Microfoundations

(See Main paper: Interaction …)

Introduction

In my paper on interaction, I almost "assumed" that the aggregate relationships could be described by the following three equations (where y – yuppies - is the number of happy drug users at time t; j is the number of unhappy drug users; p is the probability of becoming a junkie):

$$(1)\ \ y_t = y_{t-1} + \boldsymbol{b}_1 a_{t-1}(1 - p_t) - \boldsymbol{b}_2 y_{t-1}$$

$$(2)\ \ j_t = j_{t-1} + \boldsymbol{d}_1 y_{t-1} - \boldsymbol{d}_2 j_{t-1}$$

$$(3)\ \ p_t = \frac{j_{t-1}}{d_{t-1}}$$

I then made some comments on the kind of micro foundations I wanted to explore to justify my aggregate equations. In other words; What kind of assumptions about how individuals behave must be made in order to generate the aggregate equations above? The starting point of this observation is this question. It is only a starting point, however, since it turns out that thinking about microfoundations leads to a reformulation and reinterpretation of the whole model. Hence, the question becomes not what kind of microfoundations that could justify (1) to (3). Instead my thinking has led me to reinterpret/reformulate the aggregate equations. There was no point I s trying to justify an aggregate system that was less and less plausible.

Problems with the existing interpretation

After working with the model I became aware of at least three "problems."

a) Conflict between micro and macro story

Problem

First, there was a conflict between my micro story and the aggregate equations. In my micro story I imagined that all the non-users every year made a decision on whether or not to use drugs. They key variable in the decision was their "fear" of becoming a junkie – a fear that was based on the number (stock) of junkies compared to the number of drug users in the previous time period. An implication if this is that unless p changes there should be no change in the share of people using drugs. In short, why should a person who refused to take drugs in the past because of a "too high" p (fear) suddenly start to take drugs at the very same p. Hence, the microfoundations implied that only changes in p should lead to an inflow of new yuppies. The aggregate equation, however, was inconsistent with this since it implied an inflow next year even if there was no change in p. Recall:

$$(1)\ \ y_t = y_{t-1} + \boldsymbol{b}_1 a_{t-1}(1 - p_t) - \boldsymbol{b}_2 y_{t-1}$$

The equation implies that even if p is the same year after year there is still an inflow of yuppies. (Fundamentally the problem probably originates from confusing stock and flows). The question is then what I should modify, the aggregate equations or the microfoundations?

Solutions

There are two possible solutions. First I could try to reformulate the aggregate equation to consider only (expected) changes in p. That is, the inflow of new drug users depends on *changes* in p not on the level of p. The higher the "fear" the fewer new people will start to use drugs. It could be something like this:

$$y_t = y_{t-1} + b_1 a_{t-1}(p_t - p_{t-1}) - b_2 y_{t-1}$$

As it turns out, however, this is rather uninteresting because equilibrium in this case would be a situation in which $b_2 y_{t-1} = 0$. (I have so far only explored equilibriums in the sense that there I no change in the number of users. There might be steady state equilibriums in which there are "cycles." This is yet to be explored). This does not seem very interesting since (unless $y_{t-1} = 0$, which is unlikely) it implies that $b_2 = 0$ and this do not make much sense. It is a model in which nobody leaves the yuppie group in equilibrium. Thus, further extension is required. One solution could then be to use so-called Error Correction Models (ECM). These are models which have expressions dealing both with changes in variables and long run equilibrium (See for more on this). I may try this later on, but it may turn out to be rather messy so I will "the second" solution first.

The second solution is to reinterpret the model as a "generational" model. Each time period a new generation grows and each year some of them will decide to use drugs. The precise share might, as I have tried to capture, depend on the "fear" of using drugs. In this case a constant level of "fear" (p) is consistent with continued inflow of new yuppies. Some of the new generation are willing to use drugs at that p! This "solves" the problem of changes in y without changes in p in the "constant population interpretation." The generational interpretation, however, must be made consistent with my microfoundation.

b) Interpretation of microfoundation

The second problem relates to the interpreation of the original "microfoundation." After including "moral cost" of using drugs the microfoundation was expressed as:

$$EU_{it}(D) = p_t U(J) + (1 - p_t)U(Y) - m_i$$

Already when formulating this I had some problems: How should I interpret the utilities here? One could, of course, say that it was estimated utility next year. However, rational choice usually implies that people consider more than the next year when they decide.

