A Note on the Tinbergen Rule

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Abstract

The Tinbergen Rule, named after one of the first two Nobel laureates in economics, is a basic principle of effective policy. Distinguishing between policy targets, on the one hand, and policy instruments, on the other hand, Tinbergen (1952) argued that to successfully achieve n independent policy targets at least the same number of independent policy instruments are required. This has become known as the Tinbergen Rule. The purpose of this note is to introduce and explain the Tinbergen Rule and its implications to public policy students.

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A NOTE ON THE TINBERGEN RULE

Purpose

The Tinbergen Rule, named after one of the first two Nobel laureates in economics, is a basic principle of effective policy. [1] Distinguishing between policy targets, on one hand, and policy instruments, on the other, Tinbergen (1952) argued that at least n independent policy instruments were required to successfully achieve n independent policy targets. This has become known as the Tinbergen Rule.[2] The purpose of this note is to introduce and explain the Tinbergen Rule and its implications to students interested in public policy analysis and administration. It does not introduce new concepts but present implications that are easily overlooked.

Policy Targets and Instruments

It will increase clarity to provide a few definitions based on Tinbergen's (1952) influential book on this topic (see also Tinbergen, 1956; for an advanced technical discussion, see Yamada, 1990). In this work, he briefly reviewed the changing role of government in conducting economic policy, from an earlier approach which focused primarily on fiscal policy, to a broader and more comprehensive view of areas considered targets of economic policy. Tinbergen distinguishes three types of variables: (1) Data, (2) Target Variables, and (3) Instruments. In principle, there is a fourth set, namely irrelevant variables which, for our discussion, we can ignore. Data are those variables that we cannot influence but appear to us as

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[1] The Dutch economist Jan Tinbergen shared the first Nobel Memorial Prize in Economics (1969) with the Norwegian economist Ragnar Frisch.

2 The Tinbergen Rule should not be confused with a related principle that has become known in monetary economics as the Tinbergen Principle which states that monetary policy should be limited to address economic stability and other policies should be used to address the stability of the financial system. Clearly the two are related with the Tinbergen Principle addressing a specific set of policy issues whereas the Rule is general (e.g., Krug, 2018).

givens. They are frequently referred to as parameters. These include world market prices, import tariffs and regulations of other countries, and international industrial norms (e.g., ISO Standards; see ISO, n.d.). Tinbergen (1952) lists output or GDP, employment level, balance of payments, and the real wage rate as examples of target variables.

Since the publication of his book, the number of target variables has increased and their characteristics have changed. Recent decades have seen environmental targets become more noteworthy. Gender equity has also garnered increasing attention in its relatively short history. International trade is a traditional policy area, but the nature of trade issues has changed post World War II. The increased range of public policy makes discussion of the Tinbergen Rule even more relevant in today's environment.

Tinbergen argued that government expenditures, wage rate, profit margin, and labor productivity, can all be used as instruments toward targets. Available policy instruments are influenced by the economic system of a nation, with a socialist economy likely to have more relative to a free market economy. The types of instruments available to each system will also likely be different. However, we are merely interested in a conceptual discussion of interactions among policy instruments and such differences can be ignored for the remainder of this paper.

Even the short list of instruments in the previous paragraph illustrates the necessity of making clear distinctions between instruments and targets. For example, is labor productivity really an instrument and not a target? In general, labor productivity is not an end but a means to reach targets such as higher wages, greater production, improved competitiveness in the world market, etc. Therefore, it is properly regarded as an instrument, even if policy makers cannot influence it directly, but only indirectly through, for example, training programs to increase the skills of a targeted labor force or incentives to invest in the newest and most efficient

technologies. In other words, an instrument may consist of different steps to move the instrumental variable in the desired direction.

Independence, Neutrality, Complementarity, and Conflict among Policy Instruments

Tinbergen (1952) argued that to successfully achieve n independent policy targets requires at least the same number of independent policy instruments (for an application of the Tinbergen Rule to national economic policy, see Michl, 2008; Pereira da Silva, 2016). Independence of policy targets means that both can be achieved simultaneously and there is no logical or empirical contradiction between the two. In this paper, we assume that the policy target vectors are mutually orthogonal. This is a sufficient but not a necessary condition that facilitates the graphical representation (Figure 1) used in the discussion of policy implications of the Tinbergen Rule. For independence of policy instruments, we only assume that the n instruments span the whole policy space; we do not require orthogonality.

