Essays on optimal experimentation

Willems, T.

Chapter 7

Summary in English

If you put two economists in a room, you get two opinions. Unless one of them is Lord Keynes, in which case you get three opinions.

Winston Churchill

For a long time already, economists are criticized for not being able to reach a consensus view on important policy issues. Although some exaggerate this accusation to a great extent, there is an element of truth in it: opinions on the effectiveness of the two most important business cycle stabilization tools (fiscal and monetary policy) for example widely differ.

The reason for this lack of consensus lies in the fact that it is not easy to investigate "the economy" in a scientific way: when a chemist wants to know what happens when he mixes two substances, he can simply conduct an experiment - most often without fatal consequences. However, when an economist wants to know what happens when a decentralized economic structure is substituted for a centralized one, the costs of conducting such an experiment can be huge (recall the communist "experiment").

Because experimenting on actual economies can therefore be classified as immoral, and because it is practically infeasible to capture the entire economy in a laboratory environment, economists took a different route: instead of experimenting on actual economies, they started to build mathematical models (that often take the form of computer programs) that mimic the real economy. Subsequently, we can fire all possible experiments at these models (which can be thought of as virtual approximations to the real world), without endangering our real economy.

The crucial question then however becomes: to what extent do the model predictions coincide with what would happen if the policy change would be implemented in reality? In this respect, the necessary assumptions every model has to make are crucial: depending on these assumptions, the model will give different answers as a result of which different economists in a room can get to different conclusions. Some of these assumptions will be innocent, while others could lead to the wrong conclusion.

Since we do not know *ex ante* which assumptions deserve the label "innocent" (as a result of which we are uncertain on which model is "the correct one"), information extracted from actual economies continues to be valuable - especially when this information is generated by experiments. This thesis therefore focuses at the analysis of experimental behavior. Because despite the objections that are associated with experiments, there are environments in which experimentation is both possible and/or optimal, while experimental data are sometimes also generated in a more or less accidental fashion.

First of all, experimentation is possible (and present) around economic reforms. In such an environment, experimentation can be both conscious as well as accidental. China for example consciously established Special Economic Zones in the 1970s where they experimented with market forces. Experimentation in transition countries on the other hand was of a more accidental nature: because of political constraints, some reforms were started earlier than others, as a result of which both policy makers and voters had the opportunity to learn from the early reforms. Chapter 1 of this thesis analyses the learning process for voters who are uncertain on whether they will benefit from a certain reform or not. The chapter shows that the process of revealing reform outcomes is an example of sampling without replacement: when it is revealed that individual X is a winner, all the other uncertain individuals realize that this implies that there is one winning place less left for them to end up in. Consequently, they become more pessimistic on their own chances of gaining from the reform which may even lead to a situation in which they suspend their support to the reforming government. Herewith, this chapter provides an explanation for the puzzling observation that many reformist governments are voted out of office, even though (or maybe it is better to say: because of) their reform started off successfully.

Inspired by the observation that many policy makers (as well as members of

the public) still question the link between man-made emissions of greenhouse gases and recent increases in global temperature, Chapter 2 investigates what kind of policy these climate skeptics should favor. First, the chapter shows that a skeptical decision maker obtains an experimentation motive, so as to speed up his learning process on the causes of global warming. In particular, it is shown that it gives skeptics an incentive to *reduce* greenhouse gas emissions. The reason is that such a more aggressive policy eases their learning process on whether global warming is anthropogenic or not, which is valuable to know since the optimal policy depends on the answer to this question. Although an increase in emissions would also facilitate learning, that option suffers from the fact that emitting greenhouse gases is irreversible - thereby leaving downward experimentation as the most favorable option. Consequently, the question whether one is climate skeptic or not, becomes irrelevant from a policy perspective: whatever position in the debate one has, one should argue for a reduction in emissions relative to current levels. For "climate believers" this follows trivially from the fact that they are convinced that emitting greenhouse gases is damaging (which was/is not taken into account by most recent/current policy makers), while climate skeptics should argue in favor of lower emissions for learning considerations.

