Economics: The interaction of Control systems

Unedited posts from archives of CSG-L (see INTROCSG.NET):

Date: Tue Feb 11, 1992 2:24 pm PST
Subject: CT Economics

[From Bill Powers (920211.1500)]

Here's a kickoff for a thread we might call CT Economics.

It's hard to get a feel for the antiquity of Adam Smith's writings in _The Wealth of Nations_*. But there's passage in my Penguin edition that helps:

> "In the province of New York, common labourers earn three shillings and sixpence currency, or two shillings sterling, a day..."

It isn't the wages or the strange dual monetary units to which I refer, but the footnote attached to "earn":

> "1. This was written in 1773, before the commencement of the late disturbances."

This is the book, as old as the United States, in which the "invisible hand," the Law of Supply and Demand, was invented. Economists have taken this law as a basic given of economics ever since. It's been taken as the magic formula that sets a free-enterprise system straight when it goes astray, no matter what mistakes are made. Leave the system alone and the invisible hand will make sure it flourishes. Meddle with it, regulate it, insert human intentions into it, and only disaster can follow. The Law of Supply and Demand is greater than any of us and operates in majestic disregard of mere human desires and purposes -- or so we are told by theoreticians in economics.

This, however, was not Adam Smith's conception of this law. For Smith, it was simply the natural consequence of the fact that people want things and are willing to devote some labor (or labour) to getting them. Here is what he said about demand.

> "The market price of every particular commodity is regulated by the proportion between the quantity which is actually brought to market, and the demand of those who are willing to pay the natural price of the commodity ... to bring it thither. Such people may be called the effectual demanders, and their demand the effectual demand; since it may be sufficient to effectuate the bringing of the commodity to market."
>
> " ... When the quantity of any commodity which is brought to market falls short of the effectual demand, all those who are willing to pay the whole value of the rent, wages, and profit, which must be paid in order to bring it thither, cannot be supplied with the quantity which they want. Rather than want it [lack it] altogether, some of them will be willing to give more. A competition will immediately begin among them, and the market price will rise more or less above the natural price, according as either the greatness of the deficiency, or the wealth and wanton luxury of the competitors, happen to animate more or less the eagerness of the competition. ... Hence the exorbitant price of the necessaries of life during the blockade of a town or a famine."

Similarly, he says, when there is an excess of supply over effectual demand, some of the goods must be sold to those who are willing only to pay less, so the market price will sink lower than the "natural" price.

"Effectual demand" is one side of a purely psychological explanation of the Law of Supply and Demand (the other side would describe the producer- seller's adjustments of the price, given the need to pay the costs of production and distribution and the desire to have a profit left over).

The payment of money for goods, Smith pointed out, misrepresents what is actually traded. "The real price of everything, what everything really costs to the man who wants to acquire it," he said, "is the toil and trouble of acquiring it."

So we have the basis for a model of the demand side of economic transactions. Human beings desire goods and services, some being desired because human beings can't live without them and the rest because human beings have learned to value them. People are willing to exert a certain amount of toil and trouble in order to bring the goods and services thither -- a great deal of toil and trouble, if they require the goods and services to say alive. If the shortfall is great, they will put out more effort to get what they want and need; if there is an excess, they will not make any effort to get more than they want or need.

On the supply side, there are people who also want goods and services, and are willing to go through toil and trouble to get them. Their labor is not on the production line, but is used to buy materials, rent facilities, borrow, organize, and otherwise manage production in order to create the goods and services that they and others want. They give receipts for goods and services to laborers who transform raw materials into production machinery and commodities, and they adjust prices (which are paid to them using the same receipts they gave out) for those commodities, so that the whole product can be sold and the costs of production can be repaid. The receipts returned to the producer-seller are used in part to pay the laborers who harvest the raw materials, build the machinery, and produce the goods and services; in part to repay the borrowed receipts with interest; and in part (the part they are most concerned about) to spend on goods and services for their own consumption.

So all human beings produce toil and endure trouble in order to bring the quantity of goods and services made available to them by that toil and trouble to the level that they need or want. This is the great engine that drives all human interactions, including those that come under the heading of economics. The invisible hand is the hand of a human being working to control what happens, not to an abstract economy, but to that human being. There are no other forces at work.

Theoretical economics has dropped the human being from these equations and has tried to explain the workings of an economic system with no human beings in it. This is why theoretical economics has so little relationship to what actually happens in this economy. In order to build a clear picture of economic interactions, we must understand that they result from the basic nature of living control systems, human beings.

Best Bill P.

Date: Mon Jun 01, 1992 7:23 pm PST
Subject: Economics

[From Bill Powers (920601.2000)] to Greg Williams (920601)

Good point about the reference levels. But I think there's a deeper glitch in the economy than just oil prices.

