1 | *An overview: the realm of economic policy*

Summary. The theory of economic policy has its roots in the contributions of Tinbergen and Theil, who solved the problem of a policymaker aiming to achieve certain policy targets by using the available policy instruments and considering the model of the economy as a given constraint. The theory developed by Tinbergen and Theil presented a theoretical framework for designing economic policy over a long time horizon. However, after Lucas raised the issue that the private sector could react to the policymaker's decisions, their theory lost its appeal and most policy problems have been discussed in terms of policy games, thus introducing the possibility of conflicts and externalities among different players. The new theory of economic policy continues with the policy game approach, and applies the concepts and tools introduced by Tinbergen and Theil to develop a theory of conflicts, and to be able to assert conditions for policy neutrality, equilibrium existence, and policy uniqueness or multiplicity.

1.1 The Tinbergen–Theil contributions

The theory of economic policy is an area of economic theory that focuses on the investigation of a policy problem "resulting from the interaction of a policy objective, representing some abstract policymaker's desires, with a policy model representing the feasible outcomes of policy actions" (Preston and Pagan, 1982).

The theory of economic policy has its roots in Jan Tinbergen's econometric models of the Dutch and the US economies (Tinbergen, 1936, 1939), and was developed by Tinbergen himself while serving as the first director of the Dutch Central Planning Bureau from 1945 onwards.[1] In the early 1950s, while considering the development of econometric models in a policymaking context, Tinbergen in fact

[1] See Magnus and Morgan (1987) and Hughes Hallett (1989).

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derived the formal conditions to achieve given policy targets using a set of policy instruments in a linear representation of the economy. In other words, he was able to derive the formal conditions to "control" a linear economic system (Tinbergen, 1952, 1956). Tinbergen's results are summarized in the classical Golden Rule, which asserts that a policymaker can reach any given (fixed) set of independent target values if the number of independent instruments equals or exceeds the number of targets. A similar approach was developed by Bent Hansen in the same years (Hansen, 1958). Tinbergen deserves the credit for having raised the problem of policymaking in a consistent way. But he left many issues unresolved; not least, how to deal with systems in which the number of instruments is less than that of targets (hereafter called "non-Tinbergen" systems).

Later, Henri Theil provided a solution for many of the issues that had been left unsolved in the Tinbergen theory. He prescribed that the policymaker should minimize a loss (or maximize a utility) function defined on the relevant target variables, subject to constraints describing the responses of the economy. He thus solved the problem of how to pick policies when the policymaker is confronted with a non-Tinbergen system. In so doing, Theil arrived at a solution of the policy problem formally very similar to that proposed by Ragnar Frisch, who had first conceived of policy problems in terms of minimizing a social loss function to be derived by interviewing policymakers.[2] Theil also overcame Tinbergen's rigid distinction between targets and instruments, by allowing the latter to be relevant in their own right (for example, where policymakers have preferences over how the instruments should be used; or have strong views over whether their use should be restricted to certain "acceptable" values) and introducing them directly into the objective function. Theil, in addition, was the first to develop a theory of economic policy in a multi-period dynamic setting. Finally, he introduced uncertainty into the model of the economy and the policy process with an appeal to the principle of certainty equivalence (Theil, 1954, 1956, 1958, 1964).

Further improvements and advances in the theory as to the existence, uniqueness and design of economic policies are due to a number of authors: for example, Leontief (1964, 1976), Heal (1973), Preston (1974), Johansen (1977, 1978), Preston and Pagan (1982), Hughes

[2] See Frisch (1949, 1950, 1957, 1961).

Hallett and Rees (1983), Holly and Hughes Hallett (1989). The development of modern methods of control theory[3] has complemented this strand of literature to give a very powerful set of techniques for designing and implementing policies to achieve given social and economic targets.

Tinbergen, Frisch, Theil, and the other founding fathers of the theory of economic policy were mainly concerned with its normative aspects. They were less interested in analyzing the effectiveness of specific policy instruments, an issue that has been raised more prominently in the subsequent economics literature with reference to specific policy problems; particularly in monetary policy, in fiscal policy, and in other applications.

1.2 Rational expectations and the Lucas critique: a loss of control?

The Tinbergen–Theil theory of economic policy has been the theoretical foundation for macroeconomic policy[4] since the 1960s. In 1960, Paul Samuelson and Robert Solow published a celebrated article in the *American Economic Review* in which they argued that the Phillips curve could be considered as a long run structural equation and thus treated as a sort of menu of policy options (Samuelson and Solow, 1960). As a consequence, the flexible target approach was the way to face the trade-off between inflation and unemployment along the Phillips curve.

