Mathematical models describing the effects of different tax evasion behaviors – An understanding

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In this research by M. L. Bertotti and G. Modanese, the authors establish microscopic models describing economic interactions within a closed society, accounting for taxation and redistribution. Our interpretation is presented in this report.

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Overview

“This publication aims at deriving and explaining the emergence of a population's aggregate feature like the income distribution, as a result of the whole of economic exchanges and interactions which take place between the individuals. More specifically, our focus here is on the effects that the heterogeneity of taxpayer behaviours has on the income distribution profiles of the categories of individuals evading to different degrees.” (Modanese & Bertotti)

We see that the authors develop a probabilistic model based on a list of assumptions to describe economic activity (read: exchange of money, taxation – evasion and compliance, and redistribution) in an observable, closed population. This is done systematically in three major steps:

i. Restating dynamics of a model developed in previous publications describing the basic economic parameters of the population and their transactions
ii. Defining a probability-based payer-payee model for all transactions
iii. Defining customizable tax evasion behavior for the population

It is then illustrated how these modules assimilate into a fully-functioning mathematical system to meet the objective. Many phenomena have been generalized to suit the model’s integrity, and many others have been used to fill loopholes.

The conclusion is preceded by application of the developed model to a hypothetical population. The results are illustrated for a variety of cases.

Analysis of employed methods

The population is broadly classified by average income into classes. Further on, individuals are tagged with parameters that describe their evasion behavior, probability to pay in a transaction with another individual and so on.

Transactions are assumed to take place between individuals belonging to defined income classes – individual behavior is not taken into account unless required, and generalization persists.

Though the paper begins by assuming nonlinear differential equations to fit the model, it evolves to be basically probabilistic - all transactions are defined in terms of probabilities of their occurrence (or vice versa) using simple rules of probability theory. The authors suggest, and demonstrate, that numerical solutions be used to employ the model instead of finding analytical solutions to the differential equations owing to their complexity.

No purely statistical methods were found.

Application

Alpha (α), the index used to describe evasion behavior, is assumed to be constant irrespective of the outcome of the transactions. This limits the direct application of the model to a real-world scenario where such behavior might not be found.

In addition, we read that “higher tax evasion behaviors is seen in higher income groups” (Modanese & Bertotti). By extension, if an individual moves to a higher income group as a result of a transaction, he will show modified (read: higher) tax evasion behavior. This leads us to speculate about the employment of the model over an extended period of time to any idealized population also.

In the real world, probabilities of transactions are not identical for all members of a given income class – bias naturally exist – in contrast to a fundamental assumption of the model. Members of an income class may have typical repetitive transactions that are unique and easily differentiated from other members of the same income class; a bank, for example, may be the payee of regular transactions of predictable value between other income classes.

Criticism

The graphs provided (Modanese & Bertotti, p. 10) are unclear. The parameters are not mentioned.

The phenomenon of partial migration (Modanese & Bertotti, p. 7) is unclear.

The function named ‘T’ (Modanese & Bertotti, p. 4) is vaguely described as “variation” of an unnamed quality.

Bibliography

Modanese, G., & Bertotti, M. L. (n.d.). *Mathematical models describing the effects of different tax evasion behaviours*. Italy.