Chapter 3 analyzes the optimal pricing strategy of a seller who is uncertain on the slope of this demand curve (which varies over time). As a result of this uncertainty, the seller obtains an incentive to experiment with his price, as such a pricing strategy generates more information on the unobserved demand curve. In such an environment, it turns out to be optimal to let the price of a product alternate between a "high" and a "low" price. Hereby, the model is able to replicate the empirical observation that prices tend to bounce back and forth between two more or less rigid values (a "normal" price and a "sale" price), which has proved to be a challenge to most models of price setting. In addition, the model shows that price flexibility at the individual level does not necessarily translate into aggregate price flexibility, which is an important issue for monetary authorities.

Insofar the analysis of the effects of monetary policy is concerned, comparable experimentation motives arise. Since monetary authorities typically *respond to* economic developments, it is difficult to separate cause and effect: when the ECB lowers the interest rate to combat a financial crisis, it is not clear whether the resulting change in production is due to the underlying crisis, or due to the policy

change of the ECB.

Consequently, economists are continuously looking for unpredictable, exogenous changes in monetary policy: after all, around those events there are no other disturbing factors present, as a result of which any response in economic variables should be due to the change in monetary policy.[1] One way to generate such exogenous disturbances is conscious experimentation. The ECB's board could for example agree to base their interest rate decisions on, say, the outcome of a game of roulette: if a black number comes up, the interest rate goes up by 0.25 percentage points, while a red number makes them decrease the rate by the same amount.[2] Although such a policy could learn economists a great deal about how the economy works, there are legitimate objections to such a strategy: it subjects the inhabitants of this monetary union to a (potentially costly) experiment, from which there is almost no escaping.[3]

The last two chapters of this thesis therefore look at an *accidental* situation that is able to avoid the cause-effect problem, namely the existence of dollarized countries. These are countries such as Ecuador, which no longer have their own currency but use the US dollar instead for their daily transactions. Hereby they import US monetary policy in the same way as, say, Texas does. However, when the Federal Reserve sets the interest rate, it does not pay attention to economic circumstances in these dollarized countries (instead, the Fed only looks at domestic conditions). Seen from the dollarized countries, it looks therefore as if the Federal Reserve determines its monetary policy by a game of roulette: in any case, US policy does not respond to developments in these dollarized countries, as a result of which it is easier to identify the causal effect because there are less disturbing factors present.

Chapter 4 fully relies on the aforementioned filtering capacity of the dollarized countries: the idea is that the unpredictable changes in monetary policy (the

[1] This can be compared to the use of randomized experiments in *e.g.* the medical sciences, where one also wants to eliminate sources of noise. The death rate in hospital Y for example does not say anything about the hospital's quality: it is after all perfectly possible that hospital Y receives patients that face tougher diseases compared to other hospitals (this is an example of noise). Only once the patients are allocated over the various hospitals in a random manner, the death rate in hospital Y becomes informative of its quality.

[2] This would more or less be the economic equivalent of the randomized patient allocation referred to in the previous footnote.

[3] To continue the analogy with the medical sciences: this would be comparable to adding a substance with unknown effects to our drinking water, to find out what this substance actually does to us.

so-called monetary policy shocks) immediately affect variables in dollarized countries (transmission of monetary shocks occurs almost instantaneously via financial markets), while non-monetary shocks need time for this. Consequently, we are able to get an idea of the true causal effect of an exogenous change in monetary policy (at least at short horizons). Such an analysis suggests that prices fall after a monetary contraction, while there is no clear effect on production.

Finally, Chapter 5 also exploits the information available in dollarized countries, but uses sign restrictions to identify the monetary shocks. Sign restrictions are a way to incorporate prior knowledge (for example derived from theoretical models) into the analysis. In this respect, there is for example consensus among most economists that a monetary contraction is associated with an increase in the interest rate and a decrease of the price level in the medium run. The short-run response of prices is debated, however: although the standard model predicts that prices fall immediately after a monetary contraction, it is possible that this only happens after a short period of inflation. This could be due to the fact that the interest rate is part of production costs, as a result of which an increase in the interest rate also implies an increase in production costs (this is also referred to as the "working capital channel"). If this cost increase is then passed on to consumers, inflation is a fact. In order to stay agnostic with respect to the debated short-run response of the price level, the method developed in Chapter 5 does not place any restrictions on the short-run response of prices, while it also leaves the US price response unconstrained. Instead, the method obtains its information from the dollarized countries. Despite the agnosticism on the short-run response of prices, the results of this chapter indicate the prices tend to fall after a monetary contraction. Hence, the working capital channel does not seem to be of great importance. Just like in Chapter 4, there is no clear effect of monetary shocks on output visible.