoro (2008) built a model in which adapted a standard TPs behaviour model to the institutional framework of SdS, explaining how the manipulation of relevant variables of business accounting was a crucial element for noncompliance in Italy, and Santoro and Fiorio (2011) show that, in presence of known Audit rules, lower is the size of firms, lower is the probability to be audited and less firms will tend to report their output. Other economical and statistical critics were exploited by Rey Commission (2008), and so, during the years, SdS were progressively revised by SOSE[4]: there was the introduction of other two criteria ("Normality" and

[1]This number is not only composed by "firms", but also by self-employed person, freelance, and familiar activities. To simplify, from this point we will use as synonymous TPs and firms.

[2]For an exaustive description see Arachi and Santoro (2007) and Santoro (2008).

[3]This stage was called "Adeguamento", and was the key compliance mechanism. Firms had the chance to spontaneously adjust their turnover, and, doing so, avoid the Tax Administration Audit.

[4]The achronim is "Soluzioni per il Sistema Economico", and is the company that elaborates SdS for the Italian Ministry of Treasury. SOSE has the goal to construct the metodology in a continous link with Italian national Tax Agency (Agenzia delle Entrate, AE) and the TPs Associations.

"Coherence") that allow SOSE statistical analysts to depure the sample from the firms that seem to underreport inputs or output data, and to create a list of "unfaithful" contributors[5]. Nevertheless, SdS will remain a criticized instrument with low credibility and finally not able to really improve cooperative tax compliance in Italy.

For this reasons, SOSE is building a new institutional framework that could structurally take into account these criticism: the goal is to increase tax compliance in Italy. During the Audition with Finance Committees of the Italian Parliament in 24/03/2017 Vieri Ceriani[6] spoke about SIR like a *"...radical change in the relationship between Italian Fiscal Administration and TPs'.."*, a new method characterized by an ex-ante and stimulating approach compared to the old punitive and ex-post view of the Audit role.

The goal of this paper is to provide a decription of SIR and to present a model of TPs behaviour under this new institutional framework. So, this paper is very close to Santoro (2008) for two different reasons: it develops a generalization of his basic model, with a departure from standard literature in the specification of a new Audit function, and it shows how SIR is able to surpass SdS framework. The results seem to confirm that there will be significative change in the individual TP behaviour. New SIR takes into account two main components: the estimation of a presumptive level of different tax bases (as turnover, value added and other components) and the presence of anomaly indicators, that give a signal of the inaccuracy in the fiscal TPs data declaration. An important result is that the relative weight of this two components allows the Tax Agency to change the composition of incentives for TPs. Starting from this, Fiscal Administration can determine an "optimal rule" to maximize incentives to spontaneously declare higher turnover, and, at the same time, to stop the underreporting practice of fiscal declaration.

The paper is organized as follows: in the next section there will be a deep description of the SIR process and a link with the theorical background of Audit rule and tax evasion. There will be a section based on the model description, in which the TP choices are based on Scotchmer (1987) and Cowell (2004) models and are linked with institutional framework of SIR, and then a section of theorical results. There will be a section dedicated to some empirical results obtained by calibration, and policy indications and, finally, the conclusion. All the results are proved in the mathematical appendix.

[5]From 2009 "Coherence" and "Normality" indicators were introduced in the SdS methodology. These two types of indicators were properly used to signal anomalies in business accounting. Normality controls the correct value of some variables, trying to check if these variables were collocated in a "normal" range of values, while Coherence had the goal to depure the sample from evidently false declarations.

[6]SOSE's Chief Executive Officer.

2 From SdS to SIR: facts, description of the methodology and theoretical motivations.

There is a lively debate in Italy on Audit rules: SdS were introduced in our institutional framework in 1998, but during these years there were different views on their efficiency. With SdS, Italy chosed endogenous Audit rules applied to small and micro-scale firms.

It is well known that both theoretical and empirical evidences prove the fact that smaller is the firm's size, higher is the probability of fiscal avoidance or evasion. Cowell (2004) and Slemrod (2004) suggest the negative correlation from a theoretical point of view, and there are convergent evidences from an empirical point of view, also applied to the Italian case (Santoro and Fiorio 2011). For this same reason Italy needs an endogenous kind of Audit rule: a fixed and random number of Audit controls would not represent a credible threat for TPs that want to evade.

This is not a trivial argument. In the "workhorse paper" of Allingham and Sadmo (1972) the Audit rule was exogenous, in the sense that there was a fixed and random probability of Audit controls, and many authors discuss about the difference between exogenous and endogenous Audit rule (Andreoni, Erard and Feinstein 1998). In the case of an exogenous Audit rule there is no commitment between Tax Agency and taxpayer: the Audit is random, and the compliance is based on the fact that there should be a "sufficient" probability to be audited for a single taxpayer. The high number of Italian micro-scale firms and self-employed workers seems to discourage this mechanism. Conversely, endogenous Audit rule means that there is a commitment between Tax Agency and TPs. Tax Agency fixs an Audit rule and firms, knowing this rule, choose their level of declared sales. This means that, following standard literature, there is a threshold that Fiscal Administration imposes to each taxpayer, and that divides the firms that could be audited from firms that could not. A good Audit rule is a rule that: 1) is able to distinguish really fraudolent firms from the others 2) is able to incentive firms that are close to the threshold to do all the possible actions to pass over the cutoff point. It is well known in literature that uncertainty about Audit rule will decrease tax compliance (Alm et al. 1992) and that endogenous rules of Audit selection (like the cutoff rule) are more effective in increasing tax compliance than the random Audit (Alm et al 1993, Kirchler, 2007)[7], but it is also true that a coordination between TPs could trigger the endogenous Audit rule (Alm and McKee 2004). This was a crucial point for the case of Italian SdS: the process was statistically sophisticated but was theorically weak. During the years there was revealed a "structural" and authomatic coordination between TPs on how to avoid the threshold chosen by the Tax Agency, and, in addition, there was a natural incentive to underreport data. We can explain this point

[7]There is also a competition determinant for an Audit rule: Bayer and Cowell (2009) prove that different degrees of competition have an impact on the effectiveness of compliance policy, and a smarter Audit rule is needed also to overcome this bias.

showing the Audit function as formalized in Santoro (2008):

$$q(\hat{R}_i, \hat{X}_i) = \frac{1}{\delta_i} - \frac{1}{\delta_i}\frac{\hat{R}_i}{\hat{X}_i\beta} \Longleftrightarrow \hat{R}_i < \hat{X}_i\beta \tag{1}$$

$$q(\hat{R}_i, \hat{X}_i) = 0 \Longleftrightarrow \hat{R}_i \geq \hat{X}_i\beta$$

In this we can see that the individual "perceived" probability to be audited $\left(q(\hat{R}_i, \hat{X}_i)\right)$ depends on two main elements: δ_i and $\frac{\hat{R}_i}{\hat{X}_i\beta}$. The first is the individual disregard for the Audit: higher is this parameter, flatter is the Audit function. The second is the parameter that determines the threshold for the SdS[8]. The mechanims was very intuitive: first of all there was an estimation of the parameter β, that represents a vector of regression coefficients that was computed to explain the relationship between some economic and relevant variables $\hat{X}_i$[9] and the turnover $\hat{R}_i$. In a second stage[10] TP used a software[11] to input his relevant data, and specifically $\hat{X}_i$ and $\hat{R}_i$. Is in this second stage that the cutoff springs into action: if the declared turnover was lower than $\hat{X}_i\beta$[12] then the single firm was auditable, while on the contrary was free from the Audit function[13]. So, using this Audit rule, there was an intrinsic incentive to underreport relevant variables: lowering inputs $\hat{X}_i$ was the first way to lower $\hat{X}_i\beta$ and to cut the distance between the presumptive turnover and the declared one. This created a spontaneous coordination between TPs to elude the threshold, and this mechanism determined that, for example, in the period 1998-2004 the number of auditable firms decreased of about 20% without a parallel increase of tax base (AGENZIA DELLE ENTRATE, 2007)[14].

