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Peer effects, fast food consumption and adolescent weight gain☆

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ABSTRACT

This paper aims at opening the black box of peer effects in adolescent weight gain. Using Add Health data on secondary schools in the U.S., we investigate whether these effects partly flow through the *eating habits* channel. Adolescents are assumed to interact through a friendship social network. We propose a two-equation model. The first equation provides a social interaction model of fast food consumption. To estimate this equation we use a quasi maximum likelihood approach that allows us to control for common environment at the network level and to solve the simultaneity (reflection) problem. Our second equation is a panel dynamic weight production function relating an individual's Body Mass Index *z*-score (zBMI) to his fast food consumption and his lagged zBMI, and allowing for irregular intervals in the data. Results show that there are positive but small peer effects in fast food consumption among adolescents belonging to a same friendship school network. Based on our preferred specification, the estimated social multiplier is 1.15. Our results also suggest that, in the long run, an extra day of weekly fast food restaurant visits increases zBMI by 4.45% when ignoring peer effects and by 5.11%, when they are taken into account.

1. Introduction

For the past few years, obesity has been one of the major concerns of health policy makers in the U.S. It has also been one of the principal sources of increased health care costs. In fact, the increasing trend in children's and adolescents' obesity (Ogden et al., 2012) has raised the annual obesity-related medical costs to $147 billion per year (Finkelstein et al., 2009). Obesity is also associated with increased risk of reduced life expectancy as well as with serious health problems such as type 2 diabetes (Maggio and Pi-Sunyer, 2003), heart disease (Calabr et al., 2009) and certain cancers (Calle, 2007), making obesity a real public health challenge.

Recently, a growing body of the health economics literature has tried to look into the obesity problem from a new perspective using a social interaction framework. An important part of the evidence suggests the presence of peer effects in weight gain. On one hand, Christakis and Fowler (2007), Trogdon et al. (2008), Renna et al. (2008) and Yakusheva et al. (2014) are pointing to the *social multiplier* as an important element in the obesity epidemics. As long as it is strictly larger than one, a social multiplier amplifies, at the aggregate level, the impact of any shock (such as the reduction in relative price of junk food) that may affect obesity at the individual level. This is so because the aggregate effect incorporates, in addition to the sum of the individual direct effects, positive indirect peer effects stemming from social interactions. On the other hand, Cohen-Cole and Fletcher (2008b) found that there is no evidence of peer effects in weight gain. Also, results from a placebo test performed by the same authors (Cohen-Cole and Fletcher, 2008a) indicate that there are peer effects in acne (!) in the Add Health data when one applies the Christakis and Fowler (2007) method discussed later on.

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While the presence (or not) of peer effects in weight has been widely researched,[1] the literature on the mechanisms by which peer effects flows is still scarce. Indeed, most of the relevant literature attempts to estimate the relationship between variables such as an individual's Body Mass Index (BMI) and his average peers' BMI, without exploring the channels at source of this potential linkage.[2] The aim of this paper is to go beyond the black box approach of peer effects in weight gain and try to identify one potentially important mechanism through which peer effects in adolescence overweight may flow: *eating habits* (as proxied by fast food consumption).

Three reasons justify our interest in eating habits in analyzing the impact of peer effects on teenage weight. First of all, there is an important literature that points to eating habits as an important component in weight gain (*e.g.*, Niemeier et al., 2006; Rosenheck, 2008).[3] Second, one suspects that peer effects in eating habits are likely to be important in adolescence. Indeed, at this age, youngsters have increased independence in general and more freedom as far as their food choices are concerned. Usually vulnerable, they often compare themselves to their friends and may alter their choices to conform to the behaviour of their peers. Therefore, unless we scientifically prove that obesity is a virus, it is counter intuitive to think that one can gain weight by simply interacting with an obese person.[4] This is why we are inclined to think that the presence of real peer effects in weight gain can be estimated using behavioural channels such as eating habits. Third, our interest in peer effects in youths' eating habits is policy driven. There has been much discussion on implementing tax policies to address the problem of obesity (*e.g.*, Caraher and Cowburn, 2007; Powell et al., 2013). As long as peer effects in fast food consumption is a source of externality that may stimulate overweight among adolescents, it may be justified to introduce a consumption tax on fast food. The optimal level of this tax will depend, among other things, on the social multiplier of eating habits, and on the causal effect of fast food consumption on adolescent weight.

