# Necessary Luxuries

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**Abstract**

Fixed quantities are minimum consumption levels which must be exceeded to get any utility at all. Analyses and descriptions of peer effects in consumption choices (e.g., 'keeping up with the Jones') often envision the average consumption of one's peers as driving variation in fixed costs. We show that peer effects on fixed costs are semiparametrically identified in typically available consumer demand data. We show that nonlinearities inherent in demand functions overcome many of the identification problems that social interaction models like these typically suffer from. We implement the model with Indian household-level consumption microdata from 1999-2004. Peer effects in consumption are important only within goods, and not across goods, and peer effects are important for luxuries and not necessities. Spillovers from peer-average luxury consumption on to individual fixed costs are about one for one, that is an increase in peer-average luxury consumption of Rs1000 raises fixed costs by about Rs1000. Thus, peer effects are found to substantially diminish the welfare gain from income growth–keeping up with the Jones' effects wasted about 25 per cent of Indian GDP growth over 1994 to 2010.

November, 2013 - Preliminary and Horribly Incomplete

# 1 Introduction

Among others, Frank (1999, 2012) argues that although there has recently been spectacular income and consumption growth at the top of the income distribution, this has not resulted in much more well-being, because utilities depend on other people's consumption levels. The possible mechanisms for this are varied: Veblen effects make us value consumption of visible status goods; reference-dependent utility functions make consumption valuable only inasmuch as it is bigger than that we see around us; "keeping up with the Jones'" make our ‘effective consumption’ smaller if our peers consume a lot; the consumption of our peers affects what we perceive as necessary to just ‘get by’; etc. What these stories have in common is that each individual’s consumption may have externalities on the utility functions of others around them.

In this paper, we bring this intuition to the data using a simple model of consumption externalities in which the welfare cost of such externalities is easily expressed. We exploit the intuition that a plausible mechanism by which a consumption externality could work is to have the consumption of my peers affect what I think I need ’at the minimum’.

In the context of utility and cost functions, minimums are fixed costs, representing the minimum quantity vector you need to get any utility at all. The idea that preferences have fixed costs that need to be spent before one starts to get positive utility is an old one in economics, going back at least to Samuelson’s (1947) note on the implications of linearity. Samuelson called the minimum quantity vector corresponding to fixed costs the "necessary set" of goods, and defined "supernumerary income" as one’s remaining income, after subtracting off these fixed costs. Utility is then obtained by spending supernumery income. The classical Stone Geary Linear Expenditure System incorporates this construction. More generally, Gorman (1976), showed that these kind of fixed costs (which he calls "overheads") can be introduced into any utility function and may appropriately vary across consumers.

Our model starts with Gorman overheads or fixed costs that vary across consumers, but we assume in addition that a natural mechanism for a consumption externality is to have one’s fixed costs depend on the consumption of one’s peers. So if my peer’s consumption goes up, my fixed costs go up, making my supernumerary income go down, resulting in both a change in expenditure patterns and a loss in utility. The model therefore has testable implications, and it implies welfare losses that are quantifiable in a social sense: we can simply add up the estimated increases in fixed costs across people to measure the dollar cost of keeping up the the Jones’.

Models that include social interactions like ours often suffer from identification problems, such as Manski’s reflection problem. An interesting feature of our model is that empirically plausible demand functions are nonlinear in income, and this nonlinearity allows us to identify the model. Specifically, we show that the peer effects on fixed costs are semiparametrically identified in typically available consumer demand data.

Below we formally characterise the model, show what testable restrictions it generates, and show how it can be estimated using standard techniques from the social interactions literature. Then, we bring the model to an annual cross-section of Indian household expenditure data covering 1999-2004. Our data offer a good laboratory for this analysis because we observe relevant characteristics of each household for constructing peer groups, including education level, industry and detailed geographic area of residence. We also have a number of interesting demand shifters, including religion and caste. Moreover, our sample size is sufficiently large (over 35,000 households) to have hundreds of observations in most peer group cells of this classification.

# 2 Model

Let $\mathbf{q}$ denote a $J$-vector of quantities of each commodity. Let $\mathbf{p}$ be the corresponding $J$-vector of prices of each commodity, and let $x$ be the total budget of a household. Define a $J$-vector of peer quantities $\overline{\mathbf{q}} = \left(\overline{q}^1, .., \overline{q}^J\right)$ to be the average value of $\mathbf{q}$ across all households in a given household's peer group. Let $\overline{x}$ be the peer group average household budget.

Many researchers have considered links across these variables. For example, Boneva (2013) regresses $\mathbf{q}$ on $x$ and $\overline{x}$, to try to pick up the effect of average budgets on quantity demands. Chao and Schor (1998) regress $q^v$ on $\overline{q}^v$, where $q^v$ is quantity demands for visible luxuries (cosmetics in their case). Other researchers have considered self-reported utility and how it relates to household budgets and peer-average budgets. For example, Clark and Senik (2010) regress self-reported utility on $x$ and $\overline{x}$, and show that $\overline{x}$ is relevant. Ravina (2008) conducts a similar exercise, following households over time, and finds similar patterns. While this work is interesting, and suggests that household utilities and demands are probably related to those of peers, they do not allow for easy welfare analysis, because either the estimated parameters do not correspond to structural parameters, or the structural model estimated does not accomodate interpersonal (inter-household) comparisons of well-being. Our innovation is to offer a model that is easy-to-estimate, maps directly into a structural model of consumer choice, and structures interpersonal comparisons of well-being to allow social welfare analysis.