Solution

To solve this I simply assumed that the utilities were estimates of total expected utility for the rest of your live if you turned out to be either a Junkie or a Yuppie. *U(J)* and *U(Y)* should not be interpreted as "Utility as a yuppie" or "Utility as a junkie." Instead it should be interpreted as a sum. I imagine that taking drugs leads to two possible "careers:"

a) You might take drugs for some time without problems and then simply quit. In that way you have a number of years as a yuppie and (possible) a number of years as an abstainer. The total utility of this career is symbolized with *U(Y)*

b) You spend some years as a yuppie, but you are unable to quit and you become a junkie. After some years as a junkie you might quit/die. Hence the *U(J)* includes utility from years as a yuppie, years as a junkie and possible years as an abstainer after being a junkie.

(Both formulations are also assumed to include discounting – something that I do not model explicitly.)

Interpreting the utilities as a sum over the rest of your life is, perhaps, a legitimate simplifying assumption. It is plausible, but it does not necessarily "drive" the results. (A legitimate simplification is here defined as one that can be relaxed without changing the main results in the model). More problematic is the degree to loose connection between the microfoundation and the aggregate equations in the original paper. This leads to my third problem.

Is the aggregate relationship between p and number of new yuppies linear?
I have assumed that the number of new yuppies was a linear function of the "fear" of becoming a junkie. The question is whether the microfoundation justifies this linear aggregate relationship.

<u>A starting point</u>
Assume that individuals in each new generation (cohort, group) decides whether to use drugs based on the following mechanism:

$$EU_{it}(D) = p_{it}U_{it}(J) + (1 - p_{it})U_{it}(Y) - m_{it}$$

$EU_{it}(D)$	The total expected utility of beginning to "experiment with drugs"
$U_{it}(J)$	The total utility (for the rest of your life) if you turn into an addict/junkie
$U_{it}(Y)$	The total utility (for the rest of your life) if you avoid becoming an addict
p_{it}	The probability of becoming a junkie
m_{it}	The moral cost/stigma associated with taking drugs

A few comments are in order:
$U_{it}(J)$ does *not* represent annual utility if you are a junkie. It represents the total (discounted) sum of utilities from the rest of your life if it turns out that experimenting with drugs results in addiction. Hence, it may include years, first, as a happy users (a yuppie), then some years as a junkie and then, finally, some years as a non-users (treated or "matured out"). The same goes for *U(Y)*. It does not only include years as a happy drug users, but also years as a non-users after being a "happy user." While this is a simplification, I think the formulation is both justified considering the issue I want to focus on (interaction). For instance, I have simply ignored discounting which many people argue is an important phenomena when trying to explain addiction. I do not deny this, but the issue in this paper is to focus on something else, namely the effects of interaction through observational learning and social stigma. I want to isolate this and to do so I do not want to bring in more complications than necessary.

<u>Simplifications</u>
To make things simpler, I now make the following assumptions:

$p_{it} = p_t$	$\forall i$	(every individual uses the same probability of becoming a junkie)
$U_{it}(.) = U(.)$	$\forall it$	(the utility of ending up as a junkie or as a yuppie is the same for every individual at all times)

i.e. that every individual uses the same probability of becoming a junkie and that the utility of ending up as a junkie or as a yuppie is the same for every individual at all times. This implies that at abstainers at time t base their decision as to whether or not to begin to use drugs on:

