Livelihood Disruption and Venture Creation:

Entrepreneurship as Technology Adoption

A Comparison between Kentucky and Shaanxi Farmers

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Abstract

In the US, The Tobacco Transition Payment Program, also called the "tobacco buy-out," helps tobacco quota holders and producers transition to the free market. In China, the transaction of Land Use Rights providing farmers' ability to buy or sell Land Use Rights has been seriously considered by the Chinese government. The uncertainty in household income and changes in economic environment during the US Tobacco Transition Payment Program and the Chinese Land Use Rights Regime lead many individuals into entrepreneurial activities. Entrepreneurship often means making changes in livelihood activities that involve substantial risks to income. While the rewards may be substantial, transactions costs may make decisions irreversible. This paper draws a comparison between entrepreneurship and technology adoption. Adopting a new production technology also involves substantial risks. The economics of technology adoption is a well developed literature with many accepted and testable models. Most prominent are the theories of learning by using and learning by doing.

We review the technology adoption literature, drawing out lessons for entrepreneurship research. We then apply an 'entrepreneurship as technology adoption' model to a unique dataset collected in Kentucky, US and in Shaanxi province, China. Using a sample of 702 Kentucky farmers at the time of the buyout and 730 Chinese farmers, we test several of the implications of this model and compare significant results between Kentucky and Shaanxi farmers.

This study finds that both farmers in Kentucky and Shaanxi with a strong social network are more likely to become entrepreneurs. Kentucky farmers with low

income are more likely to start new businesses. The finding supports the “push” hypothesis as farmers with low income are pushed into starting a new business. The human capital factor is strongly associated with Shaanxi farmer’s entrepreneurial decision.

1. Introduction

Starting a new business venture can involve a substantial change in work activities as well as substantial uncertainty and risk about the potential rewards and costs. Similarly a manager making a decision about whether or not to adopt a new and unfamiliar technology also faces substantial uncertainty regarding the potential costs and rewards, or how the new technology will affect the use of other inputs in the production process. By comparing the similarities in the act of venture creation and the adoption of a new technology, this paper seeks to introduce the entrepreneurship model, examine factors influencing entrepreneurial adoption decision and estimate the effect of internal family events on the decision to start a new business.

Drucker (1985) defines an entrepreneur as a person who looks out for any changes, responds to it and exploits the opportunity generated by the change. It may mean provision of a new business, new product or a new service. Entrepreneurship ranges from individual projects to major activities creating many job opportunities and may involve the entrepreneur either on a full-time or part-time basis. The potential entrepreneur succeeds if the venture makes a sustainable profit (in terms of money and enjoyment) relative to other employment or business opportunities forgone. In this sense, we can think of the potential entrepreneur as involved in the joint production of profit and enjoyment. The entrepreneur may produce profit and enjoyment through some current mix of production technology, or through an entrepreneurial technology. In this way, the considerations of venture creation can be directly compared to the technology adoption decision of a producer.

Noting the similarities between venture creation and technology adoption is important for two primary reasons. First, a long and well developed literature exists to examine the adoption and diffusion of new technologies (see Geroski (2000) for a review). This literature involves substantial rigor and much of it is devoted to empirical application and testing of candidate theories. This is in stark contrast to the literature on entrepreneurship which may be characterized as comprising many eclectic theories that are difficult to test and often supported only anecdotally. Secondly, technology adoption is an entrepreneurial activity. Thus, it is important to recognize this literature as contributing to our understanding of how entrepreneurship decisions are made and how policy may spur such activities in a way that promotes growth.

In demonstrating how the technology adoption literature may be applied to venture creation, we will employ two novel data sets consisting of a survey administered to tobacco farmers in Kentucky and Chinese farmers in Shaanxi province. The first survey collected detailed information on the socioeconomic background, entrepreneurial decision and attitude, livelihood disruption, ability levels and personality traits of the Kentucky farmer at the time of tobacco buyout. On October 22, 2004, President Bush signed the Fair and Equitable Tobacco Reform Act of 2004 (P.L. 108-357) which ended the tobacco quota program and established the Tobacco Transition Payment Program (TTPP), also called the "tobacco buyout". The TTPP helps tobacco quota holders and producers transition to the free market by providing annual transitional payments for 10 years to eligible tobacco quota holders and producers. Kentucky is one of the most tobacco-dependent states and Kentucky tobacco farmers are particularly vulnerable to changes in tobacco economy. Farmers faced a declining return to tobacco farming and, at the same time, received a large sum of money from the government (often a lump sum) potentially encouraging farmers to consider alternative livelihoods.