SIR structurally takes into account these evidences.
First of all, the stage of comparation between presumptive and declared turnover is substituted with an analysis of the firms "reliability": now, for each TP will be computed a Synthetic Index, to indicate his fiscal behaviour. This indicator will represent a "grade" on the reliability of TPs, that goes from 1 to 10, and that is constructed with a continous match between the observations of AE and of the Trade Associations.
This is an important point. In SdS, was predominant a compliance "ex-post" view, that had the goal to divide firms in auditable and not auditable activities. Declaring the estimated quote of higher turnover was a method used by TPs to avoid the Audit, that took action with a punitive target. With the SIR

[8]This is called in Santoro and Fiorio (2011) "The Italian cutoff Auditing Rule".

[9]We don't go into details, but these are the variables present in the business accounting declared two years before the reference period. This stage was called "construction", because was the stage at which the goal was to estimate the main sectoral relations between input and output.

[10]That was a stage called "Implementation", and is essentially a prediction done authomatically in the moment of fiscal declaration.

[11]That was called "Gerico".

[12]That is the "presumptive" turnover.

[13]Is in this stage that the TP could adjust his declared turnover to avoid possible future Audit: Fiscal Administration gave him the exact amount of turnover to close the gap, and firms choose if declare this additional amount of turnover or not.

[14]And this evidence was not due to the economic cycle (Pisani 2004).

introduction the attention is all focused on an "ex-ante view", in which firms compare the reliability level estimated by Tax Administration with their real fiscal behaviuor. Each TP will be able to check the Tax Agency's judgment on his business accounting declaration, and after this, can choose to adjust his input's variables and his turnover to reach a sufficient level of reliability. Compliance mechanism can now be richer than before, considering the fact that there could be more than one cutoff point: in fact we are not in a 0-1 world but in a continous scale (1-10) world, in which will be possible to establish different degrees of incentives at different stages of the fiscal grade[15].

New SIR is the simple mean of different indicators, divided in two prevalent groups: presumptive estimations of tax bases and anomaly indicators. Presumptive estimations are built with the same reasoning as before, a threshold useful to measure the consistency of the main tax bases; the news is that now there is not only the estimation of turnover but also of value added and other variables. These kind of indicators have an evaluation that goes from 1 to 10, and are computed for all TPs. Anomaly indicators have the goal to signal the difference between the declared and the real input in business accounting; this is a crucial element, because now the contributor's fiscal judgment is affected by some indexes that measure the TPs coherence and honesty in the business accounting. This comparation is possible thanks to an intensive match between data of different sources and the production of different indexes that controls the normality of different variables[16].These indicators are elements of the final simple mean only if there is an estimated difference between the declared and the real inputs, and have a graduation that goes from 1 to 5. TPs that will compile correctly their fiscal declaration will have a Synthetic Index only composed by presumptive estimations.

Finally, Tax Administration has the goal to give back some information to TPs. Coherently with the "service paradigm" literature, the purpose is to *"recognize the role of the enforcement but also emphasizes the role of Tax Administration as a facilitator as a provider of services to taxpayer-citizen"*(cit. Alm et al, 2011[17]). This new stream of contributions shows how informations and services provided by the Tax Agency have a positive impact on cooperative compliance. This is precisely the way chosen with SIR: a customized report will be prepared for each TP, explaining his economic situation, the global market trends, his comparative situation with respect to other economic activities. To sum up, there will be provided a personal Audit analysis,

[15]In SdS the incentives was established by Art.10, D.L. 201/2011, and determines, substantially, the auditability of TPs. Now is possible to study different incentives for each reliability level to increase compliance.

[16]Now the "normality" and "coherence" are integrated directly in the SIR. SIR has the goal to reinforce these kind of indicators, integrating them directly into the judgment of contributor's reliability. Now TPs know, at the moment of declaration, that his honesty has a direct influence on his fiscal "grade".

[17]A huge literature is reported on their paper, as for example Alm and Martinez-Vazquez (2003), Alm and Torgler (2011) Kirchler et al.(2008), and all these authors explain how the service paradigm plays a new and key role in the regards of TPs.

that tries to distribute a sufficient amount of information with the aim to give the right incentive to increase cooperative compliance. A deep change, that will have an impact on the future fiscal obligations of Italian small and micro-scale firms, and that represents a big challenge for the Italian Fiscal Administration.

3 The model

The basic model is a well known combination of the models proposed by Scotchmer (1987) and Cowell (2004), and adapted by Santoro (2008) to the institutional framework of SdS. The TP is a firm with risk-neutral preferences, that minimizes the amount of its expected tax payment gross of the concealment cost generated by evasion. Specifically, Cowell (2004) speaks about concealment cost like an increasing and convex function. This conjecture is based on some key factors: first of all the nature of the business, because it is easier to conceal some services compared to some physical good, secondly, firms size and organizational structure, because higher is the number of workers and employees, higher is the difficulty in concealment, and, at the end, the role of reputation, that is badly damaged by exposure to illegal activity[18]. If the first consideration could be related with the structure of a small and micro-scale firm, the second and the third considerations are not. Infact, the organizational structure of this kind of firms is very simplified, often familiar, in a context in which (in Italy) the tax morale is very low. Moreover, the fact that TPs (or their accountants) "play with Gerico"[19] means that, for them, declare some inputs is like "playing a game", and for this reason it is hard to think that is costly. This seems to suggest that the hypotesis of concealment cost like an increase and convex function could be relaxed. In what follows we will show that, with SIR scheme of precommitment, there are different possible solutions to this question, but, for future work, there is the need to take into account this consideration when the objective is to study behaviour of small and micro-scale firms. We also use the hypotesis of proportional taxation instead of "ad valorem" and progressive taxation, but this is just to simplifly the computations and there are no big differences in the main results.

The innovation of this paper is in the Audit function, that generalize Santoro's SdS framework and adapt it to SIR case. There are two type of Audit: Audit type I, that verifies the reliability of the TP, and Audit type II, that verifies the distance between the true or the relevant level of the reported variables[20].

For the type I Audit there are relevant news. As we said before, while in SdS

[18]These three arguments are contained in Cowell (2004). There was also another argument: the degree of industry concentration, but in our case is redundant.

[19]A common sentence that reveals the attitude towards fiscal declaration.

[20]This is known in Italy as "Accesso Breve". The framework that we are using is the same of Santoro (2008).

the attention was pointed on the threshold created comparing the presumptive and the declared level of turnover, with the new SIR the Tax Administration will focus its attention on the TP's "reliability". This fact has two main consequences. First of all, the Audit rule is now coherently a continous function: in the previous system was possible to think that the TPs presenting a lower level of declared turnover (respect to the presumptive one) were all "evaders", while now there is a differentiated judgement. Secondly, with SIR the Tax Administration is trying to analyze all the factors that affects the economic life of a firm, and the TPs have the possibility to correct their level of reliability looking to different indicators. This mechanism is the base of an improved cooperative tax compliance.

