Keeping up with peers in India

A new social interactions model of perceived needs

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Overview

- A model of peer effects in consumption where perceived **needs** depend on group-average expenditures
  - show identification
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In our model:

- utility function has *needs*
  - act like negative income,
  - may depend on group-average expenditures (on many goods).
- Unlike typical social interactions models,
  - utility maximization implies nonlinearity in peer effects,
  - we can have group-level fixed (or random) effects,
  - a fixed (and small) number of group members are observed.

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  - Stevenson and Wolfers (2008): probably get somewhat happier;
  - Fliessbach et al (2007): FMRI evidence on relative rewards;
  - Kuziemko, Buell, Reich and Norton (2014): lab experiments show 'last place aversion'
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- This paper: use revealed preference instead of stated well-being.

Empirical Consumption Peer Effects

- Veblen/observability
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  - De Giorgi, Frederiksen and Pistaferri (2016) use unbelievable Danish consumption data
- All find big externalities. But magnitude or significance of effects of $\overline{q}$ or $\overline{x}$ on behaviour does not measure economic implications or identify welfare effects. More structure is needed for that.

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- Estimates similar to well-being-based estimates
    - highly educated vs primary educated vs uneducated

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- Using self-reported well-being data for utilities V_i, Luttmer (2005) estimates a social interactions model like

$$V_i = ax_i + b\overline{x}_g.$$

  the externality is captured by $\alpha = -\frac{b}{a}$.
- α says how much group-average income costs you in terms of your own income.
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- In this paper, we take a derivative and use consumer behaviour to illuminate the same externality.

What's At Stake?

- If α is large:
- the pareto set for helicopter drops of income is different from the standard model
  - the helicopter drop has to be somewhat equal, compensating everyone in the group for the externality
- interventions (e.g., taxation) that induce deadweight loss and thus reduce consumption are less bad in welfare terms (though their benefits might be similarly attenuated)
  - Boskin and Sheshinski (1978) show that the marginal cost of public funds is different
  - the MCPF for redistribution in the presence of costly transfers is lower, inducing a more equal optimal distribution of income
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- if α is very large, we're burning down the Earth for nothing

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- (reference point) direct utility U and indirect utility V

$$U_i(\mathbf{q}) = U(\mathbf{q} - \mathbf{f}_i)$$

  - $\mathbf{f}_i$ is **needs** (aka: fixed costs, overheads). $\mathbf{f}_i$ depend on $\overline{\mathbf{q}}_g$ (and $\mathbf{z}_i$) .

$$V_i(\mathbf{p}, x) = V(\mathbf{p}, x - \mathbf{p}'\mathbf{f}_i)$$

    - if $\mathbf{f}_i = \alpha\overline{\mathbf{q}}_g$, $\mathbf{p}'\mathbf{f}_i = \alpha\overline{x}_g$, and $V_i(\mathbf{p}, x) = V(\mathbf{p}, x - \alpha\overline{x}_g)$

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- Roy's Identity gives demand functions $\mathbf{q}$, add error terms $\mathbf{v}_g$, $\mathbf{u}_i$:

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- Econometrics: reflection; endogeneity of $\overline{\mathbf{q}}_g$; using sample $\widehat{\mathbf{q}}_g$ instead of $\overline{\mathbf{q}}_g$; $\mathbf{z}_i$; fixed effects $\mathbf{v}_g$; system of equations
- Empirics: externalities similar across goods; α is big, about 0.5.