The entrepreneurship survey has also been carried out in Shaanxi province in November 2011. The second survey collected detailed information of the Chinese farmer on entrepreneurial decision and attitude toward the implementation of land use rights transaction in China. It is interesting to see what would happen if the Chinese government made it legal for farmers to buy or sell land use rights. By utilizing the survey data of 702 Kentucky tobacco farmers and 730 Shaanxi farmers, we can explore some of the determinants of entrepreneurial intention.

The rest of this paper proceeds as follows. First, we briefly review the literature on technology adoption, including some discussion of the most prominent models. Next we propose our own conceptual model of entrepreneurship based on the technology adoption literature and several hypotheses are derived. The data and methodology are formulated in the following section. Finally, the empirical results are presented and discussed.

2. Learning by Doing and Learning by Using

Economists have studied the effect of entrepreneurial activities and economic activities, such as trade and Foreign Direct Investment (FDI), on economic growth. It is believed that the outcome of technology adoption in those activities creates knowledge in human capital through learning and technology diffusion which increase productivity in the economy.

2.1 Leaning by Doing

Arrow (1962) and Lucas (1988), both suggest that technical change is the by-product of knowledge and experience gained in the production of goods. They call this process "*learning by doing*". The adoption of a new technology will lead to an initial change in productivity followed by some growth in productivity over time due to learning by doing.

Arrow (1962) suggested an endogenous theory of the changes in knowledge which cause inter-temporal shifts in production function. The acquisition of knowledge is usually called "learning" which is the product of experience. Learning takes place either during production or problem solving. According to the classic learning experiments, learning associated with repetition is subject to sharply diminishing returns. Thus, the stimulus situations must themselves be steadily evolving rather than simply repeating, in order to have steadily increasing performance. The role of experience in increasing productivity has been widely observed as the number of labor-hours expended in production is a decreasing function of the total number of output of the same type previously produced. Thus, there is a pronounced "learning curve" in production.

Accordingly, Arrow formulated the hypothesis that technical change in general can be ascribed to experience, that it is the activity of production which gives rise to problems for which favorable responses are selected over time. In his model, cumulative gross investment (cumulative production of capital goods) is an economic variable representing an index of "experience". Each new machine produced and put into use is capable of changing the environment in which production and learning takes place. To decide where the learning enters the production process, he assumed technical change is completely embodied in new capital goods. The amount of labor used in production and output capacity are functions of cumulative gross investment which affect an increase in total output and productivity.

Epple, Argote et al. (1996) study transfer across shifts at manufacturing facilities over time by analyzing whether knowledge acquired through learning by doing is cumulative and persists through time or whether it depreciates. The results suggest that knowledge acquired during the period of one-shift operation carried forward to both shifts of the two-shift regime. In addition, during the two-shift regime, most learning occurred on the first shift, and most knowledge acquired on the day shift was transferred to the second shift. Irwin and Klenow (1994) suggest that learning by doing in the semiconductor industry is limited and evidence on spillovers is nonexistent. Tsang (2002) uses a survey of 73 Singapore and 89 Hong Kong firms with respect to their joint venture set up in China to study channels of knowledge acquisition and finds that firms improve their skills of knowledge acquisition through learning by doing.

2.2 Learning by Using

Another form of learning introduced by Rosenberg (1982) is *" learning by using"* which is a function not of the experience involved in producing the product but of its utilization by the final user. Intuitively, producers have learned through use of consumers how to improve quality or lower maintenance and other operating costs.

Mukoyama (2006) employs a statistical model to formulate the idea of “learning by using” as a stochastic process. Capital goods (machine) producers learn from the experience of users which leads to improvement in machine quality over time. The improvement process approximately takes an exponential form, and produces an S-shape diffusion curve of machines when combine with the growth of demand due to improvement. It is found that when the initial quality of the machine is low, the dispersion of machine quality tends to increase first, and to decline as the machines diffuse.