We assume that the indirect utility functions $V$ of consumers with different demographic characteristics, $\mathbf{z}$, and different peer quantities $\overline{\mathbf{q}}$ are related to each other by absolute equivalence-scale exactness (AESE, see Blackorby and Donaldson 1994; Pendakur 2002; Donaldson and Pendakur 2006), meaning that, for a given household $i$,

$$V(\mathbf{p}, x_i, \mathbf{z}_i, \overline{\mathbf{q}}_i) = V^0\left(\mathbf{p}, x_i - \mathbf{p}'\widetilde{\mathbf{f}}(\mathbf{z}_i, \overline{\mathbf{q}}_i)\right). \tag{1}$$

Here $\widetilde{\mathbf{f}}$ is the quantity vector corresponding to Samuelson's (1947) necessary set, which, as proposed by Gorman (1976) as overheads, is a function of demographic characteristics $\mathbf{z}_i$. Our main modeling innovation is that we assume $\widetilde{\mathbf{f}}$ is also a function of peer quantities $\overline{\mathbf{q}}_i$. This introduces complications for identification, estimation, and welfare analysis that are discussed below.

Without loss of generality, assume the normalization $\widetilde{\mathbf{f}}(\mathbf{z}_0, \overline{\mathbf{q}}_0) = \widetilde{\mathbf{f}}_0$ for some arbitrarily chosen reference values of characteristics $\mathbf{z}_0$, peer quantities $\overline{\mathbf{q}}_0$, and $J$-vector of constants $\widetilde{\mathbf{f}}_0$.[1] This normalization is made without loss of generality because any alternative value for $\widetilde{\mathbf{f}}(\mathbf{z}_0, \overline{\mathbf{q}}_0)$ will yield an observationally equivalent utility function by suitable redefinition of the function $V^0$. This was shown by Donaldson and Pendakur (2006) in a model without peer quantities $\overline{\mathbf{q}}$, but their proof immediately extends to our case. An immediate implication is that we will only be able to semiparametrically identify differences in fixed costs across consumers, rather than the absolute level of fixed costs, but these differences are all that will be required for our welfare analyses. Levels of fixed costs could be obtained only by parametric restriction on $V_0$, as in the well known Stone-Geary Linear Expenditure System.

We can interpret $V^0\left(\mathbf{p}, x_i - \mathbf{p}'\widetilde{\mathbf{f}}_0\right)$ as the indirect utility function of an arbitrarily chosen reference type household, defined as one having $\mathbf{z} = \mathbf{z}_0$ and $\overline{\mathbf{q}} = \overline{\mathbf{q}}_0$. Let $\mathbf{q}^0(\mathbf{p}, x) = -\partial V^0(\mathbf{p}, x)/\partial V^0(\mathbf{p}, x)/\partial x$ be the vector valued quantity demand function obtained by applying Roys identity to $V^0(\mathbf{p}, x)$. Then applying Roys identity to equation (1) yields quantity demand functions for any given household $i$ of the form

$$\mathbf{q}(\mathbf{p}, x_i, \mathbf{z}_i, \overline{\mathbf{q}}_i) = \mathbf{q}^0\left[\mathbf{p}, x_i - \mathbf{p}'\widetilde{\mathbf{f}}(\mathbf{z}_i, \overline{\mathbf{q}}_i)\right] + \widetilde{\mathbf{f}}(\mathbf{z}_i, \overline{\mathbf{q}}_i) \tag{2}$$

Supernumerary expenditures, which is the portion of total expenditures $x_i$ that provides utility to household $i$ relative to the reference household, is then given by $x_i - \mathbf{p}'\widetilde{\mathbf{f}}(\mathbf{z}_i, \overline{\mathbf{q}}_i)$. This also equals equivalent expenditure, which we discuss below when we get to the welfare economics of the problem.

Equation (2) says that quantity demand equations satisfy a shape-invariance condition (see Pendakur 1999 and 2002). A household with characteristics $\mathbf{z}_i$ whose peers have average quantities $\overline{\mathbf{q}}_i$ has quantity demand functions that look identical to those of a reference household (with demographics $\mathbf{z}_0$ and peer average quantities $\overline{\mathbf{q}}_0$) except that they are translated. They are translated on the $x$-axis ("horizontally") by $\mathbf{p}'\widetilde{\mathbf{f}}(\mathbf{z}_i, \overline{\mathbf{q}}_i)$ Rupees and translated on the quantity demand axis ("vertically") by $\widetilde{\mathbf{f}}(\mathbf{z}_i, \overline{\mathbf{q}}_i)$ units. Not all sets of quantity demand functions satisfy this shape-invariance condition, so the model is testable. In addition, as shown by Blackorby and Donaldson (1994), under the model, these translations have a unique mapping into the structural parameters giving fixed costs. That is: the horizontal translation one could recover from comparing demand equations equals the difference in fixed costs.

[1] Technically, there are constraints on the magnitude of $\widetilde{\mathbf{f}}_0$, required to ensure that the resulting supernumerary expenditures are positive for all households. In practice this will be irrelevant, because any choice of constants $\widetilde{\mathbf{f}}_0$ will just be absorbed into the parameters of demand functions that we estimate.