The problem is that there's a basic conflict between consumers and producers -- the same one that communism tried and failed to resolve. It hasn't gone away. The split between wage income and capital income in the for-profit sector (government is not-for-profit) is about 40/60 -- 40 percent for labor, 60 percent for owners, stockholders, debtholders, etc. This has been pretty close to the ratio since 1930, with the capital-income share having risen slowly from about 53 percent in 1930 to today's approximately 60 percent. The conflict is that receivers of capital income want their share to increase, while wage-earners want it to decrease.

The composite consumer (not the producer) has the reference level of improving the standard of living. This means working fewer hours to obtain ever-better goods and services, or even just to be working and eating instead of not working and not eating. The idea is that technology or ingenuity -- increased

productivity -- should be rewarded by obtaining a better life with less prolonged, unpleasant, boring, dangerous, unremunerative, or mind-numbing labor.

The composite producer (with bean-counters in charge) has the reference level of maximizing the return on investment for the owners of the means of production, or those who have invested in it. This means cutting costs wherever possible and charging the most the market will bear for the lowest quality goods or services that can consistently be sold. Cutting costs means, in large part, reducing the cost of labor. When you reflect that cutting material costs is also cutting costs of labor (on someone else's part), it all comes down to cutting labor costs -- if capital income isn't to decrease.

The kicker is that the wage-earners who produce the products have no way of buying the products except with the money they are paid in wages. So if costs are cut by laying people off, substituting cheaper overseas labor, or reducing domestic wages, the result in all cases is that the buying power of the consumers is reduced -- so the goods and services can't be sold at higher or even the same prices, in the same volume. This is where the conflict comes to a focus.

Unfortunately, this system doesn't have any natural reference levels in the middle of its range of operation -- it just has limits. It always tends toward the state where some large number of people is existing at a subsistence level. The only thing that keeps the composite producer from reducing labor costs any further is the fact that a lot more people would begin dying of starvation or untreated illness or would have their physical living conditions reduced to an intolerable state. The result would be an explosion of crime, or revolution. So a balance is reached where the deleterious effects of further reductions in consumer buying power will increase costs (through taxes for welfare) and reduce sales (through loss of buying power) unacceptably. Government tries to alleviate this situation through redistribution -- spending tax money in ways that increases the slice of the wage-earner or dependent. But the composite producer has no such motive, except when so many people become impoverished that the market begins to fall off.

The government and private philanthropies together manage to acquire enough money from the composite consumer to bring the fraction of capital income down to about 40 percent by redistributing income. Evidently, this is the fraction at which the wage-earning or seeking population has to be maintained even to keep the economy in its current state. If there were no redistribution, there is no way that capital income could remain at 60 percent of the total without creating a violent rebellion by starving people.

People talk in the same breath about our prosperity reaching new highs, if more slowly nowadays, and about the increasing split between high-income people and low-income people. The high-income people are also the chief recipients of capital income. They form the high end of the market. So companies who see sales falling off try to aim for the people who have the money: they produce luxury services, labor-saving items and toys, high-tech or disposable goodies, that will attract the small fraction of the population that has the most money to spend. The result, of course, is that the people at the low end find fewer and fewer items they can afford to buy. The people who CAN maintain their 1970 standard of living work like hell to do so (to get to your point). But just in working like hell to do so, they've sunk below that standard of living. And of course, there are far more people who can't get or handle two jobs, who work less than they used to or at lower wages, and are having a more miserable time than ever.

I think that the owners and managers of this economy need a visit from Ed Ford. Somebody has to ask them, "Is it working?" The problem is that their answer is really "yes" -- so far, it's working for them. A CEO earning $3 million per year plus perks can't really complain. But the SYSTEM CONCEPT isn't working for the people who actually make the system go. It's only working for those who own the system or hold its debts.

There is something drastically missing from the hallowed concept of free enterprise. It's keeping the people whom the economy is supposed to serve in

the condition of Skinner's rats. This is something that I think control theorists need to be talking about.

Best, Bill P.

Date: Wed Jan 27, 1993 7:52 pm PST
Subject: Economics; misc

[From Bill Powers (930127.2030)] Bob Clark (930127) --

I have a lot of things to say about economics, Bob, but I'd better postpone them a while. I'm going away for 10 days starting Feb. 7, and Wolfgang Zocher is about to spring a very nice version 4 of Simcon on the world which I want to help get distributed, and I'm working on the 7-df arm model, and the chatter on the net never ceases.

Just a brief word. My father has done a lot of research on the factual record of economic phenomena, comparing it with basic theories, and has found that the basic theories are almost total nonsense. Examples: when money is made tight, the rate of inflation goes UP, not down. The analogy of national savings to savings of families is completely wrong. What economists use as an indirect measure of national savings really represents a loss of buying power out of the national economy. Industry has spent 20 +/- 2 percent of its total income on capital investment percent every year for the last 100 years; you can't jazz up the economy by increasing investment. And other goodies. His approach has been the macroeconomic one, and I've become very interested in it. Economists pay very little attention to the facts.