Adler and Clark (1991) distinguished between first-order learning and second-order learning. The concept of learning by doing is similar to the first-order learning which is learning based on repetition and on the associated incremental development of expertise which makes direct workers more effective in executing the tasks assigned to them. While, the concept of learning by using is similar to the second-order learning which is learning created by production experience and by explicit managerial or engineering action to change the technology, the equipment, the processes or the human capital in ways that augment capabilities. They found that the learning effect can be as strong in very capital-intensive operations as in labor/materials-intensive operations, which suggests the importance of learning in capital.

MacLeod (1992) explores the role of capital-goods suppliers in the innovation and diffusion of technical change. She emphasizes the type of interaction between users and capital-goods suppliers by studying the British mechanical engineering industry in 19th century and writes "... it was often only through the medium of their capital-goods suppliers that information about a new technology was passed back and forth among users (p.287)".

McWilliams and Zilberman (1996) introduce learning by using into an adoption model to explain why larger and more educated firms adopt earlier. They integrate the concepts of adoption and diffusion by using Tobit analysis in the empirical estimation of time of adoption, which allows the diffusion of the technology to be derived from the time of adoption analysis. The study suggests that dynamic economies of scale arise in learning by using that speed up adoption.

3. Technology Adoption

Technology adoption is the decision by a producer to begin using a different production process in the hopes of obtaining a larger profit. Once a technology is introduced to the market, few may have any specific knowledge of how to use the technology correctly, or the levels of production that can be expected given a set of inputs. For example, studies have recently examined the adoption of genetically modified cotton seed in China (Wang, Just et al. 2008); (Huang, Rozelle et al. 2002). Huang et al. find that early adopters were highly successful in reducing input costs and increasing profits leading to rapid and widespread diffusion of the new technology. More prominent examples in the literature involve the adoption of irrigation technology (Koundouri, Nauges et al. 2006), large scale farm equipment (Rees, Briggs et al. 1984), or information technology (Williams and Rao 1997). Technology adoption can be represented by Diffusion Model and Threshold Model.

3.1 Diffusion Model

Technological change is a multistage process consisting of innovation, adoption and diffusion (Schmookler 1966). Once, the innovation is introduced, the technology adoption process takes time to complete. This process was the focus a many sociologists and economists. The early literature noted that plotting the rate of technology diffusion (the percent of those adopting) over time results in an S-shaped curve (see figure 1) (Griliches 1957; Davies 1979; Klepper and Graddy 1990). With an S-shaped diffusion curve, there is a relatively low adoption rate but with a high rate of change in adoption during an initial period, a period of introduction of a technology. The takeoff period is followed by a saturation period where diffusion rates are slow, marginal rate of diffusion decreases and the diffusion rate reaches a peak. In a final period, diffusion rate and marginal rate declines and the new innovation is replaced. Diffusion tends to be concentrated geographically around cities (Baptista 1998), potentially due to the greater visibility of early adopters.

Diffusion is often modeled using the function (see Sunding and Zilberman (2001)):

(1) $$P(t) = K[1 + e^{-(a+bt)}]^{-1}$$

where *P(t)* is the rate of diffusion at time t, and *K* is the equilibrium rate of diffusion, *a* reflects diffusion at the start of the estimation period, *b* is the growth rate of diffusion.

Based on epidemiological models, this early model of technology adoption is simple in that it does not offer any explanation of why technology is adopted. Rather the model only dictates a pattern of adoption over time. Early refinements were suggested by Quirmbach (1986) to make *K* a function of profit resulting from the new technology.

Mansfield (1963) modifies the diffusion model, supposing that diffusion is primarily a function of information transfer. His logistic curve based model is written implicitly as

$$\frac{m(t)}{n(t)-m(t)} = \frac{1}{1+e^{-(\gamma+bt)}} \quad (2)$$

where *m(t)* is the number of firms adopting at time *t*, *n(t)* is the total universe of firms, *b* is the growth rate of diffusion, and γ is an integration constant that positions the logistic curve on the time scale. Mansfield argues why the curve should be S-shaped. The profit from adopting new technology increases over time due to improvements in implementation of the technology, while the cost of adoption decreases, thus the rate of diffusion accelerates. Although, the Mansfield model can explain the S-shaped curve, it disregards differences between firms by assuming that all firms are identical. In addition, while Mansfield's arguments involve dynamic aspects of technology adoption (such as lowering costs and increased profits through experience with the new technology), the model itself excludes these factors.