To reduce data requirements for estimation, we recast the model in terms of expenditures on different goods (instead of quantities) and fixed prices. Let $\mathbf{P}$ be a diagonal matrix with $\mathbf{p}$ on the main diagonal. Define the expenditure vector, $\mathbf{e} = [e^1, ..., e^J]$ to be the expenditures on each good, so $\mathbf{e} = \mathbf{P}\mathbf{q} = [p^1 q^1, ..., p^J q^J]$. Also, define peer expenditures analogously: $\overline{\mathbf{e}}_i = \mathbf{P}\overline{\mathbf{q}}_i$. We then can rewrite equation (2) as

$$\mathbf{e}(\mathbf{p}, x_i, \mathbf{z}_i, \overline{\mathbf{e}}_i) = \mathbf{e}^0 \left[\mathbf{p}, x_i - F(\mathbf{z}_i, \overline{\mathbf{e}}_i)\right] + \mathbf{f}(\mathbf{z}_i, \overline{\mathbf{e}}_i) \tag{3}$$

where

$$\begin{aligned} \mathbf{f}(\mathbf{z}_i, \overline{\mathbf{e}}_i) &= \mathbf{P}\widetilde{\mathbf{f}}(\mathbf{z}_i, \overline{\mathbf{q}}_i) = \mathbf{P}\widetilde{\mathbf{f}}(\mathbf{z}_i, \mathbf{P}^{-1}\overline{\mathbf{e}}_i), \\ F(\mathbf{z}_i, \overline{\mathbf{e}}_i) &= \boldsymbol{\iota}'\mathbf{f}(\mathbf{z}_i, \overline{\mathbf{e}}_i). \end{aligned}$$

Here, $\mathbf{e}^0$ is the expenditure vector function of the reference household, $\mathbf{f}$ is the vector of expenditures on each of the fixed quantities, and $\boldsymbol{\iota}$ is a vector of ones, making $F$ equal the total cost of purchasing the fixed quantities $\widetilde{\mathbf{f}}$. As with $\widetilde{\mathbf{f}}(\mathbf{z}_0, \overline{\mathbf{q}}_i)$, we have a free normalization $\mathbf{f}(\mathbf{z}_0, \overline{\mathbf{e}}_0) = \mathbf{f}_0$ for a chosen reference demographics level $\mathbf{z}_0$, peer expenditure level $\overline{\mathbf{e}}_0$, and $J-$vector of constants $\mathbf{f}_0$.

We will estimated models on data are that are collected over a short time span during which prices varied little, so for simplicity we treat prices as constant, and so rewrite the demand functions as Engel curves by dropping prices from equation (3). This gives $\mathbf{e}_i = \mathbf{e}^0 \left[x_i - \boldsymbol{\iota}'\mathbf{f}(\mathbf{z}_i, \overline{\mathbf{e}}_i)\right] + \mathbf{f}(\mathbf{z}_i, \overline{\mathbf{e}}_i)$. Next, let $\mathbf{u}_i$ be a $J-$vector of error terms satisfying $\boldsymbol{\iota}'\mathbf{u}_i = 0$. These error terms can be interpreted either as measurement errors in expenditures $\mathbf{e}$, or as unobserved preference heterogeneity in fixed costs (i.e., as random utility parameters, corresponding to random variation in necessary quantities across households). Either interpretation yields Engel curve demand functions of the form

$$\mathbf{e}_i = \mathbf{e}^0 \left[x_i - \boldsymbol{\iota}'\mathbf{f}(\mathbf{z}_i, \overline{\mathbf{e}}_i)\right] + \mathbf{f}(\mathbf{z}_i, \overline{\mathbf{e}}_i) + \mathbf{u}_i \tag{4}$$

As is standard for either preference heterogeneity or measurement error, we assume that $\mathbf{u}_i$ is distributed independently of $x_k$ and $\mathbf{z}_k$ for all consumers $i$ and $k$.

A generic issue regarding identification and estimation of social interactions models like this one is that, since $\overline{\mathbf{e}}_i$ equals peer group level averages of $\mathbf{e}_i$, it contains group-level averages of $\mathbf{u}_i$ by construction, and is therefore endogenous. Moreover, if $\mathbf{e}^0$ and $\mathbf{f}$ are linear, then identification can fail due to the Manski (1993) reflection problem. However, virtually all empirical studies of Engel curves find that expenditures on commodities are nonlinear in $x$, which by equation (4) introduces nonlinearities in the effects of $\mathbf{z}_i$ and $\overline{\mathbf{e}}$ that will preserve identification.

For estimation, peer-group averages of $\mathbf{z}_i$, denoted $\overline{\mathbf{z}}_i$, are valid instruments for $\overline{\mathbf{e}}_i$, since they do not directly affect individual's preferences and therefore do not directly affect $\mathbf{e}_i$. Of course, only $\mathbf{z}$'s that are not themselves group-level averages are amenable for this purpose. This use of group averages as instruments has been proposed before in the social interactions literature (see, e.g., Durlauf et al 2011). However, we have the advantage in our model that these identifying assumptions follow from nature of preferences and utility functions.

