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14:771: Recitation Handout #7

Browning and Chiappori (1998), Empirical Tests of Efficient Households

Browning and Chiappori (1998)

This paper basically sets up the collective model with endogenous bargaining power that Abhijit discussed in the last class and then derives the SR1 property of the Slutsky matrix. The big innovation here is that the paper lets us think about how an efficient household should look and function in a very general setting. To review what we talked about in class, here is the basic setup:

1. Suppose, the household has two members: M and F. Each member has preferences:

$$u^i\left(q^i, q^{-i}, Q\right) \;\; i = M, F$$

   where q^i is the quantity of private goods consumed by i, and Q are public goods. We assume that $u^i\left(q^i, q^{-i}, Q\right)$ is strongly concave and twice differentiable in all its arguments. We allso assume that it is strictly increasing in $\left(q^i, Q\right)$. Note that this is may seem a little less general than what we had in lecture because utility does not depend on actions, a. However, we can put these in with the q goods - for example, one element of q^i may be leisure.

2. There is a price vector p such that we can write the household budget constraint as

$$p'\left(q^M + q^F + Q\right) = p'q = x$$

3. There is a differentiable, homogenous of degree 0 function $\mu(p, x)$ (the bargaining weight) such that, for any (p, x) there is a vector $\left(q^{F*}, q^{M*}, Q^*\right)$ that is a solution to

$$\max_{q^F, q^M, Q} \mu(p, x)\, u^F\left(q^F, q^M, Q\right) + (1 - \mu(p, x))\, u^M\left(q^F, q^M, Q\right) \text{ s.t.}$$
$$p'\left(q^M + q^F + Q\right) = x$$

   What does this tell us about our household? It tells us that it's Pareto Efficient! Varying the value of μ would allow us to trace out the Pareto Frontier. *Note that at the moment, the bargaining weight (distribution factor in BC speak) only depends on p and x. Does this seem reasonable to you?*

Now, we just grind away using classical demand theory. For the moment, let's derive some stuff holding μ constant. We will use duality The expenditure function is:

$$\begin{aligned} E(p, u, \mu) &= \min_{q^F, q^M, Q} p'\left(q^F + q^M + Q\right) \text{ s.t} \\ &\quad \mu u^F\left(q^F, q^M, Q\right) + (1 - \mu)\, u^M\left(q^F, q^M, Q\right) \geq u \end{aligned}$$

Denote the solution to the above problem as $h(p, u, \mu)$. We can use the envelope theorem again to show that

$$\frac{\partial E(p, u, \mu)}{\partial p_i} = h_i$$

Now we can write the indirect utility function:

$$\begin{aligned} V(p, x, \mu) &= \max_{q^F, q^M, Q} \mu(p, x) u^F \left(q^F, q^M, Q\right) + (1 - \mu(p, x)) u^M \left(q^F, q^M, Q\right) \text{ s.t.} \\ & p' \left(q^M + q^F + Q\right) = x \end{aligned}$$

we denote the solution to the maximization problem $q^* = f(p, x, \mu)$. Further, we know that (via duality)

$$f(p, E(p, u, \mu), \mu) = h(p, u, \mu)$$

which implies:

$$S_{ij} = \frac{\partial f_i}{\partial p_j} + \frac{\partial f_i}{\partial x} f_i = \frac{\partial h_i}{\partial p_j}$$

This is just our friend the Slutsky equation. But note - we are holding μ constant here! This is *never* observable because as we vary p, we must also vary μ. Let's define a new demand function:

$$\xi(p, x) = f(p, x, \mu(p, x))$$

The "pseudo"-Slutsky matrix (i.e. the Slutsky equivalent here is given by:

$$S_{ij} = \frac{\partial \xi_i}{\partial p_j} + \frac{\partial \xi_i}{\partial x} \xi_i$$

The key proposition in Browning and Chiappori is the following:
In the collective setting, the pseudo-Slutsky matrix S is the sum of a symmetric and negative semi-definite matrix Σ and an outer product:

$$S = \Sigma + uv'$$

where u and v are n vectors with

$$u_i = \frac{\partial f_i}{\partial \mu} \text{ and } \nu_i = \frac{\partial \mu}{\partial p_j} + \frac{\partial \mu}{\partial x} \xi_j$$

The key observation in the collective setting, which gives us the SR1 property is that uv' will always have *at most* a rank of $n - 1$ where n is the number of household members. So in a two person household, we get the SR1 property. Here we can quickly show the SR1 derivation:

$$\begin{aligned} S_{ij} &= \frac{\partial \xi_i}{\partial p_j} + \frac{\partial \xi_i}{\partial x} \xi_j \\ &= \left[\frac{\partial f_i}{\partial p_j} + \frac{\partial f_i}{\partial \mu} \frac{\partial \mu}{\partial p_j}\right] + \left[\frac{\partial f_i}{\partial x} + \frac{\partial f_i}{\partial \mu} \frac{\partial \mu}{\partial x}\right] f_j \\ &= \left[\frac{\partial f_i}{\partial p_j} + \frac{\partial f_i}{\partial x} f_j\right] + \frac{\partial f_i}{\partial \mu} \left[\frac{\partial \mu}{\partial p_j} + \frac{\partial \mu}{\partial x} f_j\right] \\ &= \left[\frac{\partial f_i}{\partial p_j} + \frac{\partial f_i}{\partial x} f_j\right] + \frac{\partial f_i}{\partial \mu} \left[\frac{\partial \mu}{\partial p_j} + \frac{\partial \mu}{\partial x} \xi_j\right] \\ &= \Sigma_{ij} + u_i v_j \end{aligned}$$

