Causes and Effects in Macroeconomics: 2011 Nobel Prize Lecture in Economic Sciences

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Abstract: Noble Laureates Thomas Sargent and Christopher Sims have been granted the 2011 Noble Prize in economic sciences in appreciation of their empirical research on causes and effects in macroeconomics. The controversy on causality in macroeconomics was discussed in both of Sargent's and Sims's 2011 Prize lectures. While Sargent attempts to use the economic theory to interpret some historical events in order to gain insights on some contemporary issues, such as sovereign defaults, federal bailouts, and the coordination of monetary and fiscal policies, Sims is emphasizing the importance of large-scale economic models and calling for more research to be done in that area.

Keywords: Economic Modeling, Bayesian Models, Defaults, Bailout, Business Cycle.

1. Introduction

One of the most difficult challenges to economics is to understand "what explains what" when looking to economic historical data. Nowhere in economics is this challenge big as it is in Macroeconomics. Controlled experiments are required to distinguish cause and effects in economic policies, nevertheless, controlled experiments are difficult to conduct and likely undesirable. It is sort of impossible to the central bank to try different rates to see what happens. Market interest rates are usually determined by the central bank, also by the market, but it depends on what market participants and the central bank anticipate. Therefore, the importance of expectations about the future cannot be denied.

Prof Thomas Sargent and Prof Christopher Sims have both been awarded the 2011 Noble Memorial Prize in Economic Sciences in appreciation of their efforts on distinguishing cause and effects of economic variables particularly in the field of Macroeconomics. In the 2011 Noble Prize lecture conducted in the Royal Swedish Academy, both of Sargent and Sims described their findings in the field of macroeconomic modeling and provided insights on their approaches of economic analysis.

2. Should a Monetary Union Precede a Fiscal Union?

In his empirical research on causes and effects in macroeconomics, Sargent attempts to use the economic theory to interpret some historical events in order to gain insights on some contemporary issues, such as sovereign defaults, federal bailouts, and the coordination of monetary and fiscal policies. He starts his

Prize lecture with a historical case study of the United States between 1780 and 1840. During this period of time, the US faced institutional and policy choices that are similar to the present day's era. This period of time witnessed several events that shaped the economic policies like the War of independence, the Articles of Confederation "the First Constitution", the US Constitution, the Treasury department that set up the fiscal policies, and the Nationalization. This period of time was mainly characterized by an era of federal bailout, and another one without a bailout. Sargent attempts to explain the forces that underlined these events taking into consideration economic and budget constraints alongside the following concepts:

- ✓ Fiscal arithmetic: the arithmetic of the budget constraint. This part of the lecture included the main thesis of Sargent's theory that explains mainly how governments value bonds.
- ✓ Fiscal and monetary choices that the US made at the beginning after the independence.
- ✓ The current situations in the United States and the European Union.
- ✓ And the lessons to learn: how the past could be reflected on the future and differences and similarities between the past experience and the current situation.

Sargent research attempts to provide answers to questions like: should governments default on their debts? Should a central government bailout a subordinate state? Should a monetary union precede a fiscal union? or vice versa.

Sargent developed a simple model for government debt. He also asserts that two of the founding fathers: George Washington and Alexander Hamilton knew this model as the "back of their hand", thus he assumes that they had all the represented economic variables in mind when developing the US economic, fiscal, and monetary policies.

The first equation in the model represents a statistical description of the government's net-of interest surplus (represented by a small s) which is government tax revenues minus government expenditures where a negative net is a deficit. The net-of interest surplus is explained by a sigma of a Martingale probability sequence where expectations about the future are accounted for. This surplus is a function of the shocks, which are the fiscal crises that shaped the economy during a given period of time. Sigma is a polynomial lag operator according to which the vector of shocks will explain the net-of interest surplus.

The second equation is the government budget constraint. The left hand side is the value of government debt at a particular point of time. The right hand side is the backing of what government debt is. What that equation says is that the value of the government debt today is the current payout or surplus plus the discounted value of the debt tomorrow.

Two ways to solve these equations exist and each has insights. The debt of today is a reaction for some policy choice in the past. The third line says that the government debt is a reflection of policy measures, choices, and actions conducted in the past. However, market participants do not care about the past but about the future and that what the last equation is all about. That equation says that the current value of today's government debt is the present value of the government surplus. Thus, high government debts today are signals for high government surpluses in the future.

The future is uncertain so it should be forecasted by using mathematical expectations. The equation includes a time-lag variable, so it means that the debt was born and priced in the time period of this time lag (*t-1*), and that what represents the key equation in the model.