From the macroeconomic point of view, taxation has essentially no effect on the economy. Those who object so strongly to taxes seem to forget that the government spends its tax income AT LEAST as fast as it receives it. Most of the money taken in is handed right back, although redistributed, becoming buying power in the hands of the public and industry again. What changes is who gets the money, and that's a microeconomic problem, or a problem of social justice, or politics. Maybe taxing one industry discourages that industry, but another one gets the money and is encouraged. The best place to put tax money is in the hands of poor people, because they are sure to spend it all right away, and not hoard it or leak it away in bad investments outside our economy. It's the people who don't spend all of their income on goods and services in this economy who are responsible for most of our problems. Those tend to be the people and organizations who make so much money that they can't possible spend it all on goods and services.

Control theory gets into macroeconomics by explaining what keeps the circular flow going.

Later, Bill P.

Date: Sat May 01, 1993 8:14 am PST
Subject: Economics: the Williams Effect

[From Bill Powers (930430.1100)]

Six or eight years ago, an economist named Bill Williams came to visit me. He thought that control theory might be able to explain a phenomenon called the Giffen Paradox. We worked nonstop through the weekend, and indeed came up with a control-system model that reproduced this effect (no longer a "paradox"). I've recently looked into it again, and have found a simplified version of it. I think that the Giffen Effect (or perhaps it should now be known as the Williams Effect) can explain a lot of economic problems and perhaps give us a meaningful working definition of poverty.

The Giffen Paradox has been known (and ignored) for a long time. The effect is called paradoxical because it results in a reversal of the normally-accepted law of supply and demand. In a situation where people are on a limited budget, it can happen that when the price of a good increases, people are forced to

buy more of it (the normal law of supply and demand requires that an increase in price result in a decrease in sales).

The representative case that Bill Williams started with was one in which a person has a choice of buying meat or bread. Meat and bread can provide about the same number of calories per pound, but meat costs much more per pound than bread. Bill also introduced a "prestige" factor, in which there was a built-in preference for meat over bread regardless of cost of calories.

The model turned out to consist of three control systems:

1. The calorie control system had a reference level for calories needed. If the amount being obtained was less than the reference level, purchases of bread and meat would be increased equally, as either one can provide calories. This control system worked only when the obtained calories were less than the reference amount. Excesses of calories were not resisted.

2. The "budget" control system had a reference level for amount of money spent. This control system became active only when the total being spent exceeded the reference level. An error (excess of spending) was turned into a decrease in purchases of meat alone (the more expensive commodity), with no effect on purchases of bread.

3. The "prestige" control system gave a high weight to perceptions of meat being consumed, and a low or somewhat negative weight to perceptions of bread being consumed. Deficiencies of prestige led to increases in purchases of meat AND decreases in purchases of bread.

These systems operated independently and in parallel. By adjusting the gain factors and the weightings of the various perceptions, it was possible to reproduce the Giffen effect. Raising the cost of bread resulted in an increase of bread consumption and a decrease in meat consumption, but only if the total allowable budget was below a certain level.

On returning to this model, I realized that the prestige factor was unnecessary except for producing a preference for meat when the budgetary limits were removed. If the output weights of the calorie control system are equal, equal amounts of bread and meat will be purchased when no budgetary constraint exists. If a preference for meat is wanted in the model, it can be put in simply as an increased output weight for meat purchases in the calorie control system.

When the budget is reduced, the total cost of providing the needed number of calories tends to rise above the budgetary reference level, and purchases of meat are reduced. Since this reduces the number of calories consumed, the calorie control system raises the tendency to buy BOTH bread and meat. But a tendency to increase meat purchases is offset by the budget control system which forces meat purchases down, leading to a net increase in bread purchases and a decrease in meat purchases. The essence of the Williams Effect is thus recreated without any need for a third factor.

Increasing the cost of bread has the same effect as reducing the budgetary reference level: it drives the total cost above the budgetary reference level. The two control systems respond as before, increasing bread purchases and decreasing meat purchases, keeping the calories the same and reducing expenditures to the budgetary reference level. So raising the price of the cheaper commodity results in an increase in consumption of the cheaper commodity.

Actually, raising the price of EITHER bread or meat will result in consumption of more bread and less meat, which makes sense. It's only when the price of bread increases and more bread is purchased, however, that anything paradoxical (in terms of conventional economic theory) appears to occur.