Reference Point Utility

- micro:
- (perceived) needs in utility functions
  - jumping off from: Samuelson (1947), Gorman (1976), Pollak and Wales (1981), Blackorby and Donaldson (1994), and Donaldson and Pendakur (2006).
- reference points
  - reference point utility: the valuation of one's income depends on income of one's reference group.
    - Surveys by Kahneman 1992; Clark Frijters, and Shields 2008.
  - In our case, $\overline{\mathbf{q}}_g$ influence needs
    - Veblen effects - visible luxuries are status symbols; I get utility from relative status.
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- macro: $\overline{x}_g$ might affect marginal utility, and savings

What we do: Econometrics

- Individual outcomes y_i depending on group means $\overline{y}_g$ are a form of social interaction model.
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- Is similar to a spatial model, with a very sparse contiguity matrix where all individuals within each group are equidistant from each other.
- Reflection problem: Manski (1993, 2000). See also Brock and Durlauf (2001), and Blume, Brock, Durlauf, and Ioannides (2010).
  - endogenous effects, exogeneous effects, and the correlated effects cannot in general be separately identified
  - we exploit nonlinearity and utility derived restrictions to overcome the reflection problem.
- Network info helps, e.g., Bramoullé, Djebbari, and Fortin (2009).
- We show identification with sparse network info: we observe only a fixed (and small) number of members of each group.

Generic Model Definition

- To illustrate our new identification strategy, consider a simpler generic social interactions model first.
- i indexes individuals (later, households). Each individual i is in a peer group $g \in \{g = 1, ...G\}$.
- The number of peer groups G is large (assume $G \to \infty$).

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- Outcome y_i depends on regressor x_i and on $\overline{y}_g = E(y_i \mid i \in g)$.
- Later extend to vector of outcomes, vector of interactions, vector of regressors, and utility based functional forms.

Generic Model Definition - continued

- Write the model as $y_i = h\left(\theta \mid \overline{y}_g, x_i\right) + v_g + u_i$
- v_g are group level random or fixed effects.
- u_i are mean zero errors, independent all x in all groups.

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- We do not include $\overline{x}_g$ as a regressor because our model of utility implies that it does not appear in our demand equations.
- If we included $\overline{x}_g$ additively, it would be absorbed into v_g.

Generic Model Definition - continued

- The specification of $h\left(\theta \mid \overline{y}_g, x_i\right) + v_g + u_i$ we use is quadratic

$$y_i = \left(\overline{y}_g a + x_i b + c\right)^2 d + \left(\overline{y}_g a + x_i b + c\right) + v_g + u_i$$

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- Results in an additional error ε_{gi}, so $y_i = h\left(\theta \mid \widehat{y}_g, x_i\right) + v_g + u_i + \varepsilon_{gi}$

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- Difficulties for estimation of θ
  - v_g could be correlated with $\overline{y}_g$ and hence with $\widehat{y}_g$.
  - n_g does not go to infinity, so if $\widehat{y}_g$ contains y_i, it is correlated with u_i.
  - n_g fixed so ε_{gi} doesn't vanish, is potentially correlated with all regressors due to nonlinearity (which we use to avoid nonidentification from reflection). For example ε_{gi} contains $\left(\overline{y}_g - \widehat{y}_g\right) x_i$.

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- We consider two different approaches - fixed and random effects.
  - Fixed effects has fewer assumptions, random effects provides more identifying information.

Generic Fixed Effects Model

- To remove the fixed effect **difference** two people i and i' in group g:

$$y_i - y_{i'} = h\left(\theta \mid \overline{y}_g, x_i\right) - h\left(\theta \mid \overline{y}_g, x_{i'}\right) + u_i - u_{i'}$$

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- Define the leave-two-out group mean estimator

$$\widehat{y}_{g,-ii'} = \left(\frac{1}{n_g - 2}\right) \sum_{l \in g, l \neq i, i'} y_l.$$ Here i and i' are both in group g

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- To deal with measurement error due to small fixed group size, plug in $\widehat{y}_{g,-ii'}$ for $\overline{y}_g$ to get

$$y_i - y_{i'} = h\left(\theta \mid \widehat{y}_{g,-ii'}, x_i\right) - h\left(\theta \mid \widehat{y}_{g,-ii'}, x_{i'}\right) + u_i - u_{i'} + \varepsilon_{gi} - \varepsilon_{gi'}$$

