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In-farm diversity stabilizes return on capital in Argentine agro-ecosystems

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ABSTRACT

Agricultural production faces risks of various kinds caused by weather, pests, markets, and policy changes. Minimizing these risks is an ongoing objective of farmers. The diversification of activities and the selection of the most stable activities are frequently mentioned as potential stabilizing factors. The aim of this study is to determine the impact of diversification and selection of activities on economic stability over time in a set of farms located in the southwest of the Pampa Region, Argentina. We use the coefficient of variation of return on capital as indicator of economic stability. These farms routinely evaluate their economic performance through a shared methodology. We compiled a data set that included 366 annual productive and economic results for 82 farms in 7 years between 2000 and 2008. We analyzed the economic and yield results of these farms and of a set of simulated farms that differentially combined various activities. We found that a greater diversification of activities was associated with an increase of stability, measured by a reduction of the coefficient of variation of return on capital as diversification increased. This effect resulted from a significant increase of mean return on capital without changing the standard deviation as diversification increased. We also found significant differences in this indicator of economic stability of individual activities as a result of different combinations of variability in yields, prices and costs. Birth to slaughter livestock operation was much more economically stable than either cow-calf or fattening operations. Wheat was the most stable crop, corn was the least stable crop, and sunflower and soybean showed intermediate stability. Overall, livestock activities were more stable than agricultural crops. Simulated farms showed that more diversified combinations were economically more stable. The stability of the average real farm was very similar to the most stable farm simulation. This suggests that farmers in the study area have found in the diversification and selection of activities useful tools to reduce the economic risks they face.

1. Introduction

The success of agricultural production is strongly determined by many environmental and economic factors beyond the control of the farmer. Environmental factors such as floods, droughts, winds, and hail cause serious economic losses (Warrick, 1980). In the case of livestock grazing, long-lasting drought or floods may push farmers to the difficult choice between raising their costs to levels of bankruptcy or watching their animals die of starvation (Díaz-Solís et al., 2009). Economic factors, such as the sharp fluctuations in prices of inputs and outputs may also create instability in the economy of a farmer (Timmer, 1997). Epidemics of foot-and-mouth disease or the emergence of bovine spongiform encephalopathy may close markets in a matter of days. Political decisions, whether domestic, such as devaluations and changing export taxes, or international, such as suspending purchases of agricultural products may change the economy of farmers overnight.

Farmers deploy a variety of strategies to cope with these environmental and economic variations, stabilize farm income performance and reduce risks. For example, Vavra and Colman (2003) found that farmers in the United Kingdom chose their crops based not only on optimal benefit, but also on risk avoidance. Often, farmers buy insurance against weather-related disasters such as hail, fire, frost, wind and drought. They also trade both input and output products in futures markets, and carefully negotiate the conditions for purchases and sales. They often lower production costs, even giving up expectations of higher revenues (Ellis, 1993). All these strategies are common to any agricultural region, but they become critical and more expensive as the environmental conditions are less favorable (Di Falco et al., 2010a), and thus, the stability of each crop is lower, the insurance premiums are higher, and farmers seek other ways to ensure the survival of their businesses.

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Two strategies to stabilize farm income are diversification and selection of agricultural activities that are more secure and stable, yet not necessarily the most profitable (Berzsenyi et al., 2000). The stabilizing effect of the first strategy, diversification, is based on the assumption that different activities depend on different markets and are affected by the weather to varying degrees. Poor farmers in Africa and Asia look for different revenue sources to reduce risk (Ellis, 2000). Ethiopian farmers increased total production through crop diversification, particularly in drier areas (Di Falco et al., 2010a). Zentner et al. (2002), based on experimental plots, showed that a certain degree of crop diversification reduced economic risk for farmers in Western Canada. Viglizzo and Roberto (1998) showed that production of a set of farms in Argentina was more stable in those that carried out many activities (up to 6), including beef cattle and annual crops. Iiyama et al. (2007) found that some combinations of livestock and crops improved the income of farmers in a semiarid region of Kenya, and suggested that it might also increase their stability. This effect of diversification is comparable to the "portfolio effect" (Sharpe, 1970; Tilman et al., 1998), and it is more likely to act positively on stability as the response of different activities to the environment or the market is more contrasting. For example, in the Pampas region a year with a very dry and cold winter may be simultaneously unfavorable for wheat and livestock grazing, but it may be very favorable for corn and soybean if rainfall is abundant in summer. An increase in the cost of fertilizer could decrease the income of wheat and maize, but barely affect sunflower and soybean, and not affect livestock breeding at all. A sharp price fall in international oil markets may affect the returns of sunflower and soybean, but not alter the income of cereals and meat.