We define a policy instrument as being neutral if its application has no effect whatsoever on policy targets save the one it was designed to achieve. Figure 1 (a) shows that neutral instruments are a subset of independent instruments as neutrality implies independence, but not vice versa. Consider a policy instrument designed to achieve a policy target A. This instrument – call it A, after its target – is defined as complementary to a policy target B, if its application moves us closer to achieving both targets A and B. An instrument for target A is defined as in conflict or conflicting with target B, if its application moves us further away from this target.

Presentation and Discussion of Scenarios in Two-dimensional Policy Space

In this section we introduce scenarios in a two-dimensional policy space, which are distinguished based on characteristics of instruments introduced in the previous section and illustrated in Table 1. If instruments have different characteristics, e.g., one is neutral and the other harmonious, the

order plays no role in our analysis, and therefore, three scenarios are duplicates. Thus, there are six scenarios to consider. The case when instrument A completely erases the effect of instrument B on target B is unlikely to occur and would not survive long if it did; it can therefore be ignored.

Table 1: Scenarios in the Case of two Targets and two Instruments

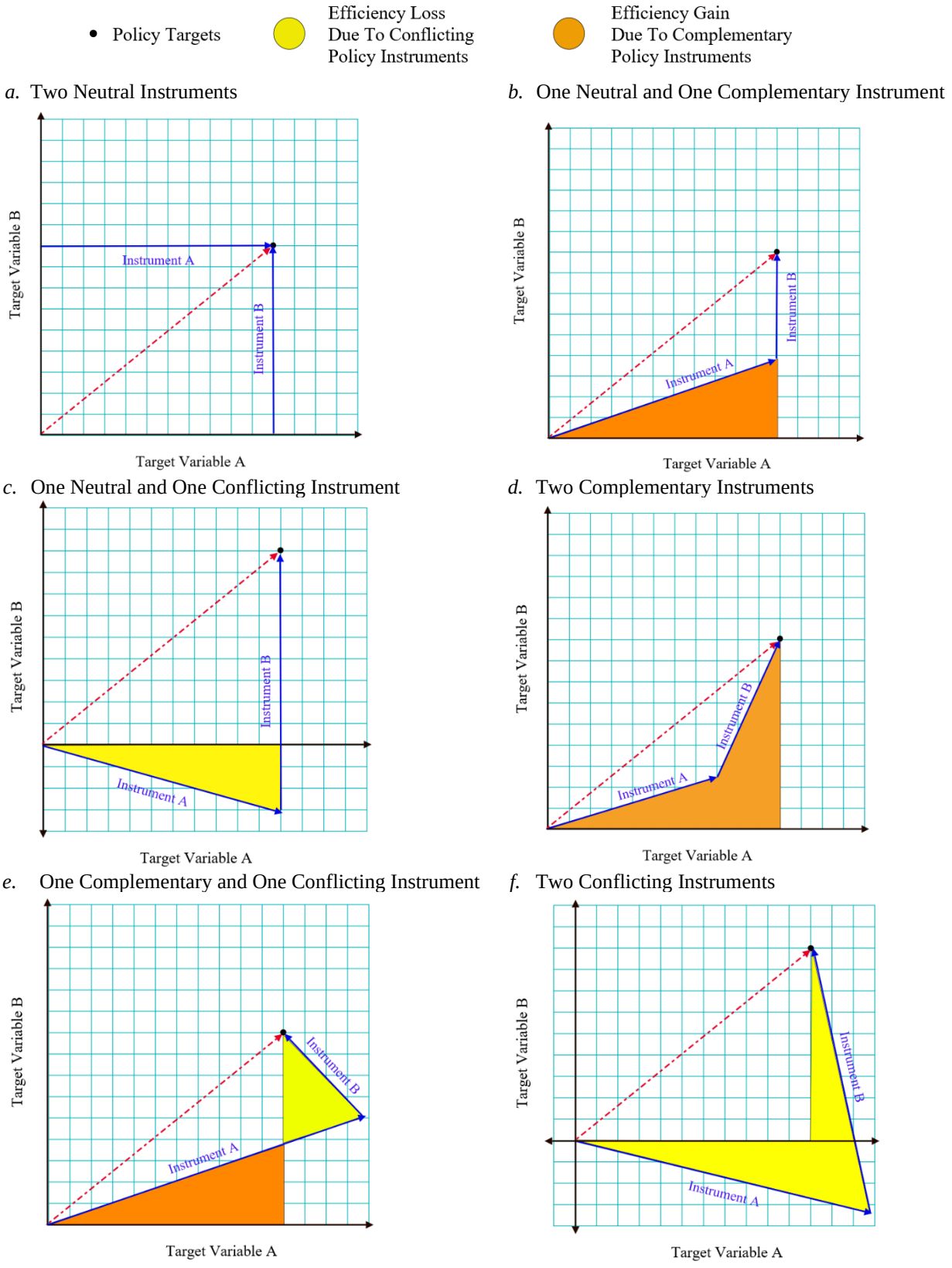
Instrument B / Instrument A	Neutral	Complementary	Conflicting
Neutral	*a*	*b*	*c*
Complementary	*b*	*d*	*e*
Conflicting	*c*	*e*	*f*