In order to analyze the impact of peer effects in eating habits on weight gain, we propose a two-equation model. The first *linear-in-means* equation relates an individual's fast food consumption to his individual characteristics, his reference group's mean fast food consumption (*endogenous peer effect*), and his reference group's mean characteristics (*contextual peer effects*). The endogenous peer effect reflects the possibility that eating behaviour of his friends influences a teenager's own behaviour. For instance, one reason why an adolescent may want to go to a fast food restaurant is to be with his friends during the lunch. Contextual effects, such as the average level of education of his friends' mother, may also affect a teenager's eating habits. Thus, mothers with higher education may encourage not only their children but also their children's friends to develop accurate eating bebaviour.

The second equation is a panel dynamic production function that relates an individual's BMI adjusted for age (BMI *z*-score or zBMI) to his fast food consumption, his lagged zBMI and other control variables. The system of equations thus allows us to evaluate the impact of an eating habits' exogenous shock on an adolescent's weight, when peer effects on fast food consumption are taken into account. To estimate our two-equation model, we use three waves of the National Longitudinal Study of Adolescent Health (Add Health), that is, Wave II (1996), Wave III (2001) and Wave IV (2008).[5] We define peers as the nominated group of individuals reported as friends within the same school. The consumption behaviour is depicted through the reported frequency (in days) of fast food restaurant visits in the past week.

Estimating our system of equations raises serious econometric problems. It is well known that the identification of peer effects (first equation) is a challenging task. These identification issues were first pointed out by Manski (1993) and discussed among others by Bramoullé et al. (2009) and Blume et al. (2015). On one hand, (endogenous + contextual) peer effects must be identified from *correlated* (or confounding) factors. For instance, students in a same friendship group may have similar eating habits because they share similar characteristics (*i.e.*, homophily) or face a common environment (*e.g.*, same school). On the other hand, simultaneity between an adolescent's and his peers' behaviour (referred to as *the reflection problem* by Manski) may make it difficult to identify separately the endogenous peer effect and the contextual effects.

We use a new approach based on Bramoullé et al. (2009) and Lee et al. (2010), and extended by Blume et al. (2015) to address these identification problems and to estimate the peer effects equation. First, we assume that in their fast food consumption decisions, adolescents interact through a *friendship network*. Each school is assumed to form a network. School fixed effects are introduced to capture correlated factors associated with network invariant unobserved variables (*e.g.*, similar preferences due to self-selection in schools, same school nutrition policies, distance from fastfood restaurants). The structure of friendship links within a network is allowed to be stochastic but conditional on the school fixed effects and observable individual and contextual variables, is strictly exogenous. The possibility that friends select each other using unobservable traits that may be correlated with their fast food consumption decisions is an important issue and is discussed later on.

To solve the reflection problem, we exploit results by Bramoullé et al. (2009) who show that if there are at least two agents who are separated by a link of distance 3 within a network (*i.e.*, there are two adolescents in a school who are not friends but are linked by two friends), both endogenous and contextual peer effects are identified. Finally, we exploit the similarity between the linear-in-means model and the spatial autoregressive (SAR) model with or without autoregressive spatial errors.[6] The model is estimated using a quasi maximum likelihood (QML) approach as in Lee et al. (2010). The QML is appropriate when the estimator is derived from a normal likelihood but the error terms in the model are not truly normally distributed. We also estimate the model using generalized spatial two-stage least square proposed in Kelejian and Prucha (1998) and refined in Lee (2003), which is less efficient than QML.

The estimation of the production function (second equation) also raises serious econometric issues. First, fast food consumption is likely to be an endogenous variable correlated with the individual error term. Moreover, the short and the long term impacts of fast food consumption on zBMI may be different, suggesting the

[1] For a complete review see Fletcher et al. (2011) who conducted a systematic review of literature that shows that school friends are similar as far as body weight and weight related behaviours.

[2] One recent exception is Yakusheva et al. (2011) and Yakusheva et al. (2014) who look at peer effects in overweight and in weight management behaviours such as eating and physical exercise, using randomly assigned pairs of roommates in freshman year.

[3] An indirect evidence of the relationship between eating habits and weight gain come from the literature on the (negative) effect of fast food prices on adolescents' BMI (see Auld and Powell, 2009; Powell, 2009; Powell and Bao, 2009). See also Cutler et al. (2003) which relates the declining relative price of fast food and the increase in fast food restaurant availability over time to increasing obesity in the U.S.

[4] Of course, having obese peers may influence an individual's tolerance for being obese and therefore his weight management behaviours.

[5] Note that for the first equation we use wave II and for the second equation we use the three waves.

[6] Our approach is more general than the SAR model as the latter usually ignores contextual effects and spatial fixed effects.