The second stabilizing strategy, the selection of activities inherently more stable, could be based on factors such as the higher drought tolerance of sunflower with respect to corn and soybean, or the relatively low variable costs in seeds and herbicides of wheat crop compared to corn and sunflower, which means less capital put at risk. It could also result from other more complex reasons, as in the case of livestock grazing (Viglizzo, 1986), which involves primary production and secondary processing of feed into meat or milk. This is an ongoing process throughout the year, which can absorb and compensate for relatively long periods of scarce resources through transfers of forage resources in time and space, or through the use of animal body reserves of energy and protein (Viglizzo and Roberto, 1998).

In the Southwest of the Pampas, Argentina, farm diversification is common. Crop yields and forage production for livestock are very unstable due to soil and climatic constraints. Economic conditions are also unstable due to the lack of consistent economic policies (Alesina et al., 1996). Thus, it is interesting to investigate whether farm diversification is a mechanism that stabilizes economic performance in the face of environmental and economic instability. Van Keulen (2006) emphasized the need for comparative studies to better understand the most important factors in complex agricultural systems and thus generate appropriate policies. In general, farm-level studies have focused on diversification as a means of increasing economic performance rather than on stabilizing it (Di Falco et al., 2010b; Iiyama et al., 2007; Villano et al., 2010). On the other hand, the few studies that focused on stability mostly concerned product yields and left aside the economic features that determine the stability of farms, such as the product prices, the costs, the resulting farm income, and the capital invested (Viglizzo and Roberto, 1998).

This paper analyzes the relationship between diversification and stability of yield and economic performance, based on information from real farms. The specific objectives are (1) to determine whether the different degree of diversification of activities carried out by a sample of farmers of Southwestern Pampa is related with the stability of return on capital, and (2) to determine if the selection of activities affects the stability of return on capital. We will test two hypotheses: (1) diversification of activities tends to offset climate and market fluctuations, so that production and return on capital is more stable in more diversified farms. (2) Some activities have more stable return on capital than others, which influences the stability of whole-farm return on capital.

2. Materials and methods

2.1. Study area

The study was based on information from farms located in the General La Madrid and Laprida Depression (SAGyP-INTA, 1990; Soriano, 1992), Southwest of Buenos Aires province and the Argentine Pampa. The area covers approximately 2 M ha between the Tandilia and Ventania hill systems. It is a vast flat plain between 130 and 200 m above sea level, part of the high basins of the Salado and Quequén rivers. Mean annual rainfall is 800 mm and mean annual temperature is 14 °C. At the landscape scale, there is a matrix of lowlands, with alkaline and poorly drained soils (typical natracuols), interspersed with small uplands, with better drained soils (typical argiudols and tapto-artic soils). These two landscape elements have contrasting agronomic capabilities, which limit both the productivity and feasibility of activities. Lowlands are always used for cow-calf operations on either natural grasslands or sown pastures of forage species best adapted to these soils. Uplands have been cropped since the beginning of the 20th century as part of a rotation with perennial pastures used for livestock fattening operations (Paruelo et al., 2006). The proximity between cow-calf lowlands and upland-based fattening livestock often fosters the implementation of birth to slaughter operations within a single farm. Thus, at the landscape scale, crops and livestock production coexist because lowlands are restricted to livestock and uplands are under either livestock or cropping production according to a rotation plan. Due to landscape structure and farm size, some farms are exclusively or nearly exclusively constituted by lowlands, but no farm is entirely constituted by uplands.

2.2. Data collection

We compiled a database of 366 yearly productive and economic results from 82 individual farms over 7 annual financial cycles between 2000–2001 and 2007–2008. The farms were members of a non-governmental organization, the Argentine Association of Consortia for Regional Agricultural Experimentation (AACREA). The database included, for each farm and each year, crop and livestock activities, area occupied by each activity, production, product prices, direct and indirect costs of each activity, farm income (revenues minus total costs), and total capital invested, which included land, all categories of livestock, and the capital required to carry out all annual activities. Fattening livestock and the capital required to carry out annual activities were included because the farms need to immobilize those resources for a year or more before they generate an income. In addition, that is how the farmers themselves consider the capital invested in their annual financial reports. Return on capital was calculated as the ratio between annual net farm income and capital invested. Economic data for different years were transformed to constant currency values (March 2009 Argentine pesos) according to the domestic wholesale price index published monthly by the National Statistics and Censuses Institute (INDEC, 2012).

The original database did not discriminate between birth to slaughter, cow-calf and fattening operations in terms of cost and production. Thus, we reached such discrimination through the fol-