It's easy now to extend the Williams Effect to a large assortment of goods that provide alternate means of supplying a specific want, but at different costs. Whatever the mix of purchases without budgetary constraints, an increase in the price of any item that tends to cause spending over the total budget will depress the purchases of at least some items. If the excess

spending is corrected by reducing purchases of the more expensive items, the Williams Effect will be observed for all the less expensive items; increasing the price of the less expensive items (one or more of them) will result in an increased consumption of those items, and less consumption of the more expensive items. This is the result of the control system controlling for the non-budgetary effect of purchasing all these items whether expensive or inexpensive -- calories, in the above example.

The Williams Effect may have a close connection with the well-known phenomenon of the rich getting richer while the poor get poorer. Richness and poorness can be measured in part by what people are able to buy. High-quality and luxury goods tend to be more expensive than low-quality ordinary goods that satisfy the same basic need such as clothing, transportation, or health care. If manufacturers continually probe the market to see what prices it will bear, there will be a tendency to raise the price on everything until resistance appears in the form of lower sales. At that point, those with the lower budgets run into the Williams Effect first. They must decrease their purchases of high-priced goods, but to maintain the same level of the needed good or service they must increase their purchases of the low-priced (and low-quality) goods. So the manufacturers find that they can raise the price on the low-priced goods disproportionately to the price of high-priced goods, and still get a net gain in profit.

The only equilibrium condition would seem to be the one where people with the lowest budgets lose entirely the ability to buy any goods or services of high quality. People in the poorest neighborhoods find themselves paying high prices for ordinary or low-quality food; they live in dilapidated housing and pay exorbitant prices for it; they drive used cars of greater and greater age, or take public transportation, the price of which keeps going up. They do without health insurance altogether, and seldom see a doctor, a dentist, an optometrist, or a counselor. They can't afford lawyers or bail. And as they are forced more and more toward the poor-quality low-cost end of the market, those supplying the lower markets find that they can increase prices even further without losing sales -- and indeed, even increasing sales.

So it appears that courtesy of the Williams Effect, the free market system is organized to create a wide gulf between people without budgetary limits and people with them, and to keep this gulf increasing, limited only by the condition in which too many people can't afford to live at all, a non-economic consideration. The law of supply and demand works only for those without budgetary limits -- who can afford to choose what they buy on the basis of aesthetic objections to high prices, rather than being forced by necessity to adjust their purchases to avoid going into debt. For all those who must spend essentially all that they make, the Williams Effect dominates and the road leads only downward.

I think this is an example of a way in which control theory can explain situations that are unexplained under the assumptions of conventional theories.

Best to all, Bill P.

Date: Thu Sep 16, 1993 7:20 pm PST
Subject: Marcos: Economic PCT Proposal

[From Marcos Rodrigues (930915.1600 BST)]

The Economic and Social Research Council in the UK has just launched a new research programme entitled "Economic Beliefs and Behaviour":

"The purpose of the programme is to investigate the economic beliefs and behaviour of people at a time of rapid economic change and to foster interdisciplinary research in this area. In particular, it will address the themes of personal financial and economic behaviour; economic socialization; and the interaction of social and cultural norms and economic beliefs and behaviour."

Since I know nothing of economics, I'm trying to convince a Professor of Accounting at Manchester University to collaborate on a PCT-based research project. I'm going to meet him over this weekend. Meanwhile, I'm writing a draft outline proposal (a 3-page document). If we get this through, then we will be invited to submit a full proposal by next April.

I would be grateful to anyone who is prepared to spare some time reading and commenting on this. The deadline for submission is in around two weeks time. Since this is an outline, details are not normally required.

I've tried to describe PCT in one paragraph, and have failed. I then decided to use Bill's description as in the Intro to CSG document. I hope Bill doesn't mind.

Best regards to all, Marcos.

The objective of this proposal is to model human behaviour during dramatic economic changes. Since the market environment is by definition dynamic, our view is that it is essential that we describe the factors that influence people's behaviour as a function of time. Those factors, or control variables, can have their relative importance dramatically changed (inside people) as new inputs are taken into consideration at different times.

We will dedicate especial attention to the change rate of some selected variables, that is, their derivative with respect to time, since we believe that people's perception of "transitions" is a determinant factor on behaviour regarding economic matters.

We propose to use a new approach for describing behaviour in living organisms called Perceptual Control Theory (PCT) whose development has started since the 1930's by William Powers.

PCT explains how organisms control what happens to them. It explains what a goal is, how goals relate to action, how action affects perceptions and how perceptions define the reality in which we live and move and have our being. Perceptual Control Theory is the first scientific theory that can handle all these phenomena within a single, testable concept of how living systems work.