3.2 Threshold Model

An alternative model is proposed by David (1969). His threshold model assumes that firms are heterogeneous, leading to different propensities to adopt a technology. Further, his model draws a distinction between adoption and the extent of adoption. He proposes two diffusion curves:

$$Y_t^1 = \frac{\int_{L_t^c}^{\infty} g(L)dL}{N} \tag{3}$$

$$Y_t^2 = \frac{\int_{L_t^c}^{\infty} Lg(L)dL}{\bar{L}}, \tag{4}$$

where, Y_t^1 is the share of farms adopting at time *t*, Y_t^2 is the share of total acres adopting the modern technology at time *t*, $L_t^c = F_t / \Delta\pi_t$ is cutoff farm size upon which adoption occurs, where F_t is fixed cost and $\Delta\pi_t$ is the profit differential per acre, *L* is farm size, *g(L)* is density of farm size, $N = \int_0^{\infty} g(L)dL$ is the total number of farms, $\bar{L} = \int_0^{\infty} Lg(L)dL$ is the total acreage.

The Threshold model potentially addresses learning-by-doing and learning-by-using. Learning-by-doing should cut the fixed costs of adopting a new technology ($\partial F_t/\partial t < 0$) through the accumulation of technology specific knowledge. Further, the profit differential between old and new technologies will grow over time ($\partial \Delta\pi_t/\partial t > 0$) because of learning-by-using as farmers will get more yields and save cost with more experience in the use of new technology. The dynamics of diffusion associated with the threshold model will lead to an S-shaped diffusion curve.

The threshold model applies in many cases where heterogeneity results from differences in farm size, land quality or human capital. David (1969) explains the adoption of grain harvesting machinery in the United States in the nineteenth century and argues that farm size is the main source of heterogeneity among farmers. He derives the minimum farm size required for adoption of various pieces of equipment. Just and Zilberman (1983) argue that adoption of new technology requires fixed costs associated with new machinery and a fixed investment of time for learning, locating and developing markets, and training hired labor. These fixed costs are more likely to discourage adoption by small farms and thus play a crucial role in the relationship of farm size and adoption. They suggest that risk attitudes and the stochastic relationship of returns per hectare under the traditional and modern technologies play an important role in determining the role of farm size in technology adoption.

4. Factors that might influence farmers considering creating a venture

Economists and sociologists have made extensive contributions to the literature on the adoption and diffusion of technological innovations in agriculture (see Feder, Just et al. (1985); Rogers (1995)). Such research typically focuses on the long-term rate of adoption and the factors that influence the adoption decision. The perceived or real characteristics of a new innovation are widely known to influence the adoption decision. Rogers (1995) hypothesizes five technology attributes that affect the rate of adoption: 1) relative advantage (i.e., profitability, initial cost, status, time savings, and immediacy of payoff over conventional practice); 2) compatibility (i.e., similarity with previously adopted innovations); 3) complexity (degree of difficulty in understanding and use); 4) trialability (i.e., ease of experimentation); and 5) observability (i.e., degree to which the results of the innovation are visible). These factors might also affect entrepreneurial adoption decision, for example; new venture expected profit over profit of current activity, ease of entrepreneurial activity and business process and observable profit and result of other entrepreneurs.

We draw an analogy between factors affecting technology and entrepreneurial adoption and investigate whether tobacco farmers are influenced by different factors when making decisions to enter entrepreneurship. Literature reported a number of determinants of entrepreneurial activities. In this section some of the determinants are reviewed.

4.1 Economic Factors, Farm Structure/Size

The technology adoption requires a large initial investment. Farmers use some of their own income and equity to finance at least part of their investments. However, low income, unemployment, fear of job loss, or dissatisfaction with the previous job are considered main "push" motives for entering entrepreneurship (Brockhaus 1980; Cromie and Hayes 1991). In addition, a basic hypothesis regarding technology transfer is that the adoption of an innovation will tend to take place earlier on larger farms than on smaller farms. Just, Zilberman et al. (1980) note that given the uncertainty, and the fixed transaction and information costs associated with innovations, there may be a critical lower limit on farm size that prevents smaller farms from adopting. As these costs increase, the critical size also increases. It follows that innovations with large fixed transaction and/or information costs are less likely to be adopted by smaller farms.