As we said before, looking specifically to the construction of the Synthetic Index, we can find two macro-components: presumptive estimations of turnover, value added and other tax bases, and the anomaly indicators. The presence of this two types of indicators allows us to generalize the Audit rule of SdS. Infact, while in SdS the threshold for each TP was only linked to $\hat{R}_i \leq \hat{X}_i\beta(1)$, now the anomalies permit to check the level of each $\frac{\hat{X}_j}{X_j}$, in which $\hat{X}_j$ is the level of declared input j, while X_j is the real level of the same input. We can specify the reliability degree for the individual i as follows:

$$Rel_i(TB^i, \hat{X}^i) = \left(\frac{1}{n_1 + n_2}\right)\left[\sum_{k=1}^{n_1}\left(\frac{TB_k^i}{PTB_k^i}\right) + \frac{1}{2}\sum_{j=1}^{n_2}\left(\frac{\hat{X}_j^i}{X_j^i}\right)\right] \tag{2}$$

$$q_{1,i}(Rel_i) = \frac{1}{\delta_{1,i}} - \frac{1}{\delta_{1,i}} Rel_i(TB^i, \hat{X}^i) \tag{3}$$

In which there is the presence of two blocks of indicators. In the first group we have n_1 indicators of the presumptive estimation block, TB_k^i that is the k tax base declared by TPs, PTB_k^i that is the k presumptive tax base estimated by Tax Administration. For the second block of indicators we have n_2 number of indicators, $\hat{X}_j^i$ that represents the j input declared in the fiscal declaration and X_j^i that is the real value of the same input; all is multiplied for 1/2 because this block of indicators has a graduation that goes from 1 to 5. We can see that the simple mean of this two blocks determines the single TP reliability level.

We can see from formula (3) that the perceived probability to be audited $q_{1,i}(Rel_i)$ is a linear decreasing function, but the cutoff is now linked to the Synthetic Index. This formula is valid if $TB_i < PTB_i$ and $\hat{X}_j < X_j$. The final Synthetic Index will not take into account anomaly indicators that have $\hat{X}_j = X_j$ for some j[21]. If the TP has no anomalies in the declaration and $TB^i \geq PTB^i$, the reliability grade is equal to the maximum grade and we impose that $q_{1,i}(\hat{Rel}_i) = 0$.

[21]For example, if $\hat{X}_j = X_j$ for all the j indicators, SIR will be composed only by the first n_1 indicators.

The strength of this new method is the flexibility: it is possible to modify the composition of the index verifying the effectiveness of their components. It is using this flexibility that Fiscal Administration will have a new role. Infact, what it is important to stress is that the composition of the final indicator will modify deeply the TPs behaviour. Presumptive estimation block strenghthen the incentive to declare more tax base in the fiscal declaration, while anomalies strenghthen the incentive to stop the underreporting practice. To clarify this point we can simplify the precedent formula (2) looking to the new indicator like a weighted mean of two component: presumptive estimations and anomalies. For simplicity we impose $n_1 = 1$ considering only the presumptive turnover $\left(\frac{\hat{R}_i}{\hat{X}_i\beta}\right)$ with weigth α and $n_2 = 1$ considering only one anomaly indicator for all inputs $\left(\frac{\hat{X}_i}{X_i}\right)$ with weight $1-\alpha$. Simplifying, the new Synthetic Index of Reliability is the following:

$$Rel_i(\hat{R}_i, \hat{X}_i) = \alpha \left(\frac{\hat{R}_i}{\hat{X}_i\beta}\right) + (1-\alpha)\left(\frac{\hat{X}_i}{X_i}\right) \tag{4}$$

As before, this is valid if $Rel_i(\hat{R}_i, \hat{X}_i) \in [0,1]$. The parameter $\alpha \in [0,1]$, is the weight that the administration gives to the estimation of turnover and $1-\alpha$ is the weight for anomalies[22]. With this formulation, the reliability is a linear combination of these two factors, and the Tax Administration chooses the level of weight for each element. If we impose $\alpha = 1$ in (4) we come back to the case of SdS: in this sense this model represents a generalization of Santoro's model (2008), and the departure from that model is given by the effect of the anomalies in the behaviour of the single TP. For this reason SIR represents an important innovation also from a theorical point of view[23]. The audit function considered, given this new reliability, is always (3), and the parameter $\delta_{1,i}$ explains (as in (1)) the disregard for the Audit, or the inverse of the perceived probability to be audited. More the TP is insensible to the Audit, bigger is $\delta_{1,i}$ and lower is the perceived probability to be audited (ceteris paribus).

There are relevant news also for the Type II Audit. As we said before, this type of Audit depends on the distance between the declared and the real firm's inputs. We maintain the Santoro's formalization for the penalty part, that implies a taxation with a specific fee multiplied for the difference between declared and real input, but now the Audit is able to be more effective. In Santoro (2008) this was represented by a constant function, composed only by the probability (the term p) to receive a Type II Audit, but this was a critical point of the SdS methodology. Infact, the probability to be audited was very low, and the incentive to underreport inputs was too high and correlated with a very low probability to be detected. As a consequence of this

[22]These weights are specular to the number of indicators that compose each block weighted for the graduation of each block. Intiutively, higher is the number n_1 (or n_2), higher will be the weigth α (or $1-\alpha$).

[23]In what follows we will talk about SdS framework referring to the model of Santoro. In the text we will frequently refer to his model, whose results are replicable imposing $\alpha = 1$.

common practice, the estimation was artificially lowered and SdS failed to increase cooperative compliance. The correction introduced with "normality" and "coherence" indicators was ineffective, and the criticism against SdS growed in time. Now there are new elements associated to the anomaly indicators: infact AE could use the information about anomalies that comes out from the reliability, and select the firms with higher anomalies in the business accounting. In this sense, each TP will look to his own reliability index knowing that higher will be the penalization given to the anomalies, higher will be the probability to receive a type II Audit control. Now we have a new Type II Audit function i.e.:

$$q_{2,i}(\hat{X}_i) = \frac{p}{1 - \frac{1}{\delta_{2,i}}(1-\alpha)\left(1 - \frac{\hat{X}_i}{X_i}\right)} \tag{5}$$

The parameters $\delta_{2,i}$ are analogue to $\delta_{1,i}$, and is the subjective insensibility to the Type II Audit[24], the product $(1-\alpha)\left(1 - \frac{\hat{X}_i}{X_i}\right)$ represents the anomalies of the business report. Bigger are the anomalies, bigger is also the perceived probability to be detected given the fact that Tax Administration has this information. This new endogenous Audit rules will have the goal to increase cooperative compliance.

Finally, the TP's problem is to minimize his gross Expected Payment, that follows the following specification:

$$\begin{aligned} EP_i = \frac{\tau}{X_i}\left(\hat{R}_i - \hat{C}_i\right) + q_{1,i}(\hat{R}_i, \hat{X}_i)\,(1+f_1)\,\frac{\tau}{X_i}\left(\beta\hat{X}_i - \hat{R}_i\right) + \\ +q_{2,i}(\hat{X}_i)(1+f_2)\tau\beta\left(1 - \frac{\hat{X}_i}{X_i}\right) + G\left(1 - \frac{\hat{X}_i}{X_i}\right) \end{aligned} \tag{6}$$

As in Santoro (2008) there is the sum of 4 elements: the proportional taxation on contributor's taxable income, specified in the difference between the declared turnover and declared comprehensive costs, the two penalties $(1+f_1)$ and $(1+f_2)$ multiplied for the possible evasion that comes out from a Type I and II Audit, and the concealment cost, assuming for now their convexity ($G'' > 0$). Coherently with the formulation we proceed with a section of results.