The development of this project, within a PCT framework, will be based on three planks: "identification", "modeling", and " simulation". Since we are working in the realm of microeconomics, these stages will be constantly checked against the behaviour of human subjects with suitably designed test procedures. "Identification" refers to the identification of a set of perceptual variables controlled by people, that is, variables people are trying to bring to some specified reference state, often through variable means. The correct level of abstraction of such variables is essential to the success of the following stages. " Modeling" is the indication of the interdependencies between those variables and the environment (internal and external). "Simulation" refers to building and running computer simulations of the representation of control variables and their interdependencies, that is, to simulate the phenomenon of perceptual control. We expect this project to give us a deeper understanding of economic perceptual control variables, their interdependency, and their varying importance as a function of time, so that we will be better equipped to predict behaviour under a certain level of abstraction.

In economics, the intersection point between supply and demand curves (the canonical representation of market behaviour) is normally referred to as the market equilibrium point for a product or service. The economist view is that markets are not always in equilibrium but, if they are not interfered with, there are good reasons to believe that they are normally moving towards an equilibrium point. The problem with this representation and view is that it may tell economists what happens with a product, that is, it may give some information about an object being produced.

It does not give, however, any information about individual behaviour of people producing or consuming a product.

It does not give information about the goals, desires and wants of both producer and consumer.

In PCT, the intersection point between supply and demand is not in any sense an equilibrium point; in fact, markets will oscillate forever as long as people have enough degrees of freedom regarding variables they can control in the process of production and consumption of economic goods.

From a PCT perspective, the economist representation is not meaningful because it fails to include people in it. In addition, PCT does not see the market as a social control system that punishes anyone who tries to interfere with its normal working.

The failure to include people in economic analysis is similar to making a detailed economic analysis of milk production, distribution and consumption with a model that does not include cows in the picture. Adam Smith's "The Wealth of Nations" is quite illuminating in both aspects concerning people's behaviour and market outcomes: it attributes self-interest as the instrument of the ``invisible hand'' whose actions economists see as an outcome, namely the market resistance to interference.

This tells us two things: first, the "invisible hand" are individual people controlling their perceptions of economic factors such as profits, budgetary constraints, dietary intake, and so on. Second, it follows that the apparent move towards market equilibrium is nothing but a side-effect of individual control of perceptual variables that are so diverse to enumerate. Markets do not resist disturbance; individual people do, and they do it by exercising choice within given constraints.

PCT implies that there is a great number of control variables that both supply and demand sides of the economy are steering close to a desired states. For instance, from the supply side perhaps arguably the most important control variable is the perception of profits. A management will almost invariably take decisions in order to maximize profits given existing economic constraints. It may be argued that not everyone during all the time go for decisions that maximize profits. Sometimes management make decisions that are just good for the employees, or safe, irrespective of being maximizing or not the company profits. Such behaviour is fully accounted for in perceptual control theory.

A decision that is just good is explained by PCT as the control of some perceptual variable (for instance, in the relation between capital and labour) that, at certain "moment in time", is more important to the management for any given reason than the immediate maximization of profits. The decision sometimes might function as a constraint in maximizing revenues or it may incur in extra expenditure. However, as soon as the decision is made, the management task is immediately to maximize profits given the new constraints imposed by the decision.

Controlling for the perception of maximum profits is a complex process that is achieved through the control of a number of potentially complex variables and interdependencies. In this project, we propose to undertake a systematic approach to the identification and modeling of economic control variables, that is, perceptual control variables inside people, and build computer simulations showing interdependencies and interactions between people within a dynamic environment of economics.

The modeled control variables should account for people's behaviour under dramatic economic changes. We expect that such studies will allow us a better understanding of people's behaviour in relation to important (to people) economic factors.

It is essential that we use the right kind of approach to modeling and simulation and that the final model shows a high correlation between predicted and expected behaviour. Once that is achieved, the approach can lead to policy.

The first aspect we would like to consider is the identification and representation of control variables. Since people interact within a dynamic environment, it does not make sense to simulate behaviour within a static environment. Therefore, it is essential that all control variables be represented as a function of time. The time factor properly taken into account will help us to understand managerial decisions and consumer behaviour. We believe that this approach will bring a broad qualitative understanding of some of the intricacies of economic interactions.

We have stated above that the maximization of profits is the single most important control variable in the supply side of the economy. It follows that for the demand side the minimization of costs is the single most important one. The following is an outline of our approach in an attempt to show how the project will be conducted in relation to the identification, modeling, and simulation of a number of control variables. We cannot possibly enumerate the number of control variables we will try to model or the level of abstraction required for a reliable simulation. Therefore, the identification and modeling presented in the following example is not claimed to be complete, it is just an indication of our methodology.