Kentucky farmers are particularly vulnerable to changes in the tobacco economy. Thus, many farmers have to adjust to the new economic conditions and are likely to experience the decrease of income. Income, land size, receiving a tobacco buyout check and availability of payment options may significantly correlate with technology and entrepreneurial adoption.

4.2 Human Capital

The ability to adapt new technologies for use on the farm clearly affects the adoption decision. Most adoption studies attempt to measure this trait through operator age, formal education, or years of farming experience (Fernandez-Cornejo, Beach et al. 1994). More years of education and/or experience is often hypothesized to increase the probability of adoption whereas increasing age reduces the probability. Younger farmers tend to have higher education and are often hypothesized to be more willing to adopt an innovation. Prior research indicates that educational level strongly correlates with self-employment. The difference in human capital (i.e. education and knowledge-based learning) may have a significant influence in entrepreneurial adoption.

4.3 Social network

The agricultural community may establish customs and other social and institutional arrangements for mutual help in technology adoption. Smaller farms may also increase their adoption because of social and government support. Individual who has a strong tie within social network and knows other entrepreneurs is more likely to start the new business.

4.4 Distance and geography

The role of distance and geography in technology adoption is emphasized in the social science literature on innovation (Rogers 1995). The emergence of a national media and the reduction in the cost of access that resulted from the establishment of railroads, the interstate highway system, and rural electrification is one of the reasons for the faster rate of technological adoption in the US. Producers living farther away from a regional center are likely to adopt technologies and new venture later.

4.5 Tenure

Land ownership is generally believed to encourage adoption of technologies associated with land. While several empirical studies support this hypothesis, the results are not consistent and the subject has been widely debated. For example, Bultena and Hoiberg (1983) find that land tenure had no significant influence on adoption of conservation tillage. The apparent inconsistencies in the empirical results are due to the nature of the innovation. Land ownership is likely to influence adoption if the innovation requires investments tied to the land. Apparently, tenants are less likely to adopt these types of innovations because they perceive that the benefits of adoption will not necessarily accrue to them.

4.6 Demographic factors

Demographic factors include age, ethnicity, and the changes in regular family structure such as death and divorce significantly correlate with entrepreneurial intention.

Hypotheses

Along with previous studies, the hypotheses of factors affecting entrepreneurial adoption decision are formulated as follows;

Economic factors

H1: Low income can “push” individuals into starting new businesses.

H2: Farm size is strongly correlated with entrepreneurial intentions.

Human capital

H3: Education level, computer and internet access significantly affect entrepreneurial intentions.

Social network

H4. Social group participation significantly correlates with entrepreneurial intentions.

H5: knowing people who started their own business significantly affects entrepreneurial intentions.

Distance and geography

H6: Urban community and distance from university or college are significantly correlated with entrepreneurial intentions.

Tenure

H7: Rent (acres of land that farmers rent) significantly correlates with entrepreneurial intentions.

Demographic factors

H8: age, white (race of farmers in Kentucky), death and divorce are strongly correlated with entrepreneurial intentions.

List of the dependent and independent variables as well as survey questions is shown in Table 1.

5. A Conceptual Model of Entrepreneurship

Studies of technology adoption behavior focus on factors that affect if and when a particular individual will begin utilizing an innovation. The purpose of this study is to identify the determinants of entrepreneurial adoption decisions. This section sets out a simple model of an individual farmer's decision of whether or not to participate in entrepreneurial activity that we use to guide our empirical work. We modify the threshold models that focus on studies of the adoption behavior of individual farmers and a search for sources of heterogeneity. In the existing approach, the dependent variables denote whether or not certain technologies are adopted by a farm product or unit at a certain period, and econometric techniques like logit or probit are used to explain discrete technology choices. Similarly, the dependent variables in our model denote whether or not entrepreneurial activities are adopted by tobacco farmers at the time after the tobacco buyout program in 2004 and by Shaanxi farmers, and a bivariate probit model is applied to explain binary entrepreneurial choices.