After the 1960s ended, however, the theory of economic policy became the object of fierce criticism for a number of reasons. The introduction of rational expectations (REs) led to an assertion of the ineffectiveness of monetary policy that was more forceful than even that most famously stated by Milton Friedman in his 1968 American Economic Association Presidential Address (Sargent and Wallace, 1975). In a similar way, with rational forward-looking expectations,

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[3] See, for example, Bellman (1957, 1961), Kalman (1960), Pontryagin, Boltyanskii, Gamkrelidze and Mishchenko (1962), Athans and Falb (1966), Pindyck (1973), Chow (1975), Aoki (1976), Petit (1990).

[4] Note, however, that their contribution (and more generally, the whole theory of economic policy) can easily be made the basis of microeconomic applications too. This is particularly true for Theil's flexible target approach (see Theil, 1958, 1964).

fiscal policy was considered ineffective as an instrument for managing income levels (Barro, 1974). A proposition of policy neutrality or policy "invariance" was thus stated with regard to the two most widely used macroeconomic policy instruments.

Apart from critiques advanced with respect to the effectiveness of specific instruments, a more general argument was raised by Lucas (1976) according to which a Tinbergen-type decision model is inconsistent with the assumption of REs. The importance of this contribution lies in the fact that it denied the validity of the solution given by Tinbergen, Theil, and others; and with it the existence of an optimal policy vector, or a sequence of policy vectors, that can achieve policy targets or get close to them. The root of the problem is that this approach assumes the private sector behavior to be invariant to the policy vector itself. In other words, when the private sector has REs of future developments, the policymaker will lose control of the economic system, as those expectations deny the existence of an equilibrium of the kind postulated in the existing theory of economic policy.

The implication of this argument is easy to understand if one realizes that assuming REs amounts to an implicit change in the nature of the economic system confronting the policymaker: the private sector has objectives conflicting with those of the policymaker and can react (to a certain degree) to actions taken by the policymaker. The policymaker then faces a system that is no longer parametric; and this in itself leads, according to Lucas, to a loss of control. However, that implication might not survive an explicit account of the underlying conflict between the policymaker and the private sector (the underlying policy game posed in explicit form). Put differently, this critique might be true of the Tinbergen–Theil theory of economic policy. But that is not to say it is also true of a revised or new theory of economic policy. It all depends on whether the private sector reactions can be accommodated in the policymaker's decisions; or whether the private sector's reactions are strong enough to *exactly* offset, in their own self-interest, what the policymaker is trying to do. In general, private agents cannot offset those actions completely – nor would they try to do so, as we shall show.

1.3 Policy games: the conflict becomes explicit

In the 1980s, starting with Barro and Gordon (1983), a new approach to the analysis of economic policy was developed: that of policy games,

exempt from the Lucas critique. As noted above, introducing REs amounts to implicitly assuming some kind of reaction of the system to the policy enacted, driven by conflicting objectives. This assumption, and the underlying conflict between policymaker and private sector which it reflects, can be made explicit if the issue facing the policy-maker is framed in a context where the private sector's behavior is explicitly modeled as having been derived from its preferences and objectives. Strategic interactions between the private sector and the policymaker then ensure that the REs of both are satisfied.

At the time of Barro and Gordon (1983), the emphasis of the policy debate was still far from the search for conditions of existence of an instrument vector that could guarantee satisfaction of some fixed targets (Tinbergen's fixed target approach) or of an optimal policy that could minimize a given loss function (Theil's flexible target approach). In fact the Lucas critique was often deemed to negate the possibility that the policymaker could control the system at all. The discussion therefore concentrated instead on issues of the effectiveness, or neutrality, of specific instruments when the private sector has some specific target and instrument; thus continuing, in a new setting, the debate that had started in the previous two decades.

Barro and Gordon (1983) in fact studied a (Stackelberg) game between central bank and private sector, where the latter is leader and trades off real wages and employment when setting the nominal wage rate. They then delivered the well-known assertion of long run monetary neutrality as a result of the private sector expectations of discretionary monetary policy: the private sector forms REs and fully crowds out monetary effects on real output. A superior solution, for the public sector, would be to commit to a certain rule. But, having induced favorable private sector expectations, the policymaker would always be tempted to cheat and renege on his commitment, the classic time inconsistency argument (Kydland and Prescott, 1977), in an attempt to achieve yet better outcomes. However, being aware of this possibility, the private sector would (in self-defense) anticipate worse results; results that can be avoided only if the temptation to cheat is balanced by a fear that the policymaker might lose his reputation and no longer be able to act effectively if this game of interactions with the private sector is repeated.[5]

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[5] See also Stokey (1989, 1991).