The scenarios are represented in six panels (a through f in Table 1) in Figure 1. That is, there are two orthogonal policy targets and two independent, but usually not orthogonal, policy instruments. The black dot shows the point where both targets are reached. The red broken line is the sum of the application of the two policy instruments that allow us to reach this point. The length of blue instrument vectors can be interpreted as the intensity of the necessary application. The two policy targets (represented by a black dot) are the same in each scenario.

a. Two Neutral Instruments

This is the simplest of the six scenarios, when analysis is restricted to the two targets–two instruments case, because policies to reach target A and target B, respectively, can be designed and administered independently from one another. The *effort* required to reach the dot in the policy space is just sum of the length of the blue instruments A and B. As will become obvious when we examine the next five scenarios, when instrument A interferes with B, then coordination between the policies may yield benefits or reduce costs. If instrument A's spillover effect on

Figure 1: Graphical Representation of Policy Targets and Policy Instruments



target B is small, then implementing and administering the policies independently may be cost efficient, but the stronger the spillover effects, the greater the need for coordination in designing and implementing policies for targets A and B.

b. One Neutral and One Complementary Instrument

In panel *b*, instrument A is sufficient to reach target A and, in the process, also advances the economy towards target B. Thus, the application of instrument B can be smaller than that shown in panel a, when both instruments were neutral. The brown triangle indicates the savings from instrument A being harmonious with target B which could be substantial. An example would be public health and full employment initiatives. Public health instruments (A) like vaccines and flu shots are complementary to achieving full employment through something like a jobs training program (instrument B), while it is unlikely that training programs will have much influence on public health, they are not contrary to it. While the savings will be welcome, to take full advantage, coordination between the policies to reach A and B, respectively, may be required. Specifically, coordination is called for if overshooting a policy target has negative consequences, as when more of a good thing turns into a not-so-good thing.

c. One Neutral and One Conflicting Instrument

The situation in this panel resembles that in panel *b*. Instrument A is still sufficient to reach target A, but now it moves the economy away from target B. Therefore, we need a larger application of instrument B to compensate, and the yellow triangle indicates the extra costs – relative to panel *a* – that results from the conflict. Many municipalities and regions are deeply concerned about culture and recreation; to support these initiatives they support things like the arts, museums, and stadiums (instrument A). These bring with them greater need for transportation infrastructure and spending (instrument B). Additional busses, subways, and

trollies do not diminish the enjoyment received from the exhibit or match. In this respect they are neutral to the A instruments; but the existence of a gallery or stadium can slow the free flow of traffic. As in the preceding scenario, this suggests that coordination of the two policies is advisable.

d. Two Complementary Instruments

This scenario shows the benefits (brown area) when both instruments mutually support the other policy target in addition to their own. An example may be seen in revitalizing a blighted area while also deterring crime. The two objectives need not be pursued simultaneously but doing so can generate a positive feedback between instruments. Deterring crime makes it easier/cheaper to revitalize the area, which in turn suppresses crime; engaging in them collectively, makes it easier to do both. Even in the case of complementary instruments practitioners need to be vigilant. It is possible to over extend a complementary instrument (see panel e) and there may still be room for further complementarity.

e. One Complementary and One Conflicting Instrument

In this scenario, the additional costs of a conflicting instrument B are compensated by the beneficial impacts of instrument A on target B. As presented in panel *e*, the net effect is to lower the combined cost of the policies compared to panel *a*. However, as in all scenarios but scenario a, the policies work most efficiently if their implementation is coordinated. To illustrate, consider housing subsidies and crime reduction. Housing subsidies (instrument A) for affordable housing can provide opportunity to low income individuals by giving them an address and a phone number to put on applications, or by making it cheaper for them to gain new skills through schooling. These should serve to reduce crime through police enforcement (instrument B). However, if they are too heavily used in a region they provide the opportunity for more crime as

in the experience of Section 8 housing. This would require a greater application of crime prevention measures to offset the extension of instrument A.