Adoption behavior is depicted by a discrete choice, whether or not to start new business, and a continuous choice, how much time or resources to devote to the new activity. Formally, we suppose that adoption of entrepreneurship depends both on the profitability of current ventures versus potential entrepreneurial ventures, and the degree of learning by doing. Here heterogeneity in learning by doing, or knowledge generated by direct or indirect experience, is determined by the degree to which the individual is connected to an entrepreneurial social network. Formally, let *S* be the degree to which an individual is integrated into a network of individuals or institutions that have created ventures. Consider an individual facing a choice between continuing in their current employment and earning π_0, or starting an entrepreneurial activity and earning some random profit π_e with some known distribution. The individual thus will solve

$$(5) \qquad max_{t\in[0,1],T} U\big(\pi_0(\theta,(1-t),T)\big) + EU(\pi_e|S,\theta,t,T),$$

where *t* is the percentage of working time devoted to the entrepreneurial activity, *T* is leisure time, *U* is a standard utility of wealth function, θ are personal and property characteristics that can influence one's ability to obtain profit in either activity (e.g., education, location, etc.) and $EU(\pi_e|S,\theta,t,T) = \int_{-\infty}^{\infty} U(\pi_e) f\,(\pi_e|S,\theta,t,T) d\pi_e$, is the subjective expected utility of profit in the new venture given the degree of learning by doing, the personal characteristics and the time devoted to the new activity. Learning by doing may raise both the mean and lower the variation associated with π_e, as the individual obtains specific knowledge not only about how to begin and run one's own venture, but also learns more about the potential market for new products or services. Thus, $\partial EU(\pi_e|S,\theta,t,T) \,/\, \partial S > 0$. Denote total time $\bar{T} = \lambda t + (1-\lambda)T$, where $\lambda \in [0,1]$. Three possible solutions exist for (5). The first order conditions for an internal solution to (5) is given by

$$(6) \qquad -U'\big(\pi_0(\theta,(1-t),T)\big)\pi_{02} + \int_{-\infty}^{\infty} U(\pi_e) f_t\,(\pi_e|S,\theta,t,T) d\pi_e = 0,$$

where π_{02} is the derivative of profit in the initial activity with respect to time devoted to that activity, and f_t is the derivative of the probability density function of profit for the new activity with respect to time devoted to this activity. Equation (6) will imply the optimum if (6) can hold for some $t \in (0,1)$. Alternatively, the individual will not engage in entrepreneurship if

$$(7) \qquad -U'\big(\pi_0(\theta,1,T)\big)\pi_{02} + \int_{-\infty}^{\infty} U(\pi_e) f_t\,(\pi_e|S,\theta,0,T)d\pi_e < 0,$$

where (7) is the first order condition with time in entrepreneurship replaced with 0. The individual will completely abandon the old activity if

$$(8) \qquad -U'\big(\pi_0(\theta,0,T)\big)\pi_{02} + \int_{-\infty}^{\infty} U(\pi_e) f_t\,(\pi_e|S,\theta,1,T)d\pi_e > 0,$$

and if $$EU(\pi_e) > U(\pi)$$

where now time in entrepreneurship has been replaced with 1. Thus, the degree to which one is socially connected to entrepreneurship will both increase the likelihood of being an entrepreneur, and increase the probability of abandoning other activities altogether. Further, factors that decrease the profitability of the old activity will increase the likelihood of entering entrepreneurial ventures. For this reason we expect an event such as the tobacco buyout and land use rights transaction to spur new entrepreneurship at some level.

A bivariate probit model was used in both Kentucky and Shaanxi cases. First, consider a rational farmer in Kentucky that seeks to maximize the present value of benefits from tobacco production and expected benefits from a new business venture.

Two decisions were made by the same Kentucky farmer and those two decisions are interrelated. First, the Kentucky farmer has to decide whether or not to continue growing tobacco and second, the farmer decides whether or not to engage in entrepreneurial effort. The time devoted to a tobacco farm and new venture is subject to a utility maximization of both tobacco farm profit and new venture expected profit as in equation (5). The probability of quitting tobacco farming is determined by the livelihood disruption of a tobacco buyout program and characteristics of farmers which affect a tobacco producer's profit. While, the likelihood to engage in entrepreneurship is determined by farmers characteristics as well as social network which affect an expected profit of new venture.