Nonparametric identification and estimation of the functions $\mathbf{e}^0$ and $\mathbf{f}$ could then be based on the conditional moment restrictions

$$E\left[\mathbf{e}_i - \mathbf{e}^0\left[x_i - \boldsymbol{\iota}'\mathbf{f}(\mathbf{z}_i, \overline{\mathbf{e}}_i)\right] - \mathbf{f}(\mathbf{z}_i, \overline{\mathbf{e}}_i) \mid x_i, \mathbf{z}_i, \overline{\mathbf{z}}_i\right] = 0 \tag{5}$$

Identification of such models requires completeness conditions, and a few kernel or sieve based estimators exist. See, e.g., Newey and Powell (2003), Hall and Horowitz (2005), Darolles, Florens, and Renault (2011), and Blundell, Chen, and Kristensen (2007). The latter paper is especially relevant, since they estimate Engel curves having a similar structure to ours, though without the peer effects.

We estimate our model using Hansen's (1982) Generalized Method Moments (GMM) estimator, by specifying $\mathbf{f}$ as linear and $\mathbf{e}^0$ as a fourth order polynomial, and using $\{x_i, x_i^2, \mathbf{z}_i, \mathbf{z}_i x_i, \overline{\mathbf{z}}_i, \overline{\mathbf{z}}_i x_i\}$ as instruments. Given the above mentioned completeness assumption for nonparametric identification, our estimates could be interpreted as nonparamatric low order sieve estimates (see Ai and Chen 2003 and Chen 2007), but we do not verify the regularity conditions required for sieve estimation and therefore treat our resulting asymptotic inference as parametric. Our model includes peer-group level averages as regressors, so we cluster the GMM weighting matrix and estimated parameter covariance matrix by group.

The functional forms we specify are as follows. For each good $j$, let fixed expenditures $f^j$ be linear in demographics and peer expenditures on the same commodity, so

$$f^j = \mathbf{z}_i'\gamma^j + \beta^j\left(\bar{e}_i^j - \bar{e}_M^j\right), \tag{6}$$

where $\bar{e}_M^j$ is the median peer expenditure on good $j$ across groups. This expression implies the free normalization for $f_j$ when $\mathbf{z}_0 = 0$ and $\overline{\mathbf{e}}_0 = \overline{\mathbf{e}}_M$. This is convenient because it means that our reported fixed costs (and other results) will all be relative to a reference person having demographic characteristics $\mathbf{z}_i = 0$ who faces the median peer expenditure vector $\overline{\mathbf{e}}_M$.

We also consider a more general specification in which the with peer averages of every good can affect the fixed expenditures for each good, so

$$f^j = \mathbf{z}_i \gamma^j + \sum_{k=1}^{J} \beta^{jk} \bar{e}_i^k. \tag{7}$$

We can write equations (6) or (7) and the associated expression for $F$ in vector form as

$$\mathbf{f}(\mathbf{z}_i, \overline{\mathbf{e}}_i) = \Gamma \mathbf{z}_i + \mathbf{B}\left(\overline{\mathbf{e}}_i - \overline{\mathbf{e}}_M\right), \qquad F(\mathbf{z}_i, \overline{\mathbf{e}}_i) = \iota' \Gamma \mathbf{z}_i + \iota' \mathbf{B}\left(\overline{\mathbf{e}}_i - \overline{\mathbf{e}}_M\right) \tag{8}$$

where $\mathbf{B}$ is the matrix of elements $\beta^{jk}$ and $\Gamma$ is the matrix of rows $\gamma^{j\prime}$. Equations (6) vs. (7) is the special case of equation (8) in which $\mathbf{B}$ is diagonal. To reduce the effects of multicollinearity, when we estimate the model using the more general specification of equation (7), we let $\beta^{jk}$ equal the same value for all $k \neq j$, so that the demand functions for each good depend on two peer effects: own-good peer effects corresponding to $\beta^{jj} = \beta^j$, and other-good peer effects corresponding to $\beta^{jk}$ for $k \neq j$.

Finally, we specify the reference Engel curve functions $\mathbf{e}^0$ as fourth order polynomials in $x_i$. This then yields the model

$$\mathbf{e}_i = \mathbf{a} + \mathbf{b}\left(x_i - F(\mathbf{z}_i, \overline{\mathbf{e}}_i)\right) + \mathbf{q}\left(x_i - F(\mathbf{z}_i, \overline{\mathbf{e}}_i)\right)^2 + \mathbf{c}\left(x_i - F(\mathbf{z}_i, \overline{\mathbf{e}}_i)\right)^3 + \mathbf{d}\left(x_i - F(\mathbf{z}_i, \overline{\mathbf{e}}_i)\right)^4 + \mathbf{f}(\mathbf{z}_i, \overline{\mathbf{e}}_i) + \mathbf{u}_i. \tag{9}$$

where $\mathbf{a}$, $\mathbf{b}$, $\mathbf{q}$, $\mathbf{c}$, and $\mathbf{d}$, are parameter $J-$vectors that satisfy $\iota'\mathbf{a} = 0$, $\iota'\mathbf{b} = 1$, $\iota'\mathbf{q} = 0$, $\iota'\mathbf{c} = 0$, and $\iota'\mathbf{d} = 0$. These equalities are implied by the budget constraint for utility maximization, which imposes the constraint that that $\iota'\mathbf{e}_i = x_i$.