We define profit-quantity (PQ) as the perceptual control variable on the supply side of the market whose mathematical modeling is given by the following equation:

"$ PQ = \integral{(price - cost)*quantity*dt}$,"

which, in graphical representation, gives the area below the curve in Figure~1.(a). In the above definition, cost is the total cost (including labour) to produce the quantity in the consider time interval. By no means the relation $(price - cost)*quantity*dt$ is a linear relationship. PQ is a non linear, multidimensional control variable that depends, among other things, on the price of the inputs, fixed costs, marginal costs for increase in amount produced, etc. Modeling such a non-linear function of interdependent variables in a way that is ease to visualize, change parameters, increase or decrease the relative importance of various inputs is one of the objectives of the present project. We propose to build a model in which such dependencies are directly indicated in a diagram, facilitating changes and the understanding of the system's dynamic behaviour within economic interactions.

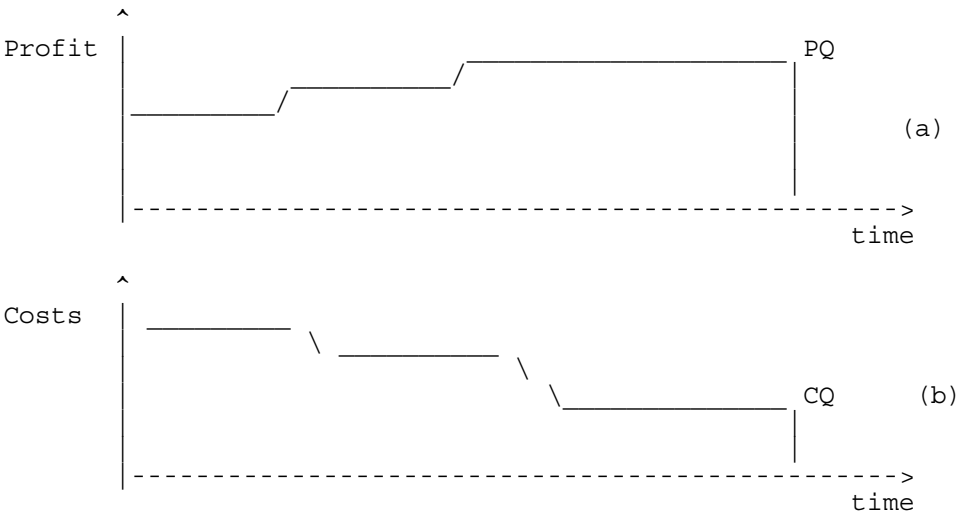

Figure 1. Examples of time-dependent perceptual control variables. (a) represents the supply side of the market and (b) the demand. While suppliers control for zero or positive slope in curve PQ, consumers control for zero or negative slope in curve CQ.

Analogously to the supply side, we identify in the demand side of the market a control variable which we define as cost-quantity (CQ). Taken the consumer's point of view, it is realistic to assume a limited budget so that within this constraint, the consumer will control for low costs spread over a period of time. Therefore, CQ is also a function of time, defined as

$CQ = \integral{(\frac{cost}{q})*quantity*dt}$,

where q is a utility function ($0<q<1$) which may depends on quality and/or use, among other things. Again, the function $(cost/q)*quantity*dt$ is a non-linear, multidimensional control variable. Graphically, CQ is represented in Figure~1.(b). The consumer will control this variable so as to minimize the area below the curve CQ.

A rigorous PCT approach will give us some invaluable insights on people's behaviour under economic changes. A continuous changing environment does not represent a handicap in a PCT model; in fact, it is in these situations that the implications of the model can be fully appreciated. For instance, if CQ has an ascending slope over a period, this means that the consumer is overspending, and s/he then may decide to cut expenses by selecting some products of which the amount purchased will be decreased. Note that it does not necessarily follow that an increase in price of one product will reduce its demand. It depends on the relative importance of the consequences for the consumer on incurring extra costs. The consumer may choose to selected a product -- whose price is falling -- that plays a large proportion in expenditure so that the quantity purchased of that product is decreased. Looking at the market outcome, it may be that a falling price product may see its demand decreased while a rising price product will have its demand increased. This seemingly anomalous market behaviour is a side-effect of consumer preferences and tastes (sometimes for religious, cultural, or some other reason) that can be fully explained and understood within a perceptual control approach to behaviour.

The modelling and computer simulations of complex interactions between people and their economic environment, their beliefs, wants, and desires will be implemented through a visual programming environment called PROX (Pictorial Programming for Control Systems and Simulation) developed within the Department of Computer Science of the University of Wales. PROX generates software code for complex systems with interdependent variables directly from a user's diagram representation of the state variables and their interconnections. PROX has been conceived as a tool for modelling control mechanisms in cognitive processes and implies a very wide range of applications for modelling dynamic systems behaviour. Moreover, the development of PROX is grounded in the assumption that dynamic behaviour is generated by the workings of closed-loop, interdependent processes. There are two kinds of such processes: negative and positive feedback. Negative feedback loops generate converging behaviour to a specified state, while positive loops are typical of runaway systems, that is, systems with no converging behaviour. Feedback is then just a means to control -- the process of producing predictable results in an unpredictable environment. The purpose of a control process is then to maintain the input signal (the controlled variable) at or near to the value specified by its reference signal.