4 Results

4.1 The new Audit functions

First of all it is useful to look to the differentiation of the Audit type I function with respect to $\hat{R}_i$ and $\hat{X}_i$, that gives what follows:

$$\frac{\delta q_{1,i}(\hat{R}_i, \hat{X}_i)}{\delta \hat{R}_i} = -\left(\frac{\alpha}{\delta_{1,i}}\frac{1}{\hat{X}_i\beta}\right) \tag{7}$$

[24]Without loss of generality we can assume that $\delta_{1,i} = \delta_{2,i}$. We have only to change the interpretation, giving to a generical δ_i the interpretation of insensibility to all the possible audits.

$$\frac{\delta q_{1,i}(\hat{R}_i, \hat{X}_i)}{\delta \hat{X}_i} = \frac{\alpha}{\delta_{1,i}} \left(\frac{\hat{R}_i}{\hat{X}_i^2 \beta} \right) - \frac{(1-\alpha)}{\delta_{1,i}} \frac{1}{X_i} \tag{8}$$

The partial derivative of $q_{1,i}(\hat{R}_i, \hat{X}_i)$ respect to $\hat{R}_i$ is negative because a negative variation of the perceived probability to be audited corresponds to a positive variation of the declared turnover (or its adaptation when the Gerico session is open). Moreover, now this differentiated probability is a fraction of the previous one, and this depends on the weight α: the term $\left(\frac{\hat{R}_i}{\hat{X}_i \beta}\right)$ is not more the only element that the TP must take into account. This is evident when we look to the second partial derivative, of $q_{1,i}(\hat{R}_i, \hat{X}_i)$ respect to $\hat{X}_i$. In SdS this derivative was positive, because declaring higher relevant variables would have the consequence to raise the distance between the presumptive and declared turnover. This was a crucial point of the critiques about SdS: underreporting costs had as consequence that probability to be audited was low. This was at the base of the incentive in underreporting inputs variable. In SIR there is a negative element that offsets this effect, taking into account that TP will declare more inputs in terms of reliability: higher is the weight of anomalies (and then higher is $(1-\alpha)$), stronger is this effect, and so weaker will be the incentive to underreport costs in term of perceived probability to be audited[25]. If we look to the derivative of the Audit Type II we obtain the following intuitive result:

$$\frac{\delta q_{2,i}(\hat{X}_i)}{\delta \hat{X}_i} = -p \left(\frac{\frac{(1-\alpha)}{\delta_{2,i} X_i}}{\left(1 - \frac{1}{\delta_{2,i}}(1-\alpha)\left(1 - \frac{\hat{X}_i}{X_i}\right)\right)^2} \right) \tag{9}$$

Obviously this derivative has always a negative sign: higher is the level of declared costs, lower will be the probability to be audited by the Tax Administration with a control on inputs. This effect is proportional to the probability p and to the weight of the anomalies in the index $(1-\alpha)$.

4.2 The reported turnover

If we go on by differentiating the expected payment with respect to declared turnover we obtain this two formulas:

$$\frac{EP(\hat{R}_i, \hat{X}_i)}{\hat{R}_i} \Longrightarrow \frac{\tau}{X_i} \left\{ \frac{\delta_{1,i} - (1+f_1)(1+\alpha)}{\delta_{1,i}} + \frac{2(1+f_1)\alpha}{\delta_{1,i}} \left(\frac{\hat{R}_i}{\hat{X}_i \beta} \right) \right\} + \tag{10}$$

$$+ \frac{\tau}{X_i} \left\{ \frac{(1+f_1)(1-\alpha)}{\delta_{1,i}} \left(\frac{\hat{X}_i}{\hat{X}_i} \right) \right\} = 0$$

[25] If the anomalies will have a relevant weight in the computation of the general index, there is the possibility that this derivative would be negative. This means that for the TP will be better to declare higher inputs, because this would lower the probability to be audited.

From which, with simple manipulation, we can arrive to:

$$\frac{\hat{R}_i}{\hat{X}_i\beta} = \frac{1}{2\alpha}\left((1+\alpha) - \frac{\delta_{1,i}}{(1+f_1)} - (1-\alpha)\left(\frac{\hat{X}_i}{X_i}\right)\right) \tag{11}$$

Interpretation of the formulas is always connected to the interpretation of the role of α[26]. Infact, while we can give to $\delta_{1,i}$ the same interpretation of the SdS case study[27], there is a new term in the determination of $\hat{R}_i$, represented by $(1-\alpha)\left(\frac{\hat{X}_i}{X_i}\right)$. Higher will be the consideration of the anomalies in the business accounting given $\hat{X}_i$, lower will be the turnover that the TP will declare. The interpretation is intuitive: If the Synthetic Index is composed also with anomalies, TP will find convenient (to receive an higher degree of reliability and, through this channel, a lower expected payment) not only to adjust the level of turnover but also to adjust business accounting.

There are other two aspects about this topic: the range of $\delta_{1,i}$ and the role of α with respect to $\hat{R}_i$. Infact, while it is obvious that the minimum value for $\delta_{1,i}$ is 1[28], we have to compute a new maximum that is equal to:

$$1 \leq \delta_{1,i} \leq (1+f_1)\left((1+\alpha) - (1-\alpha)\left(\frac{\hat{X}_i}{X_i}\right)\right) \tag{12}$$

The value that cames out from Santoro (2008) was $2(1+f_1)$. We can see that, now, the maximum is lowered by anomalies, that acts with the second term in the round brackets. The fact that the reliability takes into account the anomalies in business accounting, obviously, affects the disregard for the Audit and increase the subjective TP "fear" to have a higher level of future payments. Moreover a question arises: which is the influence of α on declared turnover? If we pay attention to (11) we have to take into account that α is present both inside the brackets and in the denominator of the formula. If we differentiate (11) with respect to α and with the constraint that this derivative must be≥ 0 we can obtain the following condition:

$$\frac{X_i - \hat{X}_i}{X_i} \leq \frac{\delta_{1,i}}{(1+f_1)} \tag{13}$$

If we consider the maximum possible values of $\delta_{1,i}$ we obtain that the TP has a positive incentive to declare more turnover for every α[29], while with $\delta_{1,i} = 1$ there is a threshold for this relation, that depends from the size of the f_1. Substantially, we can say that, except for unrealistic values of evasion[30], increasing α will increase the incentive to declare higher level of turnover.

[26]Note that if we impose $\alpha = 1$ we arrive immediately to the Santoro's (2008) formulation that gives us $\frac{\hat{R}_i}{\hat{X}_i\beta} = \left(1 - \frac{\delta_{1,i}}{2(1+f_1)}\right)$.

[27]Lower is $\delta_{1,i}$ closer will be $\hat{R}_i$ and $\hat{X}_i\beta$.

[28]If not, we will have a probability higher then 1, and this is not possible.

[29]If we substitute in (13) $\delta_{1,i}$ with the third element of (12) we obtain that the derivative has a positive sign for every $\alpha > 0$.

[30]See the Appendix to understand this point.

4.3 The declared inputs

In the previous subsection we have identified the best value of $\hat{R}_i$ given a certain value of declared inputs. What happens if we control for the variation of $\hat{X}_i$? We have to differentiate EP with respect to $\hat{X}_i$:

$$\frac{EP_i}{\delta \hat{X}_i} = \left(\frac{\alpha}{\delta_{1,i}}\frac{\hat{R}_i}{\hat{X}_i^2\beta} - \frac{(1-\alpha)}{\delta_{1,i}X_i}\right)\left((1+f_1)\frac{t}{X_i}(\beta\hat{X}_i - \hat{R}_i)\right) + \tag{14}$$

$$+\left(\frac{1}{\delta_{1,i}} - \frac{1}{\delta_{1,i}}\left(\alpha\frac{\hat{R}_i}{\hat{X}_i\beta} + (1-\alpha)\frac{\hat{X}_i}{X_i}\right)\right)(1+f_1)\frac{t}{X_i}\beta -$$

$$-\left(\frac{p(1-\alpha)}{\left(1-\frac{1}{\delta_{2,i}}(1-\alpha)\left(1-\frac{\hat{X}_i}{X_i}\right)\right)^2\delta_{2,i}X_i}\right)(1+f_2)t\beta\left(1-\frac{\hat{X}_i}{X_i}\right) -$$

$$-\left(\frac{p}{1-\frac{1}{\delta_{2,i}}(1-\alpha)\left(1-\frac{\hat{X}_i}{X_i}\right)}\right)\left(\frac{(1+f_2)t\beta}{X_i}\right) - \frac{1}{X_i}G'\left(1-\frac{\hat{X}_i}{X_i}\right)$$