After they show this, the authors derive a few more properties of the pseudo-Slutsky matrix to derive a structural test. In order to implement the test, they have to parameterize the demand functions and estimate them, and then plug the parameter estimates into the testable restrictions..This requires quite a lot of assumptions. In the end, they do not reject the SR1 property, and they thereby conclude that they cannot reject that the household is efficient.

Note that we can also extend the model to allow μ to depend on other distribution factors that only impact demand through their impact on bargaining power: $\mu(p, x, y)$. We then get the results (letting y be a scalar):

1. The pseudo-Slutsky matric takes the form $S = \Gamma + \xi_y v'$ were Γ is symmetric
2. ξ_y can be written as a linear combination of the columns of $(S - S')$

A big critique to this method is, as Abhijit pointed out at the end of lecture, that inefficient bargaining may still satisfy the SR1 property. So just because we cannot reject SR1 does not guarantee that households are efficient.

Other Tests of Pareto Efficiency

There are a number of other ways to test whether the household is efficient or not, and there is a rich literature implementing these tests. Some of them include:

1. *Income pooling tests*: The idea here is that it should not matter who gets unearned income.
   - A paper testing this hypothesis is Lundberg and Pollack (1996). They take advantage of the fact that in the 1980s, the UK had a child benefit for low income families that suddenly switched from being paid to men to being paid to women. They find that consumption of vertain goods changed, and take this as evidence that the household is not efficient. *What do you think of this assertion in the context of the collective model?*
   - Another nice example is Robinson (2008). He ran a randomized trial in Kenya where husbands and wives were given 150 Kenyan shillings with probability .5 each week for 8 weeks. He finds that expenditures on male private goods depends on who gets the transfer
   - Duflo and Udry (2003) is a different flavor of this, but I'll defer discussion since we'll focus on in Monday.
2. *Production efficiency tests*: The idea here is that given a set of resources, the household should always be production efficient - that is, production inputs that don't factor into the utility function should be allocated to maximize total output. (An example - given that a household has purchased X units of fertilizer, it should equate the marginal return to fertilizer across all of its plots).

- A good example of this is Udry (1996). He looks at households in Burkina Faso and tries to ascertain whether or not they are production efficient (this is sort of tricky in practice!). The nice thing here is that he has data on which plots are cropped by men and which are cropped by women. He finds that a reallocation of more inputs to the female plots would increase household income by around 5.9 percent. A reallocation of resources throughout the village would increase household income by around 13 percent. *Can you think of any reasons why households are efficient but such a test would fail?*
- There is a nice follow up paper to this - Goldstein and Udry (2008), which shows that in Ghana, the entire male-female productivity differential can be explained by land fallowing. The idea is that local lineages in villages have to power to reallocate land to those they percieve as neediest. The authors find that whether or not you fallow your land depends on whether or not you're in this kind of position of power, and all the people in this position of power are men. (The idea is that fallowing your land is a signal that you don't "really" need it). *What does this still not explain? What should we see if the household is efficient?*

3. *Ratio and proportionality tests:* These are generally tests of the pure unitary model, and require that you put quite a lot of structure on the problem (like assuming multiplicative separability and so on).

    - A nice paper that uses this type of test is Chiappori, Fortin, and Lacroix (2002). The idea behind this paper is that increases in sex ratios (the number of men per woman) and increases in the favorability of divorce laws for women should increase female bargaining power. They derive a proportionality test:

    $$\frac{\hat{\beta}^W_{sexratio}}{\hat{\beta}^W_{divlaw}} = \frac{\hat{\beta}^M_{sexratio}}{\hat{\beta}^M_{divlaw}}$$

      Note that these are "distribution factors" in the model of Browning and Chiappori discussed above. The authors do not reject the proportionality test (that is, they cannot reject that the model holds), but what I find much more interesting is that female labor supply declines when bargaining weights shift in their favor. They have a nice specification check where they show significant results for married women, but absolutely no significant effect for single women. This is similar to what Angrist (2002) finds - women work less when the sex ratio is in their favor.

Jeanne Lafortune's job market paper was also about bargaining power, but looked to see if these factors impact not just allocations within couples, but also premartial investments. The idea is that if you're sure to find a good spouse because your gender is in relatively short supply, then you will work less hard to make yourself look like an attractive partner. And she does indeed find evidence of this. *In a world like this, what would we think about the Chiappori, Fortin, and Lacroix specification test discussed above?*