f. Two Conflicting Instruments

In this final scenario, the costs of two conflicting instruments are illustrated. The yellow area shows that the costs can be significant relative to scenario *a*. County and municipal sales taxes can fit into this case. An increase in sales taxes decreases the quantity consumed. If the county and city both tax the same consumption good, then an increase in the sales tax by the county will decrease the revenue to the city through a decrease in the quantity demanded. If the city wished to maintain the same amount of revenue it would need to increase their taxes. In this case, as in all others except scenario a, coordination – at least in the form of an information exchange – may be required to ensure that both targets will be reached. A way to avoid the conflict above is for the county and the city to coordinate in a way to prevent overlapping taxation. Maybe the most famous case of conflicting instruments is the macro-economic conflict between full-employment and zero inflation. In this case, there is agreement that it is impossible to achieve both goals and the instruments as well as the targets must be adjusted towards an achievable combination.

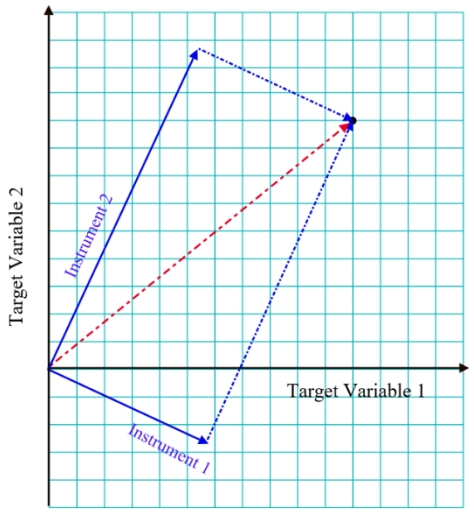
Implications for Policy Implementation and Administration

The preceding section showed that policies affect targets beyond those they are designed for, except in those cases of independent targets and neutral instruments. In a mathematical sense, the instruments in each of the six scenarios are independent, but for policy design and administration, they are interdependent. The greater the influence of an instrument for policy X on target Y, the greater the potential benefits from coordinating the policies for X and Y, up to combining responsibilities into one administrative unit. The latter is warranted if the spillover

effects are large. The Tinbergen Rule's immediate concern is the necessary number of policy instruments to reach a set of policy targets, but it also has implications for the organizational structure of policy making and administration.

The argument for policy coordination is based on the interaction of different policies. To avoid any possible confusion, we stress that independence of policy instruments is not the same as instrument neutrality. Only if policy targets and policy instruments, respectively, are orthogonal to each other and, in addition, each instrument is perfectly aligned with its target, are all instruments neutral. This is the only condition that allows separate policies for each target without the potential for spillovers from one policy to other policies. Figure 2 shows that having orthogonal targets and orthogonal instruments is not sufficient if each instrument is not also perfectly aligned with its target. It is likely that the neutrality condition is rarely met, and coordination can only be ignored if spillovers are modest or non-existent.

Figure 2: Orthogonality Does Not Guarantee Neutrality



The need for coordination is less pronounced in a stable economy that is growing incrementally at a modest pace than in one that is changing rapidly. In a stable environment, the past is a reliable guide to the future and an agency responsible for target A can accurately predict

the actions of another agency in charge of policy B, based on experience, and take it into consideration as it makes its policy decisions. The same cannot be said for an economy that is changing quickly, such as the People's Republic of China did when it achieved annual growth rates exceeding 10 percent. Consider, for example, the role of the State Environmental Protection Administration, which is responsible for water standards. Water quality depends on the actions of several agencies, including the Ministry of Transportation (shipping), Ministry of Agriculture (agricultural water use; non-point pollution), and Ministry of Construction (water supply, wastewater treatment) (Liebenthal, 2008). During periods of rapid growth and a dramatic reshaping of water use and discharges in high-growth regions, the challenge to conduct effective policy is difficult to meet even if there are pre-existing channels of communication and coordination among different agencies.

Even economies experiencing steady growth stand to benefit from Tinbergen's insights when the dynamics of the targets themselves are changing. The nature and the number of different policy targets continues to change in the United States, as we alluded to in previous sections. More targets present more opportunity for conflicting instruments, but they also provide more opportunity for coordination. Changing targets requires that care should be given to what instrument is to be used, and which authority should wield it. The United States, housed in a federalist system, can have multiple authorities operating instruments which may conflict or be ripe for coordination.