With other algebra we can arrive at the following formula:

$$\frac{1}{X_i}G'\left(1-\frac{\hat{X}_i}{X_i}\right) = \Omega + \Phi\left(\frac{1-\alpha}{X_i}\right)\hat{R}_i - \Phi\left(\frac{\alpha}{\hat{X}_i^2\beta}\right)\hat{R}_i^2 \tag{15}$$

Where Ω is given by the following equation:

$$\Omega = \Phi\beta\left(-2(1-\alpha)\frac{\hat{X}_i}{X_i} + 1\right) - \tag{16}$$

$$-\chi\left(\frac{p(1-\alpha)}{\left(1-\frac{1}{\delta_{2,i}}(1-\alpha)\left(1-\frac{\hat{X}_i}{X_i}\right)\right)^2\delta_{2,i}}\right)\left(1-\frac{\hat{X}_i}{X_i}\right) -$$

$$-\chi\left(\frac{p}{1-\frac{1}{\delta_{2,i}}(1-\alpha)\left(1-\frac{\hat{X}_i}{X_i}\right)}\right)$$

With:

$$\Phi = \frac{(1+f_1)t}{\delta_{1,i}X_i} \tag{17}$$

$$\chi = \frac{(1+f_2)t\beta}{X_i} \tag{18}$$

The interpretation of the right side of equation (15) is less intuitive, but we can note that while in Santoro (2008) there was only the quadratic term of $\hat{R}_i$ with negative sign, now there is also a linear term of $\hat{R}_i$ multiplied by a positive coefficient $\Phi\left(\frac{1-\alpha}{X_i}\right)$. This coefficient is directly proportional with $1-\alpha$, and suggests an interpretation of this new term in the equation: higher will be the weight of anomalies and higher will be the concealment cost. It is also interesting to analyze the new term Ω. Comparing (16) with the formula

of SdS[31] now there are three elements instead of two: the first is connected to the penalty for the Audit type I, while the second and third are connected to the penalty for the Audit type II. The first penalty is lower than the SdS case because the reliability takes into account also the correctness of the fiscal declaration, and we can see that higher is $(1-\alpha)$, lower is the addend related to penalty of Audit type I. On the contrary, the sum of the addends related to the Audit penalty type II is higher than the SdS case, because the influence of the anomalies determines an additive penalty directly related to the percentage of evasion (the second term of Ω), and focused by an higher probability to receive this kind of Audit.

Substituting (11) in the previous formula we can obtain, after some math the last formula from which we can arrive at the level of declared inputs that minimize the TP problem, that is:

$$\frac{1}{X_i}G'\left(1-\frac{\hat{X}_i}{X_i}\right)= \tag{19}$$

$$=\left[\frac{\Phi\beta}{4\alpha}\left(4\alpha-\left((1+\alpha)^2+\frac{\delta_{1,i}^2}{(1+f_1)^2}-\frac{2(1+\alpha)\delta_{1,i}}{(1+f_1)}\right)\right)\right]-$$

$$-\chi p\left(\frac{(1-\alpha)}{\left(1-\frac{1}{\delta_{2,i}}(1-\alpha)\left(1-\frac{\hat{X}_i}{X_i}\right)\right)^2\delta_{2,i}}+\frac{1}{\left(1-\frac{1}{\delta_{2,i}}(1-\alpha)\left(1-\frac{\hat{X}_i}{X_i}\right)\right)}\right)+$$

$$+\chi p\left(\frac{(1-\alpha)}{\left(1-\frac{1}{\delta_{2,i}}(1-\alpha)\left(1-\frac{\hat{X}_i}{X_i}\right)\right)^2\delta_{2,i}}\right)\left(\frac{\hat{X}_i}{X_i}\right)-$$

$$+\Phi\beta(1-\alpha)\left(-2+\frac{(1-\alpha)}{\alpha}-\frac{\delta_{1,i}}{\alpha(1+f_1)}\right)\left(\frac{\hat{X}_i}{X_i}\right)-\frac{3}{4}\Phi\left(\frac{(1-\alpha)^2\beta}{\alpha}\right)\left(\frac{\hat{X}_i}{X_i}\right)^2$$

It is possible to see that this formula is more complicated than the formula in Santoro (2008), but the most important thing is to note that now the level of $\hat{X}_i$ depends crucially from α.

4.4 The Tax Agency problem: the choice of α

The choice of α is a crucial point to balance the incentives. Infact, the TP (or his business accountant) will know the composition of the index and will decide to declare his inputs and turnover starting from this. If α will be too low (and $(1-\alpha)$ will be to high), there will be no incentive to declare more turnover because the Synthetic Index of Reliability will not change significantly. On the contrary, if α will be to high (and $(1-\alpha)$ will be too low) there will be a strong incentive to underreport the relevant variables determining that the presumptive turnover is artificially pulled down.

[31] We can note infact that, if we impose $\alpha = 1$ we come back to the case in which $\Omega = t\left[\beta\left(\frac{1}{\delta_{1,i}}(1+f_1)-p(1+f_2)\right)\right]$

Which is the solution? For the Tax Administration is crucial to stop the underreporting practice, and to determine a cooperative compliance mechanism in which the incentive to declare more turnover is highly as possible.

In this paper we propose a solution: a rational administration will choose the level at which there is a maximum incentive for the TP to declare relevant variables and, given this condition, the maximum level of incentive to declare turnover. This means that we proceed to solve (19) as a parametric equation: to find the required α we impose $\frac{\hat{X}_i}{X_i} = 1$ and then find the level of α that solves the equation. Proceeding with this operation in (19) we arrive to the equation:

$$\left[\frac{\Phi\beta}{4\alpha}\left(4\alpha - \left((1+\alpha)^2 + \frac{\delta_{1,i}^2}{(1+f_1)^2} - \frac{2(1+\alpha)\delta_{1,i}}{(1+f_1)}\right)\right)\right] - \chi p + \tag{20}$$

$$+\Phi\beta(1-\alpha)\left(-2 + \frac{(1-\alpha)}{\alpha} - \frac{\delta_{1,i}}{\alpha(1+f_1)}\right) - \frac{3}{4}\Phi\left(\frac{(1-\alpha)^2\beta}{\alpha}\right) = 0$$

From which, with simple manipulation, we can arrive to the final formula of α, that is:

$$\alpha = \frac{\frac{1}{4}\frac{\delta_{1,i}}{(1+f_1)} + \frac{1}{2}}{\frac{3}{2} - (1+f_2)p} \tag{21}$$

We can see that α is influenced by two types of variables: $\frac{\delta_{1,i}}{(1+f_1)}$ and $(1+f_2)p$. The first term represents the subjective and objective factors that are the deterrent for type I evasion, while the second is the deterrent (or disincentive) for type II evasion. The weight α is inversely related to these two types of deterrent. If there is a growth of the deterrent of type I evasion, α will be lower to increase the disincentive for type II evasion, and viceversa with type II disincentive. In some sense, α is a way for the Tax Agency to balance the mix of incentives for the TP, solving the problem of underreporting practice.

5 A simulation of alpha

Now the problem is to identify a value of α that can be used for SIR computation. As usual, we proceed with calibration of parameters in a coherent way with literature.

We have seen from the previous formula that α depends from four variables: $\delta_{1,i}$, p, f_1 and f_2. We impose the same values of p, f_1 and f_2 that are present in Santoro (2008). For p we take into account that Tax Administration does not change the number of type II Audit, determining that there aren't new expenditures related to the SIR Audit function. The fee that the TP must pay in the Audit I case has a range that goes from -0.1 (in case of a discount) to 1, while the fee that TP pays in the type II Audit case goes from 1 to

2. Moreover, $\delta_{1,i}$ has a range defined by (12), but with another maximum value. Infact, in the moment of the declaration, the TP knows the level of α chosen by the Tax Agency, and this level influences the range of his subjective disregard. Imposing (21) and $\frac{\hat{X}_i}{X_i} = 1$ we have that $\delta_{1,i} \leq \frac{(1+f_1)}{1-(1+f_2)p}$. We note that this maximum varies with three of the four factors that have an influence on α. First of all, we have to compute the different values of $\delta_{1,i}$ that represent the maximum disregard of the TP, and secondary we compute α with values that are taken from this computation. Particularly, we choose the mean between the minimum value of 1 and the maximum value obtained after the calibration. In this way we can obtain a coherent scheme to analyze α, and Table I and II give us the results of this exercise.