As with the identification of control variables PQ and CQ above, Figure~2 depicts an oversimplified model of how the variable PQ would be represented and interconnected with other economic variables. The model is largely incomplete and must be seen only as an indicative of our approach. One aspect that comes clear from this simple model is the role of transitions on the determination of people's behaviour. In controlling for maximum profits (maximum PQ), it is clear that the quantity produced must be dependent on the way stocks are varying. The change rate in which stocks are coming up or down is represented by the derivative dQ/dt. The perception of this transition will influence production. Suppose that Dq/dt is positive. That means that stocks are growing, and this might bring production down. If Dq/dt is negative or zero, there is a demand for the product, so that the amount produced might be increased.

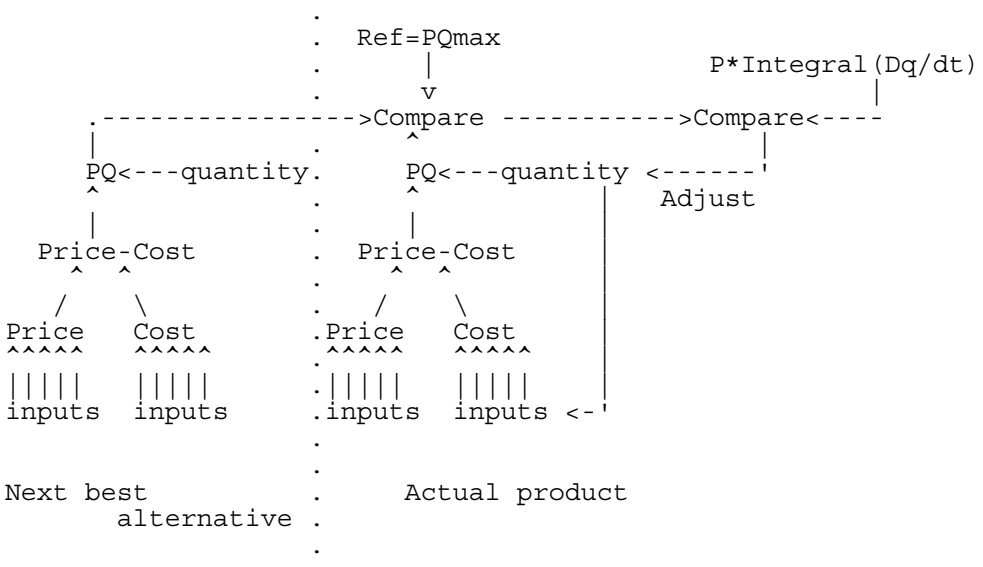

Figure 2. A simplified control model for variable PQ in the supply side of the market.

Date: Fri Sep 17, 1993 2:48 pm PST
Subject: Marcos & economics

[From Bill Powers (930917.1600 MDT)] Marcos Rodrigues (930915.1600 BST)

The economics project sounds wonderful. Economics has been in the back of my mind since a CSG member and economist, Bill Williams, enlisted me eight or ten years ago in tackling the "Giffen Paradox" as a control-system problem, and since my father started writing, in his extreme old age, about economics.

The Giffen Paradox is so-called because it concerns a situation (quite common) in which the "law" of supply and demand works backward. In this situation there is a budgetary constraint limiting the total amount of money that can be spent on a given set of goods. The representative goods Williams used were "bread" and "meat." Meat is more costly per pound than bread, but contains more calories per pound than bread. Also, eating meat is more "prestigious" than eating bread (i.e., there is a preference for eating meat on some grounds other than calories).

We set this situation up as three control systems operating in parallel:

Calorie system: perceives total calories represented by meat and bread purchases, acts by raising meat and bread purchases equally to bring calories to reference level. Purchases = consumption.

Prestige system: perceives positive prestige from meat purchases and zero or negative prestige from bread purchases. Acts to raise total perceived prestige toward reference level by increasing meat purchases.

Budget system: perceives total cost of meat and bread; if cost exceeds reference level (one-way control system), reduces purchases of meat.

When relative loop gains were properly adjusted, this set of control systems reproduced the Giffen Paradox, to wit: WHEN THE PRICE OF BREAD IS INCREASED THE SYSTEM PURCHASES MORE BREAD. That is the "paradoxical" violation of the law of supply and demand, easily explained with a PCT model. So the Giffen Paradox should now really be called the Williams Effect.

I think this solution of the Giffen Paradox has enormous implications concerning poverty, in fact providing a clear definition of what constitutes poverty. You are in poverty if your income is so low that when the price on

the cheapest goods you buy is raised, you are forced to buy more of the cheapest goods and less of the more expensive and higher-quality goods.