For each individual $i$ we observe $\mathbf{e}_i$, $x_i$, and $\mathbf{z}_i$. The entire model is then given by first allocating individuals to peer groups (based on observable characteristics, which are a subset of elements of $\mathbf{z}$), constructing peer group averages $\overline{\mathbf{e}}_i$, substituting equation (8) into equation (9), and estimating the resulting systems of equations using GMM.

## 2.1 Welfare Analysis

This model permits interpersonal comparisons of well-being. AESE can be broken into two component assumptions, rewriting equation (1) as

$$V(\mathbf{p}, x_i, \mathbf{z}_i, \overline{\mathbf{q}}_i) = g\left(V_0\left(\mathbf{p}, x_i - \mathbf{p}'\left(\widetilde{\mathbf{f}}(\mathbf{z}_i, \overline{\mathbf{q}}_i)\right)\right), \mathbf{z}_i, \overline{\mathbf{q}}_i\right), \tag{10}$$

$$g(v, \mathbf{z}_i, \overline{\mathbf{q}}_i) = v. \tag{11}$$

The first line is stated in terms of ordinal equivalence and the shape-invariance condition given in (2) is necessary and sufficient for it. The second line is an untestable restriction on interpersonal comparisons of well-being.

The assumption of AESE implies that the equivalent expenditure function, $X(\mathbf{p}, x_i, \mathbf{z}_i, \overline{\mathbf{e}}_i)$, which gives the expenditure needed by a person with characteristics $\mathbf{z}_i$ and peer group expenditures $\overline{\mathbf{e}}_i$ to get the same utility as a reference person with characteristics $\mathbf{z}_0$ and peer group consumption $\overline{\mathbf{e}}_M$, is given by

$$X(\mathbf{p}, x_i, \mathbf{z}_i, \overline{\mathbf{e}}_i) = x_i - F(\mathbf{z}_i, \overline{\mathbf{e}}_i).$$

Two consumers with different $\mathbf{z}_i, \overline{\mathbf{e}}_i$ but the same value of equivalent expenditures have the same level of utility. Further, under the model, if these two consumers each receive $k$ Rupees more expenditure, they will still be equally well off.

Suppressing the price arguments and adding in our linear model for $F$, we have

$$X(x_i, \mathbf{z}_i, \overline{\mathbf{e}}_i) = x_i - i'\mathbf{z}_i\Gamma - i'\mathbf{B}\left(\overline{\mathbf{e}}_i - \overline{\mathbf{e}}_M\right).$$

Here, equivalent expenditure is affected by differences in fixed costs due to demographic differences across households (controlled by $\Gamma$) and by peer effects in consumption (controlled by $\mathbf{B}$). Although the elements of $\Gamma$ can have any sign (depending on the definition of the reference household type $z_0$), the elements of $\mathbf{B}$ are presumed to be positive.. The sum of equivalent expenditures is an admissable welfare function, as is any S-concave function of equivalent expenditures.

Suppose that there was no variation across peer group commodity expenditures $\overline{\mathbf{e}}_i$ for different individuals. This would be the case if all peer groups were identical. The would imply $\overline{\mathbf{e}}_i - \overline{\mathbf{e}}_M$ for all $i$, and variations in equivalent expenditures would be driven solely by $\mathbf{z}_i\Gamma$.

Now consider income growth of $k$ dollars for every person. The peer expenditure vector will increase by the vector $\boldsymbol{\kappa}$ (which sums to $k$, and is different across goods). Thus, the sum of equivalent expenditures will increase by

$$\Delta \sum_{i=1}^{N} X(x_i, \mathbf{z}_i, \overline{\mathbf{e}}_i) = Nk - N\iota'\mathbf{B}\boldsymbol{\kappa}$$

The amount $Ni'\mathbf{B}\boldsymbol{\kappa}$ is the equivalent expenditure lost due to the peer effect. It is the amount of expenditure thrown away in our effort to keep up with the Jones.

If the elements of $\mathbf{B}$ are less than 1, so that peer expenditure drives up fixed expenditure by less than a Rupee per Rupee, then $i'\mathbf{B}\boldsymbol{\kappa}$ is less than $k$, then the aggregate effects of peer effects in equivalent consumption cannot overwhelm the effect of income growth. But, if the elements of $\mathbf{B}$ are greater than 0, then peer effects in equivalent consumption diminish the utility value of income growth.

# Data

We use household-level microdata on consumer expenditures from the 1999, 2000, 2001, 2002, 2003 and 2004 waves of the National Sample Survey of India. We investigate household spending in 3 categories: visible luxuries, invisible luxuries and necessities.[2] We consider luxuries and necessities because the psychological literature suggests that these are more likely to be status goods that have important peer effects than other goods. We divide luxuries into those that are visible and invisible to investigate the possibility that conspicuous consumption (Veblen goods) are more susceptle to peer effects than consumption that is not observed by peers.

Our peer groups are defined off geography, education and industry. We use only male-headed urban married households who household head is aged 20 or more. Demand shifters $\mathbf{z}$ are: household size and its square, the age of household head less 40 divided by 40; indicator variables for Dalit caste membership, non-Hindu religion, medium education level, high education level; and group-level averages of age of household head and non-Hindu religion. In addition, $\mathbf{z}$ contains a vector of either 6 zone dummies or 20 state dummies.