Table 1: 1) Maximum value of $\delta_{1,i}$

f_1 / f_2	**-0,1**	**0**	**0,1**	**0,2**	**0,3**	**0,4**	**0,5**	**0,6**	**0,7**	**0,8**	**0,9**	**1**
1	1,000	1,111	1,222	1,333	1,444	1,556	1,667	1,778	1,889	2,000	2,111	2,222
1.1	1,006	1,117	1,229	1,341	1,453	1,564	1,676	1,788	1,899	2,011	2,123	2,235
1.2	1,011	1,124	1,236	1,348	1,461	1,573	1,685	1,798	1,910	2,022	2,135	2,247
1.3	1,017	1,130	1,243	1,356	1,469	1,582	1,695	1,808	1,921	2,034	2,147	2,260
1.4	1,023	1,136	1,250	1,364	1,477	1,591	1,705	1,818	1,932	2,045	2,159	2,273
1.5	1,029	1,143	1,257	1,371	1,486	1,600	1,714	1,829	1,943	2,057	2,171	2,286
1.6	1,034	1,149	1,264	1,379	1,494	1,609	1,724	1,839	1,954	2,069	2,184	2,299
1.7	1,040	1,156	1,272	1,387	1,503	1,618	1,734	1,850	1,965	2,081	2,197	2,312
1.8	1,047	1,163	1,279	1,395	1,512	1,628	1,744	1,860	1,977	2,093	2,209	2,326
1.9	1,053	1,170	1,287	1,404	1,520	1,637	1,754	1,871	1,988	2,105	2,222	2,339
2	1,059	1,176	1,294	1,412	1,529	1,647	1,765	1,882	2,000	2,118	2,235	2,353

The value of p is imposed equal to 0.05

We can see that there is a linear dependency between the two fees (f_1 and f_2) and α (Table 1), and that the resulting final range for α is contained between 0.501 and 0.582 (Table 2). The variation of α is the same as before: higher is the deterrent for type I evasion[32] higher will be the need to balance the incentives increasing the necessity to be honest in his declaration. Viceversa, increased penalties for type II Audit means that there is an increased need to declare correctly turnover, value added and so on. This means that there is the need to balance the block of the estimated values and the block of the anomalies - more or less with equal weights - to obtain the best incentive for cooperative compliance.

Starting from this recommendation, will be crucial in the future the "check and balance" ability of Fiscal Administration. In fact, there are two parameters that must be monitored to check the correctness of the incentives: the

[32]That means higher fee or lower disregard for the Audit.

Table 2: 1) Value of α

f_1 / f_2	**-0,1**	**0**	**0,1**	**0,2**	**0,3**	**0,4**	**0,5**	**0,6**	**0,7**	**0,8**	**0,9**	**1**
1	0,556	0,546	0,538	0,531	0,525	0,520	0,516	0,512	0,509	0,506	0,503	0,501
1.1	0,558	0,548	0,540	0,533	0,527	0,523	0,518	0,515	0,511	0,508	0,506	0,503
1.2	0,561	0,551	0,543	0,536	0,530	0,525	0,521	0,517	0,514	0,511	0,508	0,506
1.3	0,563	0,553	0,545	0,538	0,532	0,527	0,523	0,519	0,516	0,513	0,510	0,508
1.4	0,566	0,556	0,548	0,541	0,535	0,530	0,526	0,522	0,519	0,516	0,513	0,511
1.5	0,569	0,558	0,550	0,543	0,537	0,532	0,528	0,524	0,521	0,518	0,515	0,513
1.6	0,571	0,561	0,553	0,546	0,540	0,535	0,531	0,527	0,524	0,521	0,518	0,515
1.7	0,574	0,564	0,555	0,548	0,543	0,538	0,533	0,529	0,526	0,523	0,520	0,518
1.8	0,577	0,566	0,558	0,551	0,545	0,540	0,536	0,532	0,529	0,526	0,523	0,520
1.9	0,579	0,569	0,561	0,554	0,548	0,543	0,538	0,535	0,531	0,528	0,525	0,523
2	0,582	0,572	0,563	0,556	0,551	0,545	0,541	0,537	0,534	0,531	0,528	0,526

The value of p is imposed equal to 0.05 and the value of $\delta_{1,i}$ is computed as a mean between 1 and the values of the table 1.

progressive increasing in the normal tax base, and the size of turnover adjustments. From an increase of the presumptive tax base we can deduce that the mechanism of underreporting relevant variables is no more prevalent. The analysis could control if this variation is determined also by cyclical effects, but there is the need to verify if the anomalies are strong enough to stop the underreporting practice of the business accountants. Conversely, Fiscal Administration has the need to take into account the amount of turnover and value added adjustments; as before, there could be different factors that have an influence on this variable, and the principal is the fiscal stimolus that is used to increase compliance. Obviously, there could be a single or multiple incentives along the grade of each contributor, and this has an effect on the compliance system. Tax Administration has the responsibility to control both the effect of the incentive to pass on the threshold and the effect of the weight of the estimations on the Synthetic Index.

6 Conclusion

In this paper we present a model with the goal to study SIR, the new Italian institutional framework for Tax Compliance. This is a crucial passage for Italian Fiscal Administration: the old endogenous Audit rule, represented by SdS, was linked to the so called "Italian threshold", a comparation between firms declared and presumptive turnover. In the new context, the goal is to provide an analysis of "fiscal reliability" of each TP, using an approach that tries to analyze every business accounting aspects. We show a new model for the TP's decision, using some well known literature's hypothesis and adapting them to the new SIR context.
The results are the following.
First of all there is an important change in the behaviour of TPs: each firm

knows that there will be a judgment on his personal "normal tax base" but also on his honesty in the business accounting. This means that, while before there was a constant incentive to underreport costs and relevant variables, now there is a decreasing or, over determinate values, negative incentive.
Second, managing the Synthetic Indicator structure, it is possible to maximize the TP's incentive to declare all the relevant inputs as possible. This determines that the future tax base will be increased because the Tax Agency is able to choose the biggest incentive to avoid the underreporting practice, a common and well known problem of the old SdS.
Third of all, it is possible to maximize the tax base adjustment in the declaration moment: this means that there is the possibility of an effective compliance mechanism, in a context in which the Fiscal Administration gives to TPs all the possible information and services to reach the most adequate level of reliability.

As consequence, there is an increased role of Fiscal Administration. In the new SIR context, Tax Administration can use a new and flexible instrument to implement tax compliance in Italy. To use it appropriately, will be crucial to implement the "check and balance" practice; infact now Tax Administration can check the effectiveness of the Synthetic Index, and change or add some simple indicator to increase it. Managing the composition of the estimated tax bases and anomaly indicators in the Synthetic Index will be crucial to reach these goals and increase the cooperative compliance between firms and Tax Administration.
Another challenge for the Italian fiscal system will be to choose the right fiscal stimulus for each reliability degree: infact, while the standard endogenous rule has only one threshold, SIR context allows to distinguish different levels of reliability associated to different Audit policies. This will be another crucial element for the future compliance, and represents a reinforcement of Tax Agency role.