My father, a retired scientist, has been interested in macroeconomic theory for about 15 years (he is now 93), and has been writing about it. The main point of his study is that he has been comparing existing economic theories with the historical record in the Statistical Abstracts (the record of what has happened in the US economy). He finds that the predictions of economic theory have almost nothing to do with the facts. In place of standard economic assumptions, he has come up with a set of relationships that DO fit the facts, and some rather startling conclusions about what makes the US economy run, and fail.

One interesting fact is that for the past 100 years, the expenditures by the "composite producer" on capital costs -- i.e., investment -- has remained constant at 20 +/- 2 percent of total income, this range not been exceeded in any year. There is no relationship between amount of investment expressed as a fraction of total income and the Gross National Product: the same ratio appears in good years, bad years, and all other years. There is a fixed market for investment: the economy can't be made to grow faster by increasing investment. And it never has been made to grow faster in that way.

Another interesting fact. In the US, the Federal Reserve has tried to reduce inflation by tightening the money supply. Tightening the money supply has had three main effects: it slows growth; it increases unemployment, and it either has no effect on inflation or it INCREASES inflation. The only clear effects of tightening the money supply have been to make the economy worse.

And now the biggest shocker. It is standard economic practice to calculate savings (consumer and producer) by subtracting total expenditures from total income (NOT by adding up actual savings). This simple approach was suggested by Keynes' analogy of the whole economy to a single family, scaled up. To Keynes, it was obvious that a family does not spend all it earns, saving the difference for future needs. It was equally obvious that this was how the whole nation works: the difference between earnings and expenditures must represent the savings of the whole nation.

What Keynes overlooked, and my father saw, was that this analogy is invalid. At any given time, the nation represents individuals or families in ALL stages of the economic cycle. Some are spending all they earn; others a little farther along are putting money aside; still others are withdrawing their money, because their future has arrived. So the net savings rate of the whole nation must be very much less than the savings rate for a family. The apparent savings rate calculated from income and expenditures, which averages about 7% of yearly income, can't possibly be the real savings rate, for the real savings rate must average around zero.

So what IS this observed difference between total income and total expenditures? It is a leakage of buying power out of the economy. There are many sources of leakage, including bad foreign loans and investments, imbalance of trade, and the use of overseas labor in place of domestic labor. One of the main reasons for leakage is the fact that some people or institutions have such huge incomes that they can't possibly spend them all on goods and services within the economy. Because they do not spend all of what they earn inside the economy, they do not return to the composite producer enough to pay for producing the whole economic product. This creates an automatic annual markup of prices: one of the main contributors to inflation. The leakage rate also directly subtracts from the exponent in the expression for growth rate of the economy.

Finally, inflation itself. It turns out that the primary culprit, other than leakage, is industry-wide collective bargaining. The historical record shows that increases in wages due to collective bargaining have, for 100 years, been completely offset by increases in prices. Organized labor has not gained one cent in purchasing power through wage increases. There may have been other kinds of gains, but wage negotiations have not produced any increase in real

wages. They have produced, instead, inflation. When leakage is added to wage increases, inflation is almost entirely accounted for.

I haven't been able to talk my father into merging his analysis with a PCT analysis ("What individuals want has nothing to do with economics!!!"). However, PCT naturally enters into macroeconomics by providing the missing explanation for what keeps the circular counterflows of goods and money going. What keeps them going is the difference between what people want and what they get.

I think it would be possible to derive a macroeconomic demand curve from the composite behavior of individuals who want specific amounts of specific goods, neither less nor more. Over a population, for any particular good, there would be a range of amount wanted, with very few people wanting none at all, and very few people wanting enormous amounts (for example, of oatmeal or movie videos). The result would be that as the available amount of a good increases, there would be less and less effort on the part of the population to obtain it, producing a concave demand curve that is high at low supply and low or zero at high supply.

This amounts to a new definition of economic man: not as a maximizer who can be driven to indefinitely large outputs of labor when given indefinitely increasing rewards, but as a controller aiming to obtain specific amounts of goods and services. This change of assumptions, it seems to me, would lend itself to surveys of people's actual economic behavior. If you simply asked people to list how much or how many of a wide variety of goods and services they would like to consume, I will bet that for most of them the number would be quite finite and reasonable. How many pencils would you like to have? How many cars? How much food would you like to eat? How many clothes would you like to have in your closet? And so forth.

In your proposal for modeling how managers work, you could try out the same idea. Do managers really try to maximize profits? According to Newell (or was it Simon), they do not: they pick what seems a reasonable goal and adjust their efforts accordingly, a process he called "satisficing." He got a Nobel prize in economics for that. While he didn't advertise this idea as following from PCT, it most certainly does.

You can use any of my writings that will do you any good: feel free.

Best, Bill P.