- Theorem 1: With $h\left(\theta \mid \overline{y}_g, x_i\right) = \left(\overline{y}_g a + x_i b + c\right)^2 d + \left(\overline{y}_g a + x_i b + c\right)$ we can show

$$E\left(u_i - u_{i'} + \varepsilon_{gi} - \varepsilon_{gi'} \mid x_i, x_{i'}\right) = 0$$

Generic Fixed Effects Model — continued

- since $E\left(u_i - u_{i'} + \varepsilon_{gi} - \varepsilon_{gi'} \mid x_i, x_{i'}\right) = 0$, valid instruments include
  - $\left(x_i - x_{i'}\right)$ and its square,
  - $\widetilde{x}_g$ equal to average x in the group in other periods and its square.

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- Let $\mathbf{r}_{gii'}$ be a vector of functions of x_i, $x_{i'}$, $\widetilde{x}_g$ and other instruments $\mathbf{r}_g$.
- Use $\mathbf{r}_{gii'}$ as instruments for GMM estimation, based on moments

$$E\left\{\left[y_i - y_{i'} - h\left(\theta \mid \widehat{y}_{g,-ii'}, x_i\right) + h\left(\theta \mid \widehat{y}_{g,-ii'}, x_{i'}\right)\right]\mathbf{r}_{gii'}\right\} = 0$$

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- Observations for the GMM are every pair of individuals i and i' in each group.
- Use clustered standard errors, each group is a cluster: by construction errors are correlated across observations within each group.

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- $\overline{y}_g a$ times itself will not be differenced out, so must now cope with squared error that results from replacing $\overline{y}_g$ with an estimate.
- Replace the *first* $\overline{y}_g$ with $\widehat{y}_{g,-ii'}$ as before, and replace the *second* $\overline{y}_g$ with $y_{i'}$.

Generic Random Effects Model—continued

- This replacement adds an error $\widetilde{\varepsilon}_{gii'}$. Model becomes

$$y_i = \left(\widehat{y}_{g,-ii'} a + x_i b + c\right)\left[\left(y_{i'} a + x_i b + c\right) d + 1\right] + v_g + u_i + \widetilde{\varepsilon}_{gii'}$$

- and, with $v_0 = E\left(v_g\right) + da^2 Var\left(v_g\right)$, we can show

$$E\left[y_i - \left(\widehat{y}_{g,-ii'} a + x_i b + c\right)\left[\left(y_{i'} a + x_i b + c\right) d + 1\right] - v_0 \mid x_i\right] = 0$$

Generic Random Effects Model—continued

- This replacement adds an error $\widetilde{\varepsilon}_{gii'}$. Model becomes

$$y_i = \left(\widehat{y}_{g,-ii'}a + x_i b + c\right)\left[\left(y_{i'}a + x_i b + c\right)d + 1\right] + v_g + u_i + \widetilde{\varepsilon}_{gii'}$$

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- Since this applies for all i, i', use observations comprised of every pair of individuals in a cluster.
- Now, x_i and $\widetilde{x}_g$ (but not $x_{i'}$) are valid instruments.

Generic Model—Formal Identification 1

- Allow a $K-$ vector of covariates $\mathbf{x}$
- **Assumption A1**: Each individual i in group g satisfies

$$y_i = \left(\overline{y}_g a + \mathbf{x}_i'\mathbf{b}\right)^2 d + \left(\overline{y}_g a + \mathbf{x}_i'\mathbf{b}\right) + v_g + u_i$$

- Unobserved v_g are group level fixed effects.
- Unobserved u_i are independent across groups g and have $E(u_i \mid \text{all } \mathbf{x}_{i'}$ having $i' \in g$ where $i \in g) = 0$.
- The number of observed groups $G \to \infty$. For each observed group g, we observe a fixed sample of $n_g \geq 3$ observations of $y_i, \mathbf{x}_i$.