Instruments in the GMM estimation include all exogenous preference shifters, individual expenditure, and may include the group-level average of any element of $\mathbf{z}$ that is not a group-level variable which affects demands. So, we use group-level averages of household size and its square and Dalit caste membership as instruments for the endogenous group-average quantities, denoting these group-average instruments as $\widetilde{\mathbf{z}}$. The complete instrument vector used is: $1, x, \mathbf{z}, \mathbf{z}x, \widetilde{\mathbf{z}}, \widetilde{\mathbf{z}}x$. We also consider alternative specifications with different $\mathbf{z}$ and $\widetilde{\mathbf{z}}$.

Most of our empirical work will use solely the 2000 wave of the NSS. We normalize expenditure by the average household expenditures so that its mean value is 1. Table 1 gives descriptive statistics for these data.

[2]Visible luxuries are defined as: flashy clothes, flashy transportation, suitcase, jewellery, motorbikes and cars. invisible luxuries are defined as: alcohol, tobacco, other hobbies, household staff, misc consumption services, furniture, nonportable technology, musical instruments, fancy ktichen implement. Necesssities are defined as: nonflashy clothes, footwear, bikes and tubes, food in, fuel, bedding, misc clothing, educ, medical, personal care, sundry articles, utensils.

Table 1: Descriptive Statistics, 2000 wave
N=35459

| Variable | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|
| expenditure/avg expend | 1.000 | 0.681 | 0.142 | 8.934 |
| vis luxuries | 0.067 | 0.240 | 0.000 | 6.943 |
| inv luxuries | 0.121 | 0.262 | 0.000 | 6.501 |
| necessities | 0.812 | 0.462 | 0.090 | 4.902 |
| peer vis luxuries | 0.027 | 0.078 | -0.040 | 0.898 |
| peer inv luxuries | 0.022 | 0.080 | -0.089 | 0.659 |
| peer necessities | 0.020 | 0.180 | -0.515 | 1.381 |
| hh size - 4 | 0.999 | 2.353 | -3 | 25 |
| (hh size-4)2 | 6.535 | 16.889 | 0 | 625 |
| (head age less 40)/40 | 1.103 | 0.307 | 0.500 | 2.475 |
| Dalit caste | 0.159 | 0.366 | 0 | 1 |
| non-Hindu religion | 0.237 | 0.425 | 0 | 1 |
| educ grade 8-12 | 0.421 | 0.494 | 0 | 1 |
| educ beyond HS | 0.175 | 0.380 | 0 | 1 |
| grp avg head age-40 | 1.103 | 0.084 | 0.838 | 1.655 |
| grp avg Dalit | 0.159 | 0.117 | 0 | 1 |
| grp avg non-Hindu | 0.237 | 0.162 | 0 | 1 |
| zone 1 | 0.179 | 0.383 | 0 | 1 |
| zone 2 | 0.020 | 0.139 | 0 | 1 |
| zone 4 | 0.126 | 0.332 | 0 | 1 |
| zone 5 | 0.186 | 0.389 | 0 | 1 |
| zone 6 | 0.248 | 0.432 | 0 | 1 |

We note that expenditures on goods (visible luxuries, invisible luxuries, necessities) are normalized to sum to 1, and that peer expenditures are averages less the median values of peer expenditures across groups. The most important thing to note about these quantities is necessities are 80% the household budget.

# Results

Our tables of results give estimates of $\mathbf{B}$, the matrix giving the response of individual expenditure on a good to peer average expenditure on that good and to peer average expenditures on other goods. We implement a 2 step GMM estimator where the second step weighting matrix and parameter covariance matrix are both robust to peer-group level random effects (that is, they are clustered at the peer group level). Asymptotic standard errors are given in italics.

Table 2 shows estimates for the 2000 wave of the NSS (the largest wave in our set). Here, we show estimates for a model where **B** has an element for own and other expenditures in the leftmost panel, and where the other effects are constrained to zero, and where peer effects are contrained to zero for necessities.

Table 2: Estimated Peer Effects in Consumption, India 2000

| | own and other | | | | own | | own, no necc | |
|---|---|---|---|---|---|---|---|---|
| N=35459 | own | | other | | own | | own | |
| 539 groups | est | *std err* | est | *std err* | est | *std err* | est | *std err* |
| visible luxuries | 1.281 | *0.221* | -0.131 | *0.142* | 1.192 | *0.184* | 1.058 | *0.176* |
| invisible luxuries | 1.133 | *0.321* | -0.039 | *0.153* | 1.242 | *0.239* | 0.981 | *0.205* |
| necessities | -0.967 | *0.571* | 0.827 | *1.587* | -0.806 | *0.560* | | |
| J-test, p-val | 35.140 | *0.019* | | | 35.170 | *0.050* | 40.107 | *0.021* |
| test no other, p-val | 1.930 | *0.587* | | | | | | |
| test no necc, p-val | 3.270 | *0.195* | | | | | | |

There are several useful findings that we draw from Table 2. First, many of the observed peer effects are large. For example, in the upper left corner of the table, we see that the coefficient on peer-average visible luxuries is 1.281 in the equation for individual demand for visible luxuries equation. This means that an increase in peer average visible luxuries consumption of Rs1000 results in an increase in fixed costs of Rs1281.