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Appendix

1 Turnover

1.1 Reported turnover $\hat{R}_i$

Formula (10) is simply the consequence of a differentiation. It's possibile, with little algebra, arrive to the formula (11) assuming that $X_i \neq 0$ and with the following proceeding:

$$\frac{\delta_{1,i} - (1+f_1)(1+\alpha)}{\delta_{1,i}} + \frac{2(1+f_1)\alpha}{\delta_{1,i}}\left(\frac{\hat{R}_i}{\hat{X}_i\beta}\right) + \frac{(1+f_1)(1-\alpha)}{\delta_{1,i}}\left(\frac{\hat{X}_i}{\hat{X}_i}\right) = 0 \Longrightarrow$$

$$\Longrightarrow \frac{2(1+f_1)\alpha}{\delta_{1,i}}\left(\frac{\hat{R}_i}{\hat{X}_i\beta}\right) = -\frac{\delta_{1,i} - (1+f_1)(1+\alpha)}{\delta_{1,i}} - \frac{(1+f_1)(1-\alpha)}{\delta_{1,i}}\left(\frac{\hat{X}_i}{\hat{X}_i}\right)$$

Using the hypothesis that $\delta_{1,i} \neq 0$[1]we arrive to:

$$\Longrightarrow 2(1+f_1)\alpha\left(\frac{\hat{R}_i}{\hat{X}_i\beta}\right) = -\delta_{1,i} + (1+f_1)(1+\alpha) - (1+f_1)(1-\alpha)\left(\frac{\hat{X}_i}{\hat{X}_i}\right)$$

$$\Longrightarrow \left(\frac{\hat{R}_i}{\hat{X}_i\beta}\right) = \frac{-\delta_{1,i} + (1+f_1)(1+\alpha) - (1+f_1)(1-\alpha)\left(\frac{\hat{X}_i}{\hat{X}_i}\right)}{2(1+f_1)\alpha}$$

$$\Longrightarrow \left(\frac{\hat{R}_i}{\hat{X}_i\beta}\right) = \frac{-\frac{\delta_{1,i}}{(1+f_1)} + (1+\alpha) - (1-\alpha)\left(\frac{\hat{X}_i}{\hat{X}_i}\right)}{2\alpha}$$

Rearranging, we have the last formula:

$$\frac{\hat{R}_i}{\hat{X}_i\beta} = \frac{1}{2\alpha}\left((1+\alpha) - \frac{\delta_{1,i}}{(1+f_1)} - (1-\alpha)\left(\frac{\hat{X}_i}{X_i}\right)\right)$$

Note that the second order condition for the minimum is:

$$\frac{\delta^2 EP_i}{\delta \hat{R}_i^2} = \frac{t}{X_i}\frac{2(1+f_1)\alpha}{\delta_{1,i}\hat{X}_i\beta}$$

[1]That is consequent to the fact that, in what follows, we will prove that the minimum value of $\delta_{1,i}$ is 1.

1.2 Maximum and minimum value of $\delta_{1,i}$

As in Santoro 2008 we have three set of constraints:$0 \leq q \leq 1$, $\hat{R}_i \geq 0$ and finally: $0 \leq \hat{X}_i \leq X_i$. Starting from the first one, the proof is the same of Santoro and shows that $\min \delta_{1,i} = 1$. If we take the second constraint and we look to the (11) we have to impose that $\frac{\hat{R}_i}{\hat{X}_i \beta} \geq 0$. So, starting from the point that $\alpha > 0$, we have that:

$$(1+\alpha) - \frac{\delta_{1,i}}{(1+f_1)} - (1-\alpha)\frac{\hat{X}_i}{X_i} \geq 0$$

and then:

$$\delta_{1,i} \leq (1+f_1)\left((1+\alpha) - (1-\alpha)\left(\frac{\hat{X}_i}{X_i}\right)\right)$$

1.3 The role of α for the declared turnover

If we differentiate (11) with respect to α and imposing this derivative greater than zero we obtain the following:

$$\frac{\delta\left(\frac{\hat{R}_i}{\hat{X}_\beta}\right)}{\delta\alpha} = -\frac{1}{2\alpha^2}\left((1+\alpha) - \frac{\delta_{1,i}}{(1+f_1)} - (1-\alpha)\frac{\hat{X}_i}{X_i}\right) + \frac{1}{2\alpha}\left(1 + \frac{\hat{X}_i}{X_i}\right) \geq 0$$

with the hypotesis that $\alpha \neq 0$ we obtain:

$$-(1+\alpha) + \frac{\delta_{1,i}}{(1+f_1)} + (1-\alpha)\frac{\hat{X}_i}{X_i} + \alpha(1 + \frac{\hat{X}_i}{X_i}) \geq 0$$

From which:

$$\frac{\hat{X}_i}{X_i} \geq 1 - \frac{\delta_{1,i}}{(1+f_1)} \Longrightarrow \frac{X_i - \hat{X}_i}{X_i} \leq \frac{\delta_{1,i}}{(1+f_1)}$$

2 Reported inputs

If we differentiate (6) with respect to $\hat{X}_i$ we obtain the following:

$$\begin{aligned}\frac{EP_i}{\delta\hat{X}_i} = &\left(\frac{\alpha}{\delta_{1,i}}\frac{\hat{R}_i}{\hat{X}_i^2\beta} - \frac{(1-\alpha)}{\delta_{1,i}X_i}\right)\left((1+f_1)\frac{t}{X_i}(\beta\hat{X}_i - \hat{R}_i\right) + \\ &+\left(\frac{1}{\delta_{1,i}} - \frac{1}{\delta_{1,i}}\left(\alpha\frac{\hat{R}_i}{\hat{X}_i\beta} + (1-\alpha)\frac{\hat{X}_i}{X_i}\right)\right)(1+f_1)\frac{t}{X_i}\beta - \\ &-\left(\frac{p(1-\alpha)}{\left(1 - \frac{1}{\delta_{2,i}}(1-\alpha)\left(1 - \frac{\hat{X}_i}{X_i}\right)\right)^2\delta_{2,i}X_i}\right)(1+f_2)t\beta\left(1 - \frac{\hat{X}_i}{X_i}\right) -\end{aligned}$$

$$-\left(\frac{p}{1-\frac{1}{\delta_{2,i}}(1-\alpha)\left(1-\frac{\hat{X}_i}{X_i}\right)}\right)\left(\frac{(1+f_2)t\beta}{X_i}\right)-\frac{1}{X_i}G'\left(1-\frac{\hat{X}_i}{X_i}\right)=0$$

If we use (17) and (18) we arrive to:

$$\begin{aligned}\Longrightarrow \Phi\left[\left(\alpha\frac{\hat{R}_i}{\hat{X}_i^2\beta}-\frac{(1-\alpha)}{\delta_{1,i}X_i}\right)\left(\beta\hat{X}_i-\hat{R}_i\right)+\left(1-\left(\alpha\frac{\hat{R}_i}{\hat{X}_i\beta}+(1-\alpha)\frac{\hat{X}_i}{X_i}\right)\right)\beta\right]-\\ -\chi\left(\frac{p(1-\alpha)}{\left(1-\frac{1}{\delta_{2,i}}(1-\alpha)\left(1-\frac{\hat{X}_i}{X_i}\right)\right)^2\delta_{2,i}}\right)\left(1-\frac{\hat{X}_i}{X_i}\right)-\\ -\chi\left(\frac{p}{1-\frac{1}{\delta_{2,i}}(1-\alpha)\left(1-\frac{\hat{X}_i}{X_i}\right)}\right)-\frac{1}{X_i}G'\left(1-\frac{\hat{X}_i}{X_i}\right)=0\end{aligned}$$

With little algebra it's possible arrive to:

$$\begin{aligned}\Longrightarrow \Phi\left(\frac{-\alpha}{\hat{X}_i^2\beta}\right)\hat{R}_i^2+\Phi\left(\frac{(1-\alpha)}{X_i}\right)\hat{R}_i+\Phi\left(-2(1-\alpha)\beta\frac{\hat{X}_i}{X_i}+\beta\right)-\\ -\chi\left(\frac{p(1-\alpha)}{\left(1-\frac{1}{\delta_{2,i}}(1-\alpha)\left(1-\frac{\hat{X}_i}{X_i}\right)\right)^2\delta_{2,i}}\right)\left(1-\frac{\hat{X}_i}{X_i}\right)-\\ -\chi\left(\frac{p}{1-\frac{1}{\delta_{2,i}}(1-\alpha)\left(1-\frac{\hat{X}_i}{X_i}\right)}\right)-\frac{1}{X_i}G'\left(1-\frac{\hat{X}_i}{X_i}\right)=0\end{aligned}$$