Generic Model—Formal Identification 2

- **Assumptions A2, A3**: Let $\overline{\mathbf{x}}_g = E(\mathbf{x}_i \mid i \in g)$, $\overline{\mathbf{xx}'_g} = E(\mathbf{x}_i\mathbf{x}'_i \mid i \in g)$. The coefficients a, $\mathbf{b}$, d are unknown constants satisfying $d \neq 0$, $\mathbf{b} \neq 0$, and $[1 - a(2\mathbf{b}'\overline{\mathbf{x}}_g d + 1)]^2 - 4a^2 d[d\mathbf{b}'\overline{\mathbf{xx}'_g}\mathbf{b} + \mathbf{b}'\overline{\mathbf{x}}_g + v_g] \geq 0$. Individuals within each group agree on an equilibrium selection rule.
- Need $d \neq 0$ to have nonlinearity, avoid the reflection problem.
- Need $\mathbf{b} \neq 0$ else no exogenous covariates.
- The inequality ensures an equilibrium $\overline{y}_g$ exists (coherence as in Tamer 2003).

Generic Model—Formal Identification 3

- **Assumption A4**: Let $\mathbf{r}_g$ be a vector (possibly empty) of observed group level instruments that are independent of each u_i. Assume $E\left((\mathbf{x}_i - \overline{\mathbf{x}}_g) \mid i \in g, \overline{\mathbf{x}}_g, \overline{\mathbf{x}\mathbf{x}'}_g, v_g, \mathbf{r}_g\right) = 0$, $E\left(\left(\mathbf{x}_i\mathbf{x}_i' - \overline{\mathbf{x}\mathbf{x}'}_g\right) \mid i \in g, \mathbf{r}_g\right) = 0$, and that $\mathbf{x}_i - \overline{\mathbf{x}}_g$ and $\mathbf{x}_i\mathbf{x}_i' - \overline{\mathbf{x}\mathbf{x}'}_g$ are independent across individuals i.
- A4 is essentially instrument validity. A stronger sufficient condition is that $\varepsilon_{ix} = \mathbf{x}_i - \overline{\mathbf{x}}_g$ are independent across individuals i and independent of group level variables $\overline{\mathbf{x}}_g, \overline{\mathbf{x}\mathbf{x}'}_g, v_g, \mathbf{r}_g$. This would hold if each $\mathbf{x}_i$ is a randomly drawn deviation ε_{ix} around $\overline{\mathbf{x}}_g$.

Generic Model—Formal Identification 4

- **Theorem**: If Assumptions A1 to A4 hold then

$$E[y_i - y_{i'} - (2ad\widehat{y}_{g,-ii'}\mathbf{b}'(\mathbf{x}_i - \mathbf{x}_{i'}) + d\mathbf{b}'(\mathbf{x}_i\mathbf{x}_i' - \mathbf{x}_{i'}\mathbf{x}_{i'}')\mathbf{b} + \mathbf{b}'(\mathbf{x}_i - \mathbf{x}_{i'}))$$

$$\mid \mathbf{r}_g, \mathbf{x}_i, \mathbf{x}_{i'}] = 0$$

- A standard order and rank condition then ensures all parameters are identified from these moments and can be estimated by GMM.
- Proof consists of plugging $\widehat{y}_{g,-ii'}$ in for $\overline{y}_g$, and then verifying that the resulting measurement and model errors $u_i - u_{i'} + \varepsilon_{gi} - \varepsilon_{gi'}$ are mean independent of $\mathbf{r}_g, \mathbf{x}_i, \mathbf{x}_{i'}$.
- Random effects are analogous.

Well-Being Analysis

- Data set WVS: 2006 and 2014 India modules of the World Values Survey (WVS). 3236 observations.
- Define groups by education of head, religion/caste, and state.

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- Define groups by education of head, religion/caste, and state.
- Ordered Logit regressions of self-reported life-satisfaction ("how satisfied are you with your life") on a 1 to 5 scale.
- Regress on imputed household expenditures x_i (in reals), demographics z_i, group average $\widehat{x}_g$ ($\widehat{x}_g$ in reals, matched from NSS data).