Sargent adopts a rational expectation approach to explain changes in the interest rate and creditors' behavior. His model accounts for developing psychological expectations with the best mathematical and statistical forecasts. In his analysis, Sargent relaxes the risk-free interest rate assumption. So, the government will not default on the debt but will default on only one part of the debt, only the fee for example, which could be some fraction between 0 and 1. Thus, expectations depend on default probability, and interest rate is adjusted accordingly. So if the government debt is valued too low, and it supposed to be valued highly, this could be achieved by changing the interest rate through changing the default probability, or by changing the government surplus process. The process by which interest rate is changed to achieve policy targets is determined by economic theory and economic modeling. Determinants of the model are environment, (behavior) constrained optimization, and new equilibrium concept.

After the War of Independence, the political environment was characterized by the Articles of Confederation or the first Constitution. It was also characterized by a weak Continental Congress or a weak government where the US had two sets of institutions with two different outcomes: high debt because of the war and uncoordinated trade and fiscal policies where taxing to raise revenue required a consensus of the thirteen States. Debts and IOU's were discounted in 1780s. Huge debts were characterized as a fiscal crisis by the holders of those debts.

Fiscal crises often produce political revolutions. It did in the US in 1787 and that led to a new Constitution which is a new environment per se. The new Constitution no longer allowed the States to run their own trade policies or to impose tariffs or to tax exports and imports. In those days, the major tax was the tax on imports and exports. This authority was given to the Federal government on the purpose of servicing Federal debt. The Federal debt was huge as the government bailouts the13 individual States.

In 1790 the government levied tariffs. Hamilton wanted the Federal government to bailout the States because he wanted the creditors of the individual States to become advocates of a strong central government, strong enough to be able to tax, so the creditors of the government support a high-tax State to service the debt which is their own. So the debt was rescheduled and there was no discount. Hamilton wanted the government to have the ability to borrow in the future so it should bailout today's debt, thus sustaining a good reputation with foreign creditors was imperative for him.

The founding fathers had a fiscal union but not a monetary union. The monetary system was under the silver standard, so the monetary union was established after the civil war. The government reputation was good in terms of repaying foreign creditors and in terms of saving individual States and bailout their big debts if any.

This was followed by a controversy on what kind of fiscal union should be established? Should the government finance infrastructure projects? It was decided that it should not. James Maddison, James Monroe, and Hamilton vetoed the Federal finance of infrastructure like railroads and canal projects, so the State started financing. Therefore, individual States started running big debts by issuing bonds thinking that such projects would eventually pay for themselves by collecting revenues. This event was followed by a recession and the States bonds failed. The creditors referred to the government to bailout the States as happened in the past, so creditors developed their expectations on the history of the Federal bailout, but the Congress refused this time. The argument was that the first bailout was for a glorious cause which is to liberate the country and to expel the English, but this time it was not. So this bailout failure had consequences:

- ✓ The British buyers of the US bonds no longer want to invest in the US.
- ✓ A political revolution caused by this fiscal crisis that led to re-write the States Constitution in the 1840s to help budget imbalance.

The question is whether this policy was wise or not. Whether the Federal government should or should not bailout States debts. From the Sargent's perspective, it was wise for the following reasons:

- ✓ If these States debts were bailed out then these amendments in the Constitution will have never been existed.
- ✓ If these States debts were bailed out, then there will be more Federal control on the States policies.

Sargent concludes that the case in the US during the above period of time was characterized by a deep discount on bonds, uncoordinated fiscal policies, an unplanned set of monetary arrangements, and a large Federal debt. This past experience could be reflected on today's status of fiscal and monetary policies of the US. The economic status currently holds similar consequences for the same policies that were adopted before, during, and after the Great Recession of 2008 with some differences. The economic scene in that era was also characterized by a deep and varied discount on member states bonds, and uncoordinated fiscal policies. However, the difference was in the centralized monetary arrangements and the "No Federal debt" character.

So, to answer the main question on deciding whether to default debts or not, Sargent asserts that the government should weigh out the costs and the benefits of debt default. If the government does not default, there will no longer be an easy access to the creditors' money and interest rates will be higher. Nevertheless, the benefit will be the lower tax rate that will positively impact current consumption rates.

On deciding whether a central government should bailout subordinate states or not, the cost is the moral hazard. The collateral damage in the future caused by bailing out some financial institutions falls on people incentive to risk-taking. So the cost is the excessive risk taking, thus the excessive federal control on local institutions. However, the gain will be the easy access to the creditors' money.

So, should a monetary union precede a fiscal union? Or vice versa, the answer is that there should be some coordination on developing these two institutions in coordination and through adapting the variables imposed by the environment, the social, and the political necessities.