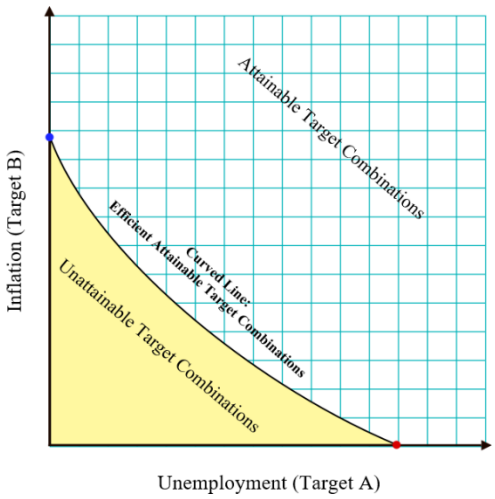
In conclusion, potential coordination among policies should always be considered and is required in a fast-changing policy environment. Although we have looked at interactions between different policies, we constrained considerations to one instrument per target. However, interactions between policies suggest that we should consider policies that influence each other

jointly and produce an optimal policy and instrument mix (see del Rio and Howlett, 2013, for an extensive discussion). Unfortunately, Tinbergen himself did not provide much guidance regarding the organization of (economic) policy (see comments by Arrow, 1958).

Attainable Targets

In the discussion of two conflicting instruments we mentioned the possibility of conflict between policy targets. In the example given, it was impossible to simultaneously achieve zero inflation and zero unemployment. Zero inflation comes with high unemployment (red dot in Figure 3) and zero unemployment with high inflation (blue dot in Figure 3). In this case, policy makers need to identify attainable target combinations (curved line and above in Figure 3). Target combinations below the green line cannot be achieved in the long-run and are therefore unattainable. Combinations above the curved line are attainable but inefficient as they take us further away from zero unemployment, zero inflation, or both. Therefore, the chosen target should be in the set of efficient target combinations.

Figure 3: Conflict between Targets



In figure 3 lowering inflation is possible only if we accept higher unemployment, or vice versa. Of course, policy targets can also be harmonious, so that progress towards target A also

moves us closer to achieving target B. In either case, the efficiency of policy can be improved if we determine the attainable policy space and, as in the inflation-unemployment example, the subspace of efficient target combinations. This reinforces the conclusion of the potential gains of policy coordination whenever instruments or targets, or both, are not neutral.

In the inflation-unemployment example, the conflict between targets that constrains the attainable policy space is systemic. The policy space may also be constraint by what is fiscally or politically feasible, and legal constraints, including those stemming from international treaties.

Summary and Conclusions

The Tinbergen Rule has implications not only for the number of policy instruments relative to policy targets, but also for the administrative organizations of policies. Our discussion also highlights the potential need for coordination among policies administered by different agencies. We assume that coordination between different policies administered by the same agency can be accomplished with relative ease.

In addition to conflicts between policy instruments, the discussion also calls attention to, and increases awareness of, conflicts between targets. We dealt with such conflicts by introducing attainable target combinations; the set of all these combinations constitute the policy space. However, not all attainable combinations are good policy choices and the eventual target combination should be chosen from the set of efficient feasible target combinations.

The coordinated application of policies is likely most difficult when it is most needed, namely in the case of rapid change when parameters cannot be assumed to be (nearly) constant and when demands on resources increase more than marginally. While in mature economies the past is a reliable guide to the near future, this is not the case in economies in transformation. This partially explains why we tend to find more governance weakness in the latter than in the former.

During the twentieth century, the range of public policy changed dramatically and added new responsibilities for governments to meet. For example, in the past social policy was rudimentary by today's standards and designed mostly to deal with the destitute and long-term poor. Beginning in the late nineteenth century when Germany introduced the world's first "social security" program, there has been a growth of the reach of social policy. Gender equity began with campaigns for women's voting rights; they now extend to pay equity and, in the United States, equal access for women to educational programs (see US Department of Education, 2017, for information about areas covered by Title IX legislation).

Another policy area that has seen significant growth is transportation, not least because of new transportation technologies and their wide adoption (automobile, trucking, commercial flights). The state of the environment has also attracted increased attention from policy makers because it is linked to the growth of industrialization and the transportation sector. Related to environmental policies, energy policies are also changing, and Fitch-Roy, Benson and Woodman (2109) discuss auctions as a relatively new instrument used in renewable energy policy. The growth of the range of public policy combined with implications of the Tinbergen Rule suggest that we may need to develop new policy instruments. While this has already occurred, particularly in the political arena, we need more systematic research to meet the challenges of a growing public policy space.

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