Satisfaction, Income, Peer Income

Table 3: Satisfaction on household and peer income

	OLS (SDs)			Ordered logit		
	(1)	(2)	(3)	(4)	(5)	(6)
Imputed expenditure	0.068***			0.179***		
	(0.013)			(0.031)		
Group expenditure	-0.100**			-0.203*		
	(0.049)			(0.115)		
Imputed expenditure, CPI deflated		0.131***	0.141*		0.335***	0.359*
		(0.025)	(0.079)		(0.058)	(0.198)
Group expenditure, deflated		-0.190*	-0.182		-0.424*	-0.407
		(0.107)	(0.114)		(0.256)	(0.285)
Own X group expenditure			-0.003			-0.006
			(0.018)			(0.044)
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Ratio	1.47	1.45	1.29	1.13	1.27	1.13
	(0.764)	(0.850)	(1.249)	(0.684)	(0.803)	(1.202)
P(Own + group = 0)	0.528	0.588	0.799	0.848	0.734	0.908
Dependent mean	0.00	0.00	0.00	3.07	3.07	3.07
Dependent SD	1.00	1.00	1.00	1.22	1.22	1.22
Observations	3236	3236	3236	3236	3236	3236

Dependent variable as noted in column header, in SD. Subjective well being data from World Values Survey, imputations from NSS. Peer groups defined as intersection of education (below primary, primary or partial secondary, secondary+) and religion (Hindu and non-Hindu). All columns include controls for household size, age, sex, marital status and education. Standard errors in parentheses and clustered at the group level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

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- $\overline{x}_g$ affects well-being like lower x_i; roughly offsetting, like Luttmer.
- Interaction $x_i\overline{x}$ insignificant, so additive model is okay

Needs and AESE Equivalent-Incomes

- Notation reminder: i indexes households, g indexes groups (of households). overbars indicate true within-group means, hats indicate sample averages. $\mathbf{q}$ is quantity vector, $\mathbf{p}$ is price vector, x is budget, $\mathbf{z}$ is characteristics.

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- The *equivalent-income function* $X_i(\mathbf{p}, x)$ is the x_i needed to give i the same utility as a reference consumer $i = 0$ having a budget x.
  - drop $\mathbf{z}$ for now—it is absorbed into i.
- $X_i(\mathbf{p}, x)$ is an interpersonally-comparable money metric utility function. It could be an argument of a social welfare function.

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- Define *Absolute Equivalence Scale Exactness* (AESE) as $X_i(\mathbf{p}, x) = x - \widetilde{F}_i(\mathbf{p})$ for some $\widetilde{F}$.
- Theorem (Blackorby and Donaldson 1994) AESE holds iff $V_i(\mathbf{p}, x_i) = V(\mathbf{p}, x_i - F_i(\mathbf{p}))$ where $\widetilde{F}_i(\mathbf{p}) = F_i(\mathbf{p}) - F_0(\mathbf{p})$.
- $F_i(\mathbf{p})$ is the cost of satisfying the **perceived needs** of consumer i.
- Our model (and Luttmer's) fits into AESE.

Implications of AESE on Preferences

- By Roys identity, AESE implies demand functions $\mathbf{q}_i = \mathbf{h}_i(\mathbf{p}, x_i)$:

