



# On the microeconomics of food and malnutrition under endogenous discounting



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## ABSTRACT

This paper explores the microeconomics and dynamics of food and nutrition. It examines the linkages between malnutrition and the incentive to invest and accumulate capital. The analysis focuses on a dynamic model where preferences about the future depend on nutrition and health. Situations of malnutrition cover both ends of the spectrum: from nutrient deficiency to obesity. The model involves preferences that are not time-additive and exhibit endogenous discounting. This provides a framework to investigate the factors affecting consumption and investment behavior. The adverse investment incentives of malnutrition are examined.

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## 1. Introduction

Malnutrition has always been a subject of concern. It covers both ends of the spectrum, going from undernutrition associated with nutrient deficiencies to overnutrition associated with obesity problems. Much research has been conducted on the economics of hunger and nutrient deficiency. It is well understood that chronic hunger results from extreme poverty when the income of poor households is too low to support an adequate diet. FAO has estimated that the number of undernourished in the world exceeds 800 million people (FAO, 2009). And 160 million people live in ultra poverty on less than 50 cents a day (Ahmed et al., 2007). In extreme situations, the purchasing power of the poor is below a minimal subsistence level, leading to starvation and death (e.g., Glomm and Palumbo, 1993; Sen, 1981). In less extreme situations, poverty can lead to insufficient food intake and nutrient deficiencies (including energy, proteins as well as micronutrients), with adverse effects on productivity and welfare (e.g., Dasgupta and Ray, 1986; Strauss and Thomas, 1998; Wheeler, 1980). Even if aggregate food production is sufficient to provide an adequate diet to every human on earth (e.g., Runge et al., 2003; Sachs, 2005), undernutrition problems persist especially in developing countries.

At the other extreme, malnutrition can come from excessive food intakes leading to obesity and health problems. Obesity issues are found in every country and are becoming more severe. The World Health Organization calls obesity a

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“global epidemic.” In the USA, the incidence of obesity has increased sharply over the last twenty years. More than 34 percent of U.S. adults are now obese; and the number of overweight children has doubled in the last decade (Anderson et al., 2003; Centers for Disease Control, 2010). Persons who are overweight face a higher risk of certain diseases (e.g., heart disease, high blood pressure, diabetes) and a loss of wages and productivity (e.g., Wada and Tekin, 2010). It has been estimated that the annual cost of obesity and overweight in the USA exceeds \$100 billion (Finkelstein et al., 2003; Wolf and Colditz, 1998).

Understanding malnutrition requires understanding food consumption behavior. The effects of prices and income on food consumption have been studied extensively. It is well understood that there is a minimal purchasing power below which a household cannot support an adequate diet for its members (e.g., Dasgupta and Ray, 1986; Glomm and Palumbo, 1993; Sen, 1981; Wheeler, 1980). It means that insufficient income is an important cause of hunger and undernutrition. However, while there are clear linkages between the rise in obesity and an increase in calorie intake (Bleich et al., 2008), the causes of overnutrition are complex (Rashad, 2006; Rosin, 2008). Lakdawalla and Philipson, 2009 have estimated that 40 percent of the recent growth in obesity is due to lowered food prices. This means that remaining 60 percent is due to other factors. These factors include the adoption of more sedentary lifestyle and a reduction in physical activities and calorie expenditures. Some have argued that an increased reliance on food away from home and fast food are also a contributing factor (Chou et al., 2004; Guthrie et al., 2002). Yet, it is not clear whether more “eating out” is a causal factor since restaurants can cook low-calorie food as easily as high-calorie food (Cutler et al., 2003). Finally, obese individuals are found in every socio-demographic group and at every income level (Centers for Disease Control, 2010; Richards and Patterson, 2006; Sundquist and Johansson, 1998; World Health Organization, 2000; Zhang and Wang, 2004). How can we explain the presence of malnutrition among the poor as well as the non-poor?

Rational individuals decide how much food to consume on the basis of tastes, prices and income, accounting for the anticipated future health consequences of their actions. Many factors play a role, including genetics, nutritional education, information as well as lifestyle. In general, weight control requires one to forego current consumption in order to gain future potential health benefits. Since there is extensive information on the relationship between health and nutrition, this suggests that individuals who become obese exhibit a high degree of “impatience”, their time preferences giving much more weight on the short-term reward of current food consumption compared to its longer-term health effect (Borghans and Golsteyn, 2006). This indicates that obesity is associated with heavy discounting of the future (Becker and Mulligan, 1997; Ehrlich and Chuma, 1990; Fuchs, 1991; Komlos et al., 2004; Smith et al., 2005; Zhang and Rashad, 2007).

This paper argues that heavy discounting of the future is a basic characteristic of malnutrition, including both overnutrition and undernutrition. To see that the argument applies to undernutrition, it suffices to note that starving individuals are not expected to be concerned about their longer-term future when starvation means imminent death. This means that hunger and starvation are expected to be associated with heavy discounting of the future. But such arguments lose their credibility under adequate nutrition. It means that the discounting of the future varies with the nutritional status of individuals. This creates a fundamental challenge to the standard economic model where discounting of the future is typically done at a constant rate (e.g., Deaton and Muellbauer, 1980; Samuelson, 1928). It indicates a need to consider situations where time discounting is endogenous (as it varies with nutrition) and examine its implications for individual behavior. Note that the argument that time discounting varies over time and across individuals is not new (e.g., Frederick et al., 2002). What is new in our analysis is the linkage between nutrition and time preferences. Our main contribution is to investigate the implications of such a linkage for individual behavior, investment incentives and capital accumulation. Like Becker and Mulligan (1997), our purpose is not to make ethical judgments about human decisions; rather it is to refine our understanding of individual behavior related to nutrition.

This paper takes a new look at the microeconomics of food consumption and nutrition. Consumer theory provides the foundation of the economics of food demand, especially the analysis of price and income effects in consumer behavior (e.g., Deaton and Muellbauer, 1980). Typically, the analysis is presented at the household level treated as the basic unit for decision making. Yet, nutritional status is an individual characteristic (e.g., nutritional achievements can vary among individuals within a household). This means that our analysis of the economics of nutrition is developed at the individual level.

We develop a dynamic microeconomic model of an individual making consumption/investment decisions over time. Building on the strong relationships existing between food consumption, nutrition and health,<sup>2</sup> we link the nutritional status of the individual with the way he/she discounts the future. As discussed above, we associate heavy discounting of the future with situations of significant malnutrition (either undernutrition or overnutrition). Arguing that time discounting varies with current food consumption, we challenge the adequacy of standard economic models that treat discounting as exogenous. This is done by developing a dynamic model under recursive (non-additive) preferences allowing for endogenous discounting. Associating malnutrition with heavy discounting of the future, we explore the implications for consumption and investment behavior. We demonstrate that nutritional considerations contribute to the concavity of the Engel curve (relating consumption with income). We show that obesity leads to a more inelastic consumer

<sup>2</sup> Note that research on the microeconomics of health is not new. For example, Grossman (1972, 2000) has investigated the demand for medical services as a derived demand for health. He argues that health capital differs from other kinds of human capital. Our analysis complements Grossman's analyses by investigating the joint determination of consumption and investment as they relate to food and malnutrition, with a special focus on the role of time preferences.

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