$$EU_{it}(D) = p_tU(J) + (1 - p_t)U(Y) - m_{it}$$

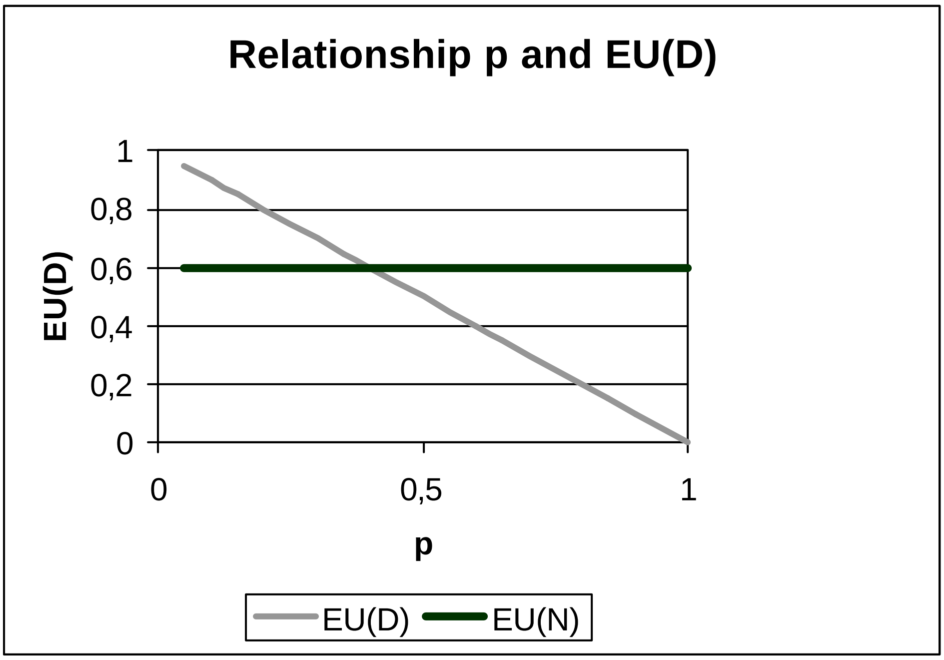
This implies that a rise in the probability of becoming a junkie, leads to a reduction in the expected utility of experimenting with drugs; the size of the reduction is determined by:

$$\frac{\partial EU(D)}{\partial p} = U(J) - U(Y) \equiv k$$

I denote this difference by the constant k. A assume that this is negative [i.e. that $U(J) < U(Y)$]. What we want to know, however, is not just the degree to which expected utility changes with p. I also want to know how changes in expected utility relates to changes in the number (or share) of people starting to use drugs. To find this I first assume some cut-off point. That is; people will start to use drugs as soon as the expected utility from doing so is larger than an exogenously determined limit. I assume that this limit is the same for all people (heterogeneity is assured elsewhere in the model; see moral cost):

Use drugs iff $EU_{it}(D) > EU(\overline{D})$

Since the partial derivative of EU(D) wrt p is a constant, we have the following relationship:



In words: An individual (in the incoming generation) decides to use drugs is his expected utility is above some constant (here EU(N)). The expected utility depends linearly on p – the probability of becoming a junkie.

How do we translate this micro-mechanism into an aggregate equation? The easiest way to do this is that say that moral costs are uniformly distributed. We would then have that the share of the new generation that begins to experiment with drugs is a linear function of p. If moral costs are not uniform, eg. it is normally distributed, then there is not a one to one relationship between changes in expected utility and changes in the number of people entering drug use. This is an extension I will study later.

Assuming a uniform distribution is necessary, but not sufficient. I also have to make sure that the cut-off points "appropriate." For instance, imagine that the "limit" for using drugs is very high, then it might be the case that a small reduction in fear is not enough to make anyone begin to experiment with drugs. Hence, there is a discontinuity here and the relationship between changes in p and changes in the number of drug users is not a continuous linear function. In order to make thinks work I then either have to make the model more complicated to account for the mentioned possibility (that changes in p do not affect the number – either because everybody wants to use it even if p changes slightly or because nobody wants to use it despite the change in p). The easiest way out is simply to assume that the “limit” is at p=0. That is, I assume values [for EU(A), U(J), U(Y)] which implies that at p=0 everybody use drugs and at p=1 nobody use drugs. By doing so I assume away the possibility that changes in p do not affect the number of users.

Conclusion
The “story” behind the aggregate model has become more consistent, but there are still things to work on; Both in terms of problems with what I already have and with possible extensions. I think there are some problems with the “generational” story as long as I have not included population growth, but not death. I also need to be more specific about whether I am talking about absolute numbers (of people) or shares of the population. I also want to include “moral interaction” in the sense that moral cost of (stigma) using drugs goes down when many people do so. In short, this is only one step, there are many left.