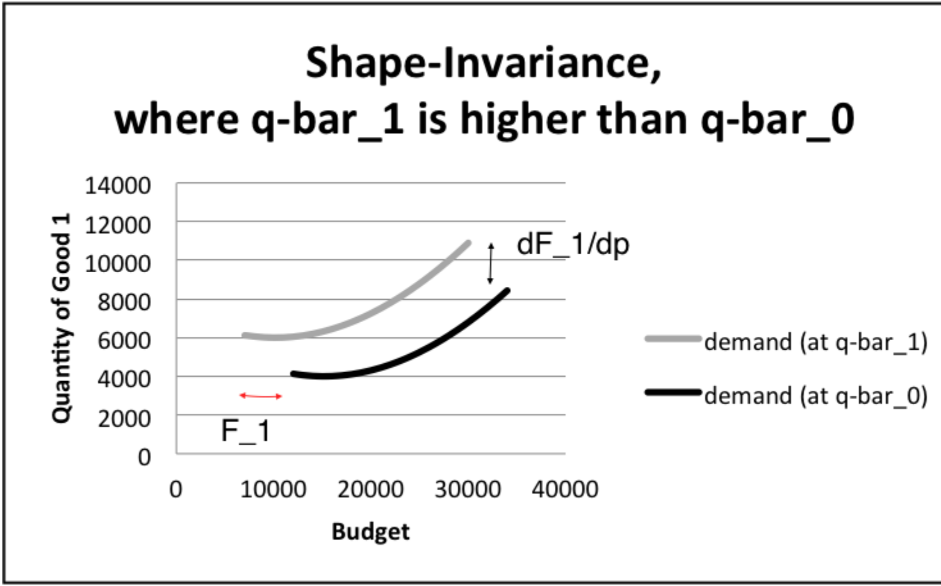
$$\mathbf{h}_i(\mathbf{p}, x_i) = \mathbf{h}(\mathbf{p}, x_i - \widetilde{F}_i(\mathbf{p})) + \frac{\partial \widetilde{F}_i(\mathbf{p})}{\partial \mathbf{p}},$$

and, if $\widetilde{F}_i(\mathbf{p}) = F_i = \mathbf{p}'\mathbf{f}_i$

$$\mathbf{h}_i(\mathbf{p}, x_i) = \mathbf{h}(\mathbf{p}, x_i - F_i) + \mathbf{f}_i.$$

- This is shape-invariance in quantity demands as in Pendakur (2005).
  - It is similar to budget share shape invariance as in Pendakur (1999), Lewbel (2010), and Blundell, Chen and Kristensen (2007).
- Shape invariance is empirically testable by comparing differences in $\mathbf{h}_i(\mathbf{p}, x)$ across consumers.
- Shape invariance exhausts the testable implications of AESE.

Shape-Invariant Demands



More Implications of AESE

- AESE has other, untestable (cardinal utility), implications.
- All shape invariant utiity functions can be written as $V_i(\mathbf{p}, x_i) = H_i\left[V^0\left(\mathbf{p}, x_i - F_i(\mathbf{p})\right)\right]$.
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- Every choice of H_i yields a new equivalent-income function.
- However, Blackorby and Donaldson (1994) show that, given AESE, differences in needs $\widetilde{F}_i(\mathbf{p}) = F_i(\mathbf{p}) - F_0(\mathbf{p})$ are identified from behaviour.
- Welfare calculations only require differences $\widetilde{F}_i(\mathbf{p})$.

Our Demand Model

- We use (AESE) demands with needs $\widetilde{F}_i(\mathbf{p}) = F_i = \mathbf{p}'\mathbf{f}_i$

$$\mathbf{h}_i(\mathbf{p}, x_i) = \mathbf{h}(\mathbf{p}, x_i - F_i) + \mathbf{f}_i + \mathbf{v}_g + \mathbf{u}_i.$$

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- So,

$$\mathbf{h}_i(\mathbf{p}, x_i) = \mathbf{h}(\mathbf{p}, x_i - \mathbf{p}'(\mathbf{A}\overline{\mathbf{q}}_g + \mathbf{C}\mathbf{z}_i)) + \mathbf{A}\overline{\mathbf{q}}_g + \mathbf{C}\mathbf{z}_i + \mathbf{v}_g + \mathbf{u}_i$$

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$$\mathbf{h}_i(\mathbf{p}, x_i) = \mathbf{h}(\mathbf{p}, x_i - \mathbf{p}'(\mathbf{A}\overline{\mathbf{q}}_g + \mathbf{C}\mathbf{z}_i)) + \mathbf{A}\overline{\mathbf{q}}_g + \mathbf{C}\mathbf{z}_i + \mathbf{v}_g + \mathbf{u}_i$$

- We are interested in $\mathbf{A}$; it may be scalar where $\mathbf{A} = \alpha\mathbf{I}$.

