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# Off-farm work and capital accumulation decisions of farmers over the life-cycle: the role of heterogeneity and state dependence

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## Abstract

This paper analyzes two principal simultaneous decisions of farm operators: off-farm labor supply and farm capital investment. We first develop a theoretical model analyzing the effects of exogenous shocks on farmers' decisions. Then, we estimate jointly a multinomial probit model of farmers' off-farm labor supply and a switching regression model of farm capital, using a two-period panel data set from Israel. This method enables to account for both unobserved heterogeneity and structural state dependence. The results demonstrate that farm capital investments during the 1970s, which were enhanced by heavily subsidized credit, prevented farmers from seeking off-farm employment opportunities. © 2002 Elsevier Science B.V. All rights reserved.

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## 1. Introduction

Past research has found that off-farm income is critical to the welfare of rural households (Rosenzweig, 1988). In many developing countries and economies-in-transition worldwide, between one-third and one-half of farm households derive income from off-farm sources, and off-farm income constitutes between 20% and 70% of total household income (Adams, 2001; Benjamin, 1992; Newman and Gertler, 1994; Reardon

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et al., 2001; Rizov et al., 2000; Rosenzweig, 1980). The role of capital investments in the development process and in the transition from rural to industrial society has also been emphasized. Mundlak (1993, 2000), for example, claims that capital constraints are a major determinant of the rate of adoption of new technologies.

Moreover, the association between off-farm labor markets and farm capital has important policy implications. Labor market policy tends to spill over to the farm sector, while agricultural policy affects both rural and urban labor markets. Rosenzweig (1988, p. 759) advocated the use of longitudinal data to “provide an essential base for . . . model formulation aimed at integrating capital accumulation with labor allocation.” Yet we are not aware of previous literature that empirically considers the joint determination of these decisions at the farm level, and in a life-cycle setting.

Recognizing the endogeneity of capital stock in empirical analyses of off-farm work is particularly important in developing countries. In those economies, capital markets are less complete and farm capital is more determined by life-cycle accumulation and less by intergenerational transfers. For example, Reardon (1997) noted that off-farm income can increase farm capital accumulation if the family farm is subject to borrowing constraints. The results of Rosenzweig and Wolpin (1993, p. 241) imply that “increasing opportunities for members of farm households to obtain jobs that pay assured salaries may also increase the capital intensity of agricultural investments. . .” in India. In addition, Kada (1992) found that farm labor and farm capital are substitutes in Japanese rice farms. These results may be specific to land-scarce agricultural societies. Rizov et al. (2001) suggest that off-farm income may be more important than farm assets in reducing capital constraints, in the context of a transitional economy. Reardon et al. (1994) cite cases in which nonfarm income had the opposite effects on farm investments, depending on agro-climatic conditions.

The purpose of this paper is to propose an empirical strategy for the joint analysis of farmers’ decisions to participate in the off-farm labor market, and their investment in farm capital. These two significant decisions determine the growth of the farmer’s earnings by determining his life-cycle paths in terms of both human and physical capital. At the macro level, the decisions taken by many individual farmers are essential to the overall development of the agricultural sector and the economy as a whole (Timmer, 1988), with the resulting major policy implications. We formulate and estimate a finite-horizon life-cycle model that incorporates the major features of those factors influencing these decisions such as returns to ability, experience, and investments, and the effects of farm size and location. We illustrate this strategy with panel data on Israeli farmers from the 1970s. Israeli agriculture recorded a rapid transformation from the 1950s to the 1990s. The situation in the 1970s can be thought of as midway through the development process. Several aspects that were unique to Israel in the 1970s make the illustration useful for developing and transitional economies at the beginning of the 21st century. Moreover, the proposed empirical strategy can be used for a wide range of countries and applications.

In the rest of this introductory section we lay out and explain in detail how the paper is organized. In Section 2, we present an intertemporal optimization model for the family farm, in which off-farm labor supply and farm capital accumulation are jointly determined. We treat the two decisions as simultaneous, without assuming any particular causality between them. On one hand, farm capital and off-farm labor supply can move in the same

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