3. "Preserve the Momentum" of Economic Modeling

In his Prize lecture, Sims evaluates and compares different economic modeling methods. Particularly, the Keynesians' and the monetarists' approaches to economic modeling. He starts his presentation discussing a project that Jan Tinbergen (1938) started in the 1930s. Real scientific progress in economics does not run as smoothly in economics as it does in natural sciences. It could be more complicated, and for Sims, Tinbergen's project gives an idea of what real scientific progress in economics is.

Tinbergen project is organized as follows:

- ✓ A statistical model with error terms and confidence intervals on parameter estimates.
- ✓ Multiple equations, covering whole the economy at the aggregate level.
- ✓ A testing ground for theories on the business cycle.

Tinbergen's model was followed by an academic debate between Trygve Haavelmo (1943), who advocated the model, and John Maynard Keynes (1939), who wrote an "extremely negative" review of Tinbergen's book that included this model.

4. Haavelmo's Approach of Modeling Business Cycles

While Keynes (1939) argued that because the model includes error, random term, it could explain any set of data. Thus, the model cannot be used to test theories of business cycle. Haavelmo (1943) defended the model. According to him, it was possible for a statistical model to be used as a testing ground for economic theories. Tinbergen used multiple equations, but he estimated one at the time. There was no attempt to treat the set of equations as a joint probability model of all the time series. He did not use his model to explain the joint behavior of all the data that he had. Nor did he attempt to model how the system evolved dynamically through time.

Haavelmo defended the model arguing that economic models should be conceived as probability models that generate a distribution of possible outcomes for all the variables that were involved in the model. But in order to be testable, models should include a distribution of the error terms, so they have to be probability models. So, Haavelmo argued that even Keynesian models could be formulated, estimated, and tested in this way. However, the Keynesian viewpoint implied that business fluctuations had many sources and that policy instruments were relevant to stabilization policy. Fiscal disturbances and monetary policies could be sources for business cycle fluctuations too.

A guideline was needed for policy decisions, so the Cowles Foundation methodology for codifying and expanding Haavelmo's ideas about inference was developed by a group of theorists. By 1960s, with the aid of computing power, macroeconomic and econometric modeling included hundreds of equations and variables, and that caused a problem of scale. Large scales models with hundreds of unknown coefficients require defining a priori coefficient by signaling that few coefficients are not important. The models were simplified by approximating restrictions that was assumed to be correct. Thus, such models

were not believed as probability models, because a big range of uncertainty was omitted. So when these models made a prediction and provided a probability distribution for this predicted value, it was not perceived as a realistic prediction. The probability distribution did not reflect lots of the real uncertainties about these models.

5. Monetarist Models

Milton Freidman, Ana Schwartz, David Meiselman and others formulated a view of business cycle and stabilization policy. Their view suggests that the large Keynesian models were overcomplicated and had missed some simple statistical relationships that were central to a good policy. They argued that the growth in the stock of money was tightly related to growth in income, and patterns of timing suggested that the relations were causal, and that fluctuations in money came before the fluctuations in income. Statistically estimated equation implied that most of the business cycle could be eliminated by simply making money supply growth constant.

Large scale probability distribution models, or in Haavelmo's models, share some flaws with monetarist models. Haavelmo showed how to do a policy experiment in his simple model. The cause that the model included multiple equations is to do some policy experiment by removing one of the equations later and see how the system will run when this part is removed. But Haavelmo did that by eliminating an identity function and not a policy behavior function. He had no policy behavior function. He attempted to analyze the effect of a change in the government expenditure in a model that does not include a variable for the government expenditure, nor does it includes an equation explaining what determine government expenditure.

The Keynesian models followed the same approached. They did not include a behavioral equation that explains the behavior of government policy-makers. And it is the flaw that they share with the Haavelmo's models and the monetarist models. Keynesians did not model monetary policies, then they realized that it is significant to be modeled.

This controversy on economic modeling was followed by a set of academic papers that were debating two different views, Friedman and Meisleman were advocating the monetarist view, and Albert Antoine and Franco Modigiliani were pushing the Keynesian view. They were arguing on how to interpret these regressions that showed high correlation between money and income. They were also arguing which variable should be treated as a non-random one, but none of them came up with the policy variable that should be treated as a non-random variable. So, this made the debate between the two views a "confused battle field".