Thus, with Barro and Gordon (1983) we have a result of policy neutrality. But their result is specific to the assumptions of their model. We certainly do not have a general theory of policy neutrality. A part of the subsequent literature has tried to elaborate such a theory in different ways, without making any reference to Tinbergen's contribution.

In an influential article, Rogoff (1985) showed that uncertainty can break the neutrality mechanism, in terms of second moments, by creating a trade-off between the variances of inflation and output (or employment). Sargent (1999) also explored the short run trade-off between inflation and unemployment by focusing on uncertainty, specifically on imperfect knowledge and misperceptions by policymakers and/or private agents in a policy game with learning. He showed that the rise and fall of US inflation can be attributed to policymakers' changing beliefs about the natural rate hypothesis. In other words, he put forward a hypothesis that US inflation dynamics can be explained by the Federal Reserve discovering and subsequently abandoning the Phillips curve. In a similar manner, Orphanides and Williams (2002) attributed the volatility and failure of US anti-inflation policies in the 1970s to the Federal Reserve's misunderstanding of the natural rate of output, and hence output gap, on the basis of real-time data. Real-time data is, of course, the only data available to the policymakers when they have to make their decisions. So these volatility trade-offs will always be present; there is no point in supposing the policymakers used the ex post data they could not have had at the time.

By introducing nominal rigidities, the New Keynesian school has developed a more refined version of Rogoff's model, where uncertainty derives from the forward-looking behavior of the private sector.[6] It is worth noticing that, in an influential article, Clarida, Galì and Gertler (1999) explicitly mentioned the Tinbergen–Theil approach in illustrating their solution:

This formulation is in many ways in the tradition of the classic Jan Tinbergen (1952)/Henri Theil (1961) (TT) targets and instruments problem. As with TT, the combination of quadratic loss and linear constraints yields a certainty equivalent decision rule for the path of the instrument.

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[6] The New Keynesian approach is well illustrated by Woodford (2003) and Galì (2008).

The optimal feedback rule, in general, relates the instrument to the state of the economy.[7]

Another interesting line of investigation has followed the idea that neutrality depends on the preferences of the private sector. Simply adding other targets explicitly shared with the policymaker to the private sector's preferences could have avoided the neutrality result. Gylfason and Lindbeck (1994) suggested that monetary policy non-neutrality arises whenever the private sector (e.g., labor unions) explicitly shares the objective of price stability with the central bank, in addition to their usual targets for real wages and employment. Jerger (2002) likewise demonstrated that the traditional paradigm of neutrality does not hold if wage setters are inflation averse. Acocella and Ciccarone (1997) generalized that result by taking into consideration a concern for public debt. However, this way of ruling out policy neutrality seems to lose ground when imperfectly competitive markets are introduced into the story: Guzzo and Velasco (1999), Soskice and Iversen (2000), Cukierman and Lippi (2001), Lippi (2003), and Coricelli, Cukierman, and Dalmazzo (2006) all show that non-neutrality of monetary policy can also derive from the interaction between imperfectly competitive goods and labor markets even when unions do not explicitly share a common objective with the monetary authorities. Acocella and Di Bartolomeo (2004) then show that even the implicit addition of shared targets would have the effect of violating the neutrality result. Only in their conclusions do they hint at a possible explanation in terms of number of instruments and targets of the various players. So there are a great many ways in which this neutrality (the Lucas critique) can be overcome. Many of them are illustrated in the examples in Chapters 5 and 6. Chapter 12 develops a general theory of policy under REs that knits these different results together.

1.4 The new theory of economic policy: rediscovering Tinbergen

An advance in explaining the neutrality of the policy of a player was made when it was realized that neutrality might have to do with the

[7] However, as they correctly remark, in New Keynesian models "target variables depend not only on the current policy but also on expectations about future policy" (Clarida, Galì and Gertler, 1999).

existence of conflicts with the desired values of targets shared by other players and the possibility that the player in question does, or does not, have enough instruments for reaching its targets. This consideration led to a rediscovery of the requirements for controllability of an economic system as asserted by the Tinbergen theory of economic policy (Acocella and Di Bartolomeo 2005, 2006; Acocella, Di Bartolomeo and Hughes Hallett, 2007).

For purposes of illustration, let us consider a situation in which different players have at least one overlapping target but they conflict on the precise value preferred for that (those) target(s). Assume that one player, say player 1, can control his variables of interest, since he has at least as many linearly independent instruments as independent target variables: that is, the Tinbergen Golden Rule holds. It is then fairly obvious that no other player can have an influence on, or shift those shared targets if that player's target values (for the targets held in common) are different from those of player 1, and if that player does not have enough instruments to reach his own targets and hence control those shared with player 1. In this situation the conflict can be only solved to the benefit of the controlling player, and the other player's policies are neutral with respect to the shared objectives. This is the first fundamental proposition of the new theory of economic policy.