Empirical Application: NSS Data

- Household consumption and demographics from rounds 59 to 62 of the National Sample Survey (NSS) of India (2002/3 to 2005/6).
- Rural Hindu non-Dalit households head over 20 only. Yields 56,516 households.
- Groups: education (3 levels) by district (575 across 33 states).
  - Get 1111 groups with at least 10 observations in at least 1 period.
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- Also consider further dividing luxuries and necessities into visible (to others) vs invisible as in Roth (2014).

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- Also consider further dividing luxuries and necessities into visible (to others) vs invisible as in Roth (2014).
- Deaton-styled local-average unit-value commodity prices $\mathbf{p}$ vary by time and state.
- Demographics $\mathbf{z}$ include household size, household head age, marital status, land-holdings (in hectares) and ration card holder status.

NSS Data

Table 5: Summary Statistics for Indian NSS Data
2354 group-rounds

	Observations (N=56,516)			
	mean	std dev	min	max
x_i	1.12	0.66	0.10	8.75
q_i luxuries	0.31	0.37	0.00	7.96
q_i necessities	0.83	0.40	0.03	4.32
p luxuries	0.98	0.08	0.81	1.29
p neccessities	0.99	0.07	0.86	1.34
Educ med	0.48	0.50	0.00	1.00
Educ high	0.06	0.24	0.00	1.00
(hhsize-1)/10	0.40	0.22	0.00	1.10
headage/120	0.40	0.11	0.17	0.94
married	0.87	0.34	0.00	1.00
ln(land+1)	0.60	0.58	0.00	2.30
ration card	0.23	0.42	0.00	1.00

Fixed Effects Estimates

Table 4: 2 good system, Fixed Effects

	Needs Response	Fixed Effects $\mathbf{A} = \alpha\mathbf{I}$ est	*std err*	$\mathbf{A}$ Diagonal est	*std err*
luxuries	own	0.50	*0.11*	-2.63	*0.40*
neccessities	own	0.50	*0.11*	2.99	*0.28*
test A same	χ^2 stat, *[p-val]*			80	*[0.00]*
Hausman test RE	z stat, *[p-val]*	-0.31	*[0.76]*	-7.8	*[0.00]*
				8.8	*[0.00]*

Std errors are big with different A elements.

A is identified off $x_i\widehat{\mathbf{q}}$ interactions.

Since, the elements of $\widehat{\mathbf{q}}$ are correlated with each other, it is hard to pick up 2 parameters

Random Effects Estimates

Table 5: 2 good system, Random Effects

		Random Effects					
		$\mathbf{A} = \alpha\mathbf{I}$		**A** Diagonal		**A** Full	
		est	std err	est	std err	est	*std err*
luxuries	own	0.55	*0.02*	0.46	*0.02*	0.20	*0.09*
neccessities	own	0.55	*0.02*	0.57	*0.02*	1.09	*0.10*
luxuries	cross					0.42	*0.08*
neccessities	cross					-0.33	*0.11*
test $\mathbf{A} = \alpha\mathbf{I}$				43	*[0.00]*		

- RE diagonal estimates don't show much difference across goods.
- RE Full estimates (with crosses) are difficult to identify—interaction terms identify cross effects.

Visible and Invisible

Table 6: 4 Goods

		Fixed Effects		Random Effects			
		FE: $\mathbf{A} = \alpha\mathbf{I}$		RE: $\mathbf{A} = \alpha\mathbf{I}$		RE: $\mathbf{A}$ Diag	
		est	*std err*	est	*std err*	est	*std err*
lux	vis	0.71	*0.05*	0.65	*0.01*	0.54	0.01
	invis	0.71	*0.05*	0.65	*0.01*	0.62	0.01
necc	vis	0.71	*0.05*	0.65	*0.01*	0.76	0.01
	invis	0.71	*0.05*	0.65	*0.01*	0.66	0.01
test RE		1.26	*[0.21]*				
test $\mathbf{A} = \alpha\mathbf{I}$						658	*[0.00]*

Bigger Demand Systems

- Like Di Giorgio, Frederiksen and Pistaferri (2016), visible luxuries don't have larger peer effects than invisible luxuries or necessities.
- However, visible necessities do have larger peer effects than invisible necessities.
- Not the typical Veblen type conspicuous consumption story.
- Changing the number of goods does not change the spirit of the estimates: peer effects are still similar across goods, and large.
- Using more goods yields substantial benefits in terms of precision, because each element of **A** shows up in each equation.