6. Bayesian Models

A review of Bayesian models is also included in Sims analysis. The Bayesian model calls for developing probability on things that we do not know in order to help making decisions. The Bayesian model finds no paradox in the notion that policy-makers see their own actions as non-random. But econometricians and private sector scholars develop probability distribution for policy-makers' actions. This assumption is very crucial to develop probability model of policy-makers behavior. Markov Chain Monte Carlo methods were implemented to do this kind of inference. Two flaws of the Keynesian models were met by this Bayesian approach:

- ✓ The problem of the conceptual idea of modeling policy choices as random, yet being able to condition on them and treat them as given.
- ✓ The Bayesian approach accommodates the idea that you can borrow external variables from out of the model and they may not consist of exact values for certain coefficients, but approximated as reasonable ranges of the coefficients value. Then a test could be conducted to check whether the data of the model can provide information about this parameter values or not. That would provide more realistic probability distributions when predictions are made in the model.

Sims takes into consideration the main claims of Rational Expectations in building his analysis. One basic insight of the rational expectations theory is that these policy variables have to be random in order to be part of the economic models. If it is confirmed that the policy behavior is systematic and that public develop expectations about it, the nature of the policy behavioral component of the model affects the behavior of people in the private sector. Thus, rational expectations theory has some "bad" side effects. First, economists, who are not comfortable with the idea of the randomness of policy actions, took the view that rational expectations modeling can consider these actions as exogenous, non-random changes. Second, all these large models used to help policy-making decision process hold no help and will be ignored. Yet they were used in central banks, but they are less frequently used than before.

Sims stresses the following as his main research contribution. The monetarist view stresses the strong correlation between money growth and income which reflects a causal effect of monetary policy errors on income. So, future money growth should not contribute to explaining current income. In his 1972 paper, Sims run the test on data and he found out that the monetarist regressions passed the test, and that future money growth did not predict current income (Sims, 1972). For Sims, this claim was mistaken. In economic models a causal direction based on predictive power can be misleading. If rational expectations theory was applied in financial market analysis, the perfect financial market hypothesis will be achieved. Assets prices will accommodate for new information, hence will be unpredictable themselves, so no influence of future stock prices exist. If money stock was exogenous in these monetarists equations, future growth will never help explaining money stock in the money demand equations. Empirical studies showed that money demand equations passed the same test. Thus, for Sims, more than one equation should be considered, or what Haavelmo did when he used two equations could be applied.

Using Structural Vector Auto-Regressions (SVAR), Sims concludes that influence of monetary policy on income is detectible in the data. At the same time, changes in money stock and interest rates represent systematic reactions of monetary authority to the state of the economy, not random policy errors. Only small part of the macroeconomic fluctuations, and particularly not most of the post-war recessions represented in the time series, could be attributed to erratic monetary policy. Thus, for Sims, policy variables are systematic and should not be treated as random variables in the economic modeling.

Descriptive linear multiple equation systems were used in the economic literature to capture the empirical regularities in the time series. Linear models were developed upon using prior beliefs about the model that did not have any economic content. Thus, coefficients on longer lags were not important as variables are likely to evolve smoothly over time. That was denoted as Vector Auto-Regressions (VAR). For Sims, the estimated system holds potential causal interpretation only if a descriptive linear multiple

equation systems is constructed upon prior beliefs that reflect an economic content. So the VAR models could be transformed into Structural VAR models so they can be characterized as follows:

- ✓ They will be of the same scale of the Keynesian models and of Tinbergen's original proposal.
- ✓ These models are big enough to be used for policy analysis,
- ✓ They are fully interpreted so the variation in them had an economic interpretation.
- ✓ They are specified as complete probability models and Bayesian models, so they follow Haavelmo's original examples, and they allow us to test theories against one another in a consistent manner.
- ✓ They fit to unstructured VAR.
- ✓ Finally, they resolve the issue of how to interpret the correlation between money and income.

Sims concludes his Prize lecture commenting on how economists and econometricians rapidly shifted their interest away from serious probability-based modeling for policy after rational expectations "revolution". That reflects the inherited sociology of the profession. Despite interesting, there is a hug resistance to give these issues respect and Sims calls for more research to be done in this area in order to "preserve the momentum of this research".

7. Conclusion

The above review attempts to highlight the main contribution made by Prof Thomas Sargent and Prof Christopher Sims who have both been awarded the 2011 Noble Memorial Prize in Economic Sciences in appreciation of their empirical research on causes and effects in Macroeconomics.

Sargent provides policy recommendation. He constructs his analysis of policy measures on comparing US fiscal and monetary policies that were adopted in the aftermath of the Great Depression to the current policy measures adopted in the aftermath of the Great Recession. Meanwhile, Sims constructs his analysis upon the assumption of rational expectations, so his analysis includes a more technical description of the different approaches of modeling business by comparing Keynesian, Monetarist and Bayesian large scale models. Sims highlights the controversy of economic modeling and provides an approach to modeling business cycle in which he makes use of the techniques used in large scale models to overcome the shortcoming of other economic modeling approaches.

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