And finally we have:

$$\frac{1}{X_i}G'\left(1-\frac{\hat{X}_i}{X_i}\right)=\Omega+\Phi\left(\frac{1-\alpha}{X_i}\right)\hat{R}_i-\Phi\left(\frac{\alpha}{\hat{X}_i^2\beta}\right)\hat{R}_i^2$$

With Ω that is given by (16). Now, taking (11), substituting into (15) and taking common factor respect to $\frac{\hat{X}_i}{X_i}$ we have the following:

$$\begin{aligned}\Longrightarrow \frac{1}{X_i}G'\left(1-\frac{\hat{X}_i}{X_i}\right)=\left(\Omega-\frac{\Phi\beta}{4\alpha}\left((1+\alpha)^2+\frac{\delta_{1,i}^2}{(1+f_1)^2}-\frac{2(1+\alpha)\delta_{1,i}}{(1+f_1)}\right)\right)+\\ +\Phi\frac{\beta(1-\alpha)}{\alpha(1+f_1)}\left((1+\alpha)(1+f_1)-\delta_{1,i}\right)\left(\frac{\hat{X}_i}{X_i}\right)-\frac{3}{4}\Phi\left(\frac{(1-\alpha)^2\beta}{\alpha}\right)\left(\frac{\hat{X}_i}{X_i}\right)^2\end{aligned}$$

Substituting Ω and rearranging terms we arrive to the last formula:

$$\implies \frac{1}{X_i}G'\left(1-\frac{\hat{X}_i}{X_i}\right)=\left[\frac{\Phi\beta}{4\alpha}\left(4\alpha-\left((1+\alpha)^2+\frac{\delta_{1,i}^2}{(1+f_1)^2}-\frac{2(1+\alpha)\delta_{1,i}}{(1+f_1)}\right)\right)\right]-$$

$$-\chi p\left(\frac{(1-\alpha)}{\left(1-\frac{1}{\delta_{2,i}}(1-\alpha)\left(1-\frac{\hat{X}_i}{X_i}\right)\right)^2\delta_{2,i}}+\frac{1}{\left(1-\frac{1}{\delta_{2,i}}(1-\alpha)\left(1-\frac{\hat{X}_i}{X_i}\right)\right)}\right)+$$

$$+\left[\chi p\left(\frac{(1-\alpha)}{\left(1-\frac{1}{\delta_{2,i}}(1-\alpha)\left(1-\frac{\hat{X}_i}{X_i}\right)\right)^2\delta_{2,i}}\right)+\Phi\beta(1-\alpha)\left(-2+\frac{(1-\alpha)}{\alpha}-\frac{\delta_{1,i}}{\alpha(1+f_1)}\right)\right]\left(\frac{\hat{X}_i}{X_i}\right)-$$

$$-\frac{3}{4}\Phi\left(\frac{(1-\alpha)^2\beta}{\alpha}\right)\left(\frac{\hat{X}_i}{X_i}\right)^2$$

3 The weight α

If we impose $\frac{\hat{X}_i}{X_i}=1$, and we substitute (17) and (18), with some manipulation and starting from (19) we can arrive to:

$$\frac{(1+f_1)t}{\delta_{1,i}X_i}\frac{\beta}{4\alpha}\left(4\alpha-\left((1+\alpha)^2+\frac{\delta_{1,i}^2}{(1+f_1)^2}-\frac{2(1+\alpha)\delta_{1,i}}{(1+f_1)}\right)\right)-\frac{(1+f_2)t\beta}{X_i}p+$$

$$+\frac{(1+f_1)t}{\delta_{1,i}X_i}\beta(1-\alpha)\left(-2+\frac{(1-\alpha)}{\alpha}-\frac{\delta_{1,i}}{\alpha(1+f_1)}\right)-\frac{3}{4}\frac{(1+f_1)t}{\delta_{1,i}X_i}\left(\frac{(1-\alpha)^2\beta}{\alpha}\right)=0$$

Than we simplify the analysis imposing $\alpha>0$, and with simple algebra we obtain the following:

$$\frac{t\beta}{X_i}\left(\alpha(1+f_1)-\frac{1}{4}(1+\alpha)^2(1+f_1)-\frac{1}{4}\frac{\delta_{1,i}^2}{(1+f_1)}+\frac{1}{2}(1+\alpha)\delta_{1,i}\right)-$$

$$-(1+f_2)\frac{t\beta}{X_i}p\delta_{1,i}\alpha+\frac{t\beta(1-\alpha)}{X_i}\left(-2\alpha(1+f_1)+(1+\alpha)(1+f_1)-\delta_{1,i}\right)-\frac{3}{4}\frac{t\beta}{X_i}(1+f_1)(1-\alpha)^2=0$$

Assembling the previous expression with $\frac{t\beta}{X_i}$ and with simple algebra (that requires the obvious hypothesis that $X_i\neq 0$) we arrive to the last expression:

$$\alpha=\frac{\frac{1}{4}\frac{\delta_{1,i}}{(1+f_1)}+\frac{1}{2}}{\frac{3}{2}-(1+f_2)p}$$

4 Table about formula (13)

In this section we compute all the possible values given by (13). For the calibration of $\delta_{1,i}$ we use, as usual, the mean between 1 and his maximum value (and hence all the possible values of Table I), while for the fee f_1 we use the usual variation range. The results are the following:

Table 1: $\frac{\delta_{1,i}}{(1+f_1)}$

f_1	**-0,1**	**0**	**0,1**	**0,2**	**0,3**	**0,4**	**0,5**	**0,6**	**0,7**	**0,8**	**0,9**	**1**
	1,111	1,056	1,010	0,972	0,940	0,913	0,889	0,868	0,850	0,833	0,819	0,806
	1,114	1,059	1,013	0,975	0,943	0,916	0,892	0,871	0,853	0,836	0,822	0,809
	1,117	1,062	1,016	0,978	0,946	0,919	0,895	0,874	0,856	0,840	0,825	0,812
	1,121	1,065	1,020	0,982	0,950	0,922	0,898	0,877	0,859	0,843	0,828	0,815
	1,124	1,068	1,023	0,985	0,953	0,925	0,902	0,881	0,862	0,846	0,831	0,818
	1,127	1,071	1,026	0,988	0,956	0,929	0,905	0,884	0,866	0,849	0,835	0,821
	1,130	1,075	1,029	0,991	0,959	0,932	0,908	0,887	0,869	0,852	0,838	0,825
	1,134	1,078	1,033	0,995	0,963	0,935	0,911	0,891	0,872	0,856	0,841	0,828
	1,137	1,081	1,036	0,998	0,966	0,939	0,915	0,894	0,876	0,859	0,845	0,831
	1,140	1,085	1,039	1,001	0,969	0,942	0,918	0,897	0,879	0,863	0,848	0,835
	1,144	1,088	1,043	1,005	0,973	0,945	0,922	0,901	0,882	0,866	0,851	0,838

The value of $\delta_{1,i}$ is computed as a mean between 1 and the values of the table 1.

The term $\left(\delta\left(\frac{\hat{R}_i}{\hat{X}_\beta}\right)/\delta\alpha\right)$ is positive if $\frac{X_i-\hat{X}_i}{X_i}$ (that is the percentage of evasion) is lower than the terms that are showed in the table. We can see that, in the extreme case of $f_1 = 1$, the tax evasion that determine a negative incentive to declare more turnover must be greater of 0.8, an implausible level of evasion.