Second, we cannot reject the hypothesis that the only peer-average effects that matter are for own-goods. For example, the peer-average of visible luxuries consumption affects individual visible luxuries demand, but the peer-average of other consumption does not strongly affect individual visible luxuries demand (that coefficient is only -0.131 and is insignificantly different from 0). The Wald test statistic for the joint hypothesis that all three other-effects are zero is 1.93, with a p-value of 0.587.

Third, necessities do not have any statistically significant peer effects. In the model with both own- and other-effects, the coefficients are both large, but are each insignificantly different from zero. Further, the test statistic for the joint hypothesis that both of these coefficients are zero in the necessities equations is 3.270 with a p-value of 0.195. In the model with only own-effects, the z-test on the own-effect for necessities is 1.439 (equal to 0.806/0.560).

Fourth, in the specifications with own-effects only, the own-effects for luxuries are close to 1. This means that an increase in peer-average luxury demand of Rs1000 leads to an increase in fixed costs of about Rs1000. As luxuries comprise about 20 per cent of consumption, this is a pretty big deal.

Finally, the $J$-test suggests that the instruments for endogenous peer-average quantities, peer-average household size and squared size and their interactions with individual budgets $x_i$, are 'okay'. The p-values of the $J$-test are at the margins of rejection, but not overwhelmingly decisive. In particular, for our preferred specification with diagonal $\mathbf{B}$, the p-value of the $J$-test is 0.050. This suggests that the instruments are valid-ish.

If our observed patterns were actually driven by unobserved price variation, then we would expect to see own-effects equal to 1 for all goods. Instead, we see own-effects equal to 1 for luxuries and equal to 0 for necessities. This suggests that the estimates are not just picking up unobserved heterogeneity in prices that feed into nominal demands of both peer groups and individuals.

In sum, Table 2 provides evidence that peer effects operate mainly from peer quantities to individual choices for the same good (that is, only own-effects matter), and that peer effects are equal to about 1 for luxuries and are insignificatly different from 0 for necessities. We now consider several types of specification tests and robustness tests, and will find that these two findings are intact across these tests.

Table 3 considers alternate specifications of which variables have group-level averages that are demand shifters, and consequently which group-level averages may be used as additional instruments $\widetilde{\mathbf{z}}$. In the baseline results presented in Table 2, the group-level averages of non-Hindu religion and age are shifters in individual demand functions. This leaves the group-level averages of household size, its square and Dalit caste to use as instruments to identify the parameters on endogenous group-average commodity expenditures. In Table 3, we check to see whether adding or deleting group-level shifters in individual demand functions changes estimated peer effects.

Table 3: Estimated Peer Effects in Consumption, India 2000, varying group-level variables

| | | | | *baseline* | | | |
|---|---|---|---|---|---|---|---|
| N=35459 | | age, dalit, hindu | | age, hindu | | none | |
| 539 groups | | est | std err | est | std err | est | std err |
| with zone | visible luxuries | 1.422 | 0.282 | 1.192 | 0.184 | 0.940 | 0.097 |
| dummies | invisible luxuries | 1.472 | 0.300 | 1.242 | 0.239 | 0.606 | 0.112 |
| | necessities | -1.598 | 1.136 | -0.806 | 0.560 | 0.015 | 0.138 |
| | J-test, p-val | 33.071 | 0.033 | 35.170 | 0.050 | 52.804 | 0.004 |
| | test no age | 8.760 | 0.033 | | | | |
| | test no hindu | 8.670 | 0.034 | | | | |
| | test no dalit | 1.760 | 0.625 | | | | |

In the leftmost columns, we add group-level average Dalit caste to individual demand shifters, and in the rightmost columns, we delete all group-level average demand shifters. In all cases, the instrument vector is the same, and includes all group-average demographic variables. The test statistics reported in the leftmost columns suggest that group average age and group average religion are relevant to individual demands, but group average Dalit caste status is not, and so it may safely be excluded from the list of demand shifters.

In the rightmost columns, we present results for a model in which no group-average demographics are demand shifters, and all are therefore available to use as additional instruments to identify the coefficients on group-average quantities. The broad patterns hold up: peer effects are large for luxuries and near zero for necessities. But the J-statistic suggests that we should not exclude all group-average demographics from the list of demand shifters.

Table 4 gives results like those in Table 2 for all waves 1999-2004, but for Maharashtra only. Here, we use the Maharashtra industrial workers price index to deflate for price changes across years, and drop the zone dummies from the list of demographic shifters $\mathbf{z}$. The advantage of the within-state estimates is that they may have less unobserved price variation than the estimates based on India as a whole for a given year. In the table, we vary the group-level average variables included in the demand shifters.