In the event, the new theory has proved to be a theory not only of neutrality, but also of game equilibrium existence, uniqueness, and multiplicity. A unique equilibrium arises when only one player or no player at all controls its targets. In the case when more than one player can control common targets, all the controlling players should be able to reach their objectives by assumption. However, if they have conflicting target values, none can actually do so as the system cannot admit different values for the same variable at the same time. But if there is no such conflict, that is, if the players capable of controlling the system share not only the same targets but also the same target values, there will be multiple combinations of the instruments controlled by different players capable of reaching those values and a coordination failure will arise. These results represent the second fundamental proposition of the new theory of economic policy.

Proceeding in this way amounts to using the Tinbergen and Theil theory of economic policy in a new setting – that of policy games – and involves a situation of conflicts among different agents. The possibility that one agent, the policymaker, might pursue his own objectives in a

situation of conflict easily brings us to the conditions under which that conflict can (or cannot) be solved to his benefit; or, if another player also controls the system, to the conditions where no equilibrium will exist. From this point of view, the new theory of economic policy can be regarded as a theory of conflict resolution. Neutrality, policy effectiveness and the non-existence, uniqueness or multiplicity of equilibrium are all key aspects of such a theory.

The most important implication of the new theory is that all the results concerning the properties of a policy game can be stated in terms of simple rules about the number of (linearly independent) instruments compared with (linearly independent) targets for each player. These characteristics can therefore be determined without solving the game, which appears to be of relevance from a methodological point of view for a researcher in the process of building a model. To design a model of a "viable" policy process, we need a check on the mutual consistency between the optimal decisions of the agents involved. This must exclude controllability of the same targets by more than one player. In addition, if we want to ensure some important feature of the policy game we are going to analyze, in the form of a certain action to be taken by a certain player, we need that player only (and no other player) to satisfy the Golden Rule of economy policy.

Economic models obviously have an institutional counterpart. Important implications of the new theory for institution building have first been derived when looking at a game from the perspective of groups of players or of all the players. From the former point of view, there may be situations involving no conflict among some players, leading to implicit coalitions between them; and also cases where conflicts between groups of players lead to the same results in terms of neutrality and equilibrium existence as we have derived for single players (Acocella, Di Bartolomeo and Piacquadio, 2009). So, for example, when looking at the system as a linear quadratic (LQ) policy game with overlapping preferences, if the total number of instruments available for all the players exceeds the total number of targets of all the players, multiple equilibria will arise and conditions for existence are unlikely to be satisfied. This implies the existence of a fundamental asymmetry in institutional solutions: if an economic system is over-determined (i.e., the total number of instruments is higher than the number of targets), it can always be solved by some

"social planner" by setting the excess instruments, over targets, at arbitrarily fixed values. Meanwhile the decentralized solution might fail to exist and, in case of existence, problems of coordination in setting instruments always emerge. Thus the advantages of centralization that derive from an abundance of instruments are lost in the decentralized solution and indeterminacy arises. This raises again a problem of coordination failure that can be solved in various ways: e.g., by voluntarily giving up the use of its instrument by some country; or by resorting to a hegemon; or by imposing some kind of centralized solution (Hughes Hallett, Acocella, and Di Bartolomeo, 2011) or by introducing announcements (Acocella, Di Bartolomeo, Hughes Hallett and Piacquadio, 2009).

Another institutional implication of the new theory that deserves a mention at this point derives from an extension of the Tinbergen–Theil analysis to dynamic problems in a context where a policymaker interacts with the private sector and REs hold. In fact REs, rather than implying ineffectiveness of policies, will typically help the policymaker to pursue his targets if he makes proper announcements, when a weaker condition involving the possession of sufficient instruments is satisfied. If this is the case, the policy problem is no longer a matter of finding institutions guaranteeing a credible commitment; but of how the necessary policy changes should be announced (Hughes Hallett, Di Bartolomeo and Acocella, 2012).

The importance of this new theory of economic policy can therefore be summarized in four points.

First, its two fundamental propositions (on policy neutrality and equilibrium existence) appear to be essential for model building, as they state the conditions under which the effectiveness of policy instruments, as well as consistency of the optimal strategies of all the players (and thus the existence of the equilibrium of the game), are guaranteed.

Second, the theory has important applications for devising proper institutions.

Third, REs are not necessarily an obstacle to policy effectiveness. On the contrary, they can enhance it and make debates on time inconsistency and the need for commitment irrelevant when the policymaker and the private sector share the same information on the working of the economic system. That again carries important implications for the design of institutions and how they work.