Population Subgroups

Table 7: Fixed Effects, $\mathbf{A} = \alpha \mathbf{I}$, Subgroups						
	Religion		Education		Expenditure	
	separate regs		Hindus only		separate regs	
	est	*std err*	est	*std err*	est	*std err*
Hindu, non-SC/ST	0.50	*0.11*				
SC/ST	0.13	*0.18*				
non-Hindu	-0.06	*0.23*				
Illiterate/None			0.08	*0.15*		
Pri. or some Sec.			0.56	*0.12*		
Sec. or more			0.37	*0.22*		
below med. exp.					0.26	*0.05*
above med. exp.					0.59	*0.17*

Poorer Subgroups Have Smaller α

- Hindu has much bigger value of α.
- Not the same as in the well-being analysis.
- Primary education (middle group) has the biggest value of α.
- The same as in the well-being analysis.
- SC/ST have lower α
- uneducated/illiterate have lower α
- below median expenditure households have lower α.

Public Goods Are Half a Free Lunch

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- In our model, there is an additional public benefit channel: public goods raise money metrics more than do transfers.
- if jealousy or envy are the underlying cause:
  - Public goods, e.g.,clean water, public sanitation, better air quality, or better schools.
  - public goods–all people consume the same quantity–cause no envy.
  - so, are better in terms of money metric than private goods

Public Goods Are Half a Free Lunch

- The National Food Security Act (2013)
  - subsidized cereals to 75 per cent of households at 1/3 market price,
  - (projected) costs roughly 1.35% of GDP.
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  - up to 5 kg/month/person at Rs3/kg. Rice was Rs15/kg in 2016.
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  - Public cost: Rs12/kg, so Rs60/month/person.
- suppose households increase their necessities spending by Rs60/month/person.
  - Given our (RE) estimate of 0.57,
    - the needs spending of every group member rises by Rs34 (0.57*60).
    - money-metric utility increase of Rs26 Rs/month/person.
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  - but they could have had Rs60/month/person, via public goods.
- NFSA program targets 1 billion people, yielding potential annual money-metric welfare gains (of switching from rice subsidies to a public goods program) of Rs336 billion to Rs408 billion.
  - smaller welfare gains if consumers increase luxury spending instead.
  - larger welfare gains if rich taxpayers have bigger consumption externalities.

Summary: Econometrics

- identification and GMM estimation of peer effects in a generic quadratic model,
    - in data where we observe a fixed and small number of members of each group
    - allows for fixed or random effects
- a utility and consumer demand model where ones perceived needs for each commodity depends in part on the average consumption of one's peers.
    - demand model is extension of our generic quadratic peer effects model, and so identification and GMM estimation are the same
- model specifies the equivalent-income function, and so can be used for utility and social welfare analysis

Summary: Findings

- Peer effects in consumption are large.
  - If peer-average spending rises by Rs1000, household needs rise by roughly Rs500.
- Increased needs affect utilities exactly as do decreased budgets. So, some of the gains to income growth may be lost.
  - 50 per cent of income growth may be eaten away by increased needs.
- Public goods may be a "half-price" lunch.
- Income taxes are less costly in terms of welfare then they seem - no longer need to spend as much for the same level of welfare when neighbors are taxed.
  - If peer effects were larger for luxuries, then progressive taxes would be smart, even if, absent peer effects, the marginal utility of money was the same for rich and poor.
  - But, they're not.