Table 4: Estimated Peer Effects in Consumption, Maharashtra 1999-2004

| N=10489 | age, dalit, hindu | | age, hindu | | dalit, hindu | |
|---|---|---|---|---|---|---|
| 251 groups | est | std err | est | std err | est | std err |
| visible luxuries | 1.012 | 0.515 | 0.940 | 0.097 | 1.826 | 0.750 |
| invisible luxuries | 2.011 | 0.592 | 0.606 | 0.112 | 0.935 | 0.683 |
| necessities | 2.797 | 0.481 | 0.015 | 0.138 | 2.47 | 0.676 |
| J-test, p-val | 35.81 | 0.016 | 52.804 | 0.004 | 20.54 | 0.609 |
| test no age, p-val | 2.05 | 0.562 | | | | |
| test no hindu, p-val | 11.52 | 0.009 | | | | |
| test no dalit, p-val | 10.97 | 0.012 | | | | |

The results from Table 4 are moderately in synch with those in Tables 2 and 3. However, unlike with the national-level estimates, the tests of group-average variables suggest that group-average age is not relevant but group-average Dalit status is relevant. Thus, the most interesting model for Maharashtra is in the rightmost column where group-average Dalit and non-Hindu are included as demand shifters, and group-average age is left as an instrument for endogenous group-average demands.

The estimated own-effect for visible luxuries is large and significant, and again insignificantly different from 1. However, the coefficient for invisible luxuries is so imprecisely estimated that it is insignificantly different from both 0 and 1. The big difference in comparison with the national-level estimates is that the own-effect for necessities is large, with an estimated value of 2.47. Indeed, this coefficient is implausibly large given that necessities account for about 80% of the budget.

Table 5 considers two different specifications in terms of how geographic location shifts individual demands. In the leftmost columns, we include 20 state dummies, in the middle columns 6 zone dummies, and in the rightmost columns no geographic location shifters. Like the results presented in Table 4, these results are aimed at controlling for unobserved variation in prices across states by including state dummies as demand shifters.

Table 5: Estimated Peer Effects in Consumption, India 2000, various geography

| | | | | *baseline* | | | |
|---|---|---|---|---|---|---|---|
| N=35459 | | state dummies | | zone dummies | | no dummies | |
| 539 groups | | est | std err | est | std err | est | std err |
| with zone | visible luxuries | 2.756 | 0.484 | 1.192 | 0.184 | 0.973 | 0.125 |
| dummies | invisible luxuries | 3.296 | 0.447 | 1.242 | 0.239 | 0.913 | 0.139 |
| | necessities | -1.016 | 0.662 | -0.806 | 0.560 | -1.621 | 0.929 |
| | J-test, p-val | 43.954 | 0.234 | 35.170 | 0.050 | 38.475 | 0.003 |

In Table 5, we see that including state dummies has a big effect on the estimated own-effects for luxuries, pushing these coefficients up to about 3. The estimated own-effect for necessities is again statistically indisguishable from 0. Large coefficients (e.g., bigger than 1) on own-effects for small parts of the budget (like luxuries) are not a priori impossible, but they do make the model feel less plausible.

A different view of the model is to compare the estimates across years. If the model is picking up real peer effects, there should not be too much variation in estimated peer effects across years. In Table 6, we give results estimated separately for each year 1999 to 2004.

Table 6: Estimated Peer Effects in Consumption, India Year-by-Year

| | 1999 | | 2000-*baseline* | | 2001 | | 2002 | | 2003 | | 2004 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N | 17004 | | 35459 | | 18262 | | 9131 | | 9899 | | 6798 | |
| number of groups | 461 | | 539 | | 448 | | 370 | | 389 | | 346 | |
| | est | *std err* | est | *std err* | est | *std err* | est | *std err* | est | *std err* | est | *std err* |
| visible luxuries | 0.796 | 0.100 | 1.192 | 0.184 | 1.273 | 0.160 | 1.222 | 0.096 | 1.074 | 0.071 | 0.981 | 0.172 |
| invisible luxuries | 1.345 | 0.155 | 1.242 | 0.239 | 0.685 | 0.265 | 0.968 | 0.131 | 0.845 | 0.089 | 1.442 | 0.221 |
| necessities | -0.667 | 0.493 | -0.806 | 0.560 | 0.042 | 0.159 | 0.035 | 0.189 | 0.325 | 0.155 | 0.499 | 0.185 |
| J-test, p-val | 39.678 | 0.017 | 35.170 | 0.050 | 46.045 | 0.003 | 44.774 | 0.004 | 48.611 | 0.001 | 25.813 | 0.310 |

Table 6 shows that estimated own-effects are remarkably similar across years. Estimated own-effects for visible and invisible luxuries are each statistically indistinguishable from 1 in each year. Estimated own-effects for necessities are statistically indistinguishable from 0 in each year from 1999-2002, and slightly positive in 2003 and 2004.

# 3 Discussion and Welfare Analysis

If we take the estimates of our model parameters as 'true', then we can answer the question "how much equivalent expenditure was wasted in keeping up with the Jones'?". Above, we found evidence that the only peer effects that matter are own-good effects for luxuries, and that these are equal to about 1. Thus, if peer average luxuries increase by Rs1000, then fixed costs rise by Rs1000. From national accounts data, we see that over 1994 to 2010, real per-capita GDP in India rose from 1340 US$ (1995 real PPP) to 3121 US$. From NSS data, we observe that in 1994, luxuries expenditures commanded 15% of expenditure (US$ 201) and in 2010, they commanded 22% of expenditure (US$ 688). Since equivalent expenditures are linear in peer-average expenditures, we don't need to know the distribution of this increased luxury expenditure. We can simply take the increase of $487, multiply it be the peer effect parameter of 1, and conclude that $487 US$ of the total GDP growth of $1781 was thrown away via the channel of increased fixed costs driven by peer effects. Bummer.

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