Farmers are assumed to make adoption decisions based upon an objective of utility maximization. The first term in equation (5) can be represented as a utility maximization of tobacco farm profit;

(9) $$U_i^* = U(\pi_{0i}(\theta_i, (1 - t_i), T_i; u_i))$$

where U_i^* is a maximized utility function of Kentucky farmer *i* growing tobacco farm, U_A is an alternative activity. Denoting z_i as the observed binary variable of farmer *i* equal to 1 if a farmer does not plan to raise tobacco in the future, otherwise, it equals to 0, we have:

(10) $$z_i = \begin{cases} 1 \; if \; U_i^* \leq EU(\pi_{ei}|S_i, \theta_i, t_i, T_i), U_A \\ 0 \; if \; U_i^* > EU(\pi_{ei}|S_i, \theta_i, t_i, T_i), U_A \end{cases}$$

Farmers evaluate whether or not to quit tobacco farm. When the discounted expected benefits of adoption (entrepreneurial activities) are greater than the benefits of tobacco farming, the new venture will be adopted.

The second term in equation (5) can be represented as an expected utility maximization of entrepreneurial profit;

(11) $$EU_i^* = EU(\pi_{ei}|S_i, \theta_i, t_i, T_i; \varepsilon_i) = \int_{-\infty}^{\infty} U(\pi_e) f(\pi_e| S_i, \theta_i, t_i, T_i; \varepsilon_i) d\pi_e$$

where EU_i^* is an expected maximized utility function of Kentucky farmer *i* engaging in new venture. The farmer *i* makes a decision whether or not to start a new business, regardless of quitting tobacco farm. The observable choices are y_i equal to 1 if farmer *i* plan to start a new business and 0 otherwise.

(12) $$y_i = \begin{cases} 1 \; if \; EU_i^* > U(\pi_{0i}(\theta_i, (1-t_i), T_i)), U_A \\ 0 \; if \; EU_i^* \leq U(\pi_{0i}(\theta_i, (1-t_i), T_i)), U_A \end{cases}$$

His expected profit of new venture compared to benefits from tobacco production affect decision whether or not to engage in entrepreneurship.

Net benefits U_i^* and EU_i^* are assumed to be random functions of vectors of exogenous variables X_1 and X_2, respectively,

(13) $$U_i^* = X_{1i}\beta_1 + u_i \qquad EU_i^* \cong X_{2i}\beta_2 + \varepsilon_i$$

where u_i and ε_i are random errors assumed to be independently and normal distributed with zero mean and variance one. β_1 and β_2 are vectors of unknown parameters.

The system of equations (10) and (12) should be estimated using a bivariate probit procedure. This is because when the random factors affecting the two decisions are not independent because of unobserved factors that could affect both decisions, then $corr(\varepsilon_i, u_i) = \rho$. In this case, the disturbances of the two selection equations (10) and (12) have a bivariate normal distribution with mean vector zero and covariance matrix $\Sigma = \begin{bmatrix} 1 & \rho \\ \rho & 1 \end{bmatrix}$ (Hausman and Wise 1978). A joint (simultaneous) decision model with a four way classification of observations into the following groups would result: $(z_i = 1,\ y_i = 1)$, $(z_i = 1,\ y_i = 0)$, $(z_i = 0,\ y_i = 1)$ and $(z_i = 0,\ y_i = 0)$. This four-way grouping of observations with a nonzero ρ leads to a bivariate model with the probabilities of the four outcomes;

(14) $P_{zy} = \Pr(z_i = 1, y_i = 1)$

$$= \Phi_2[EU(\pi_{ei}|S_i, \theta_i, t_i, T_i) - X_{1i}\beta_1,\ X_{2i}\beta_2 - U(\pi_{0i}(\theta_i, (1 - t_i), T_i)), \rho]$$

(15) $P_{zo} = \Pr(z_i = 1, y_i = 0)$

$$= \Phi\big(EU(\pi_{ei}|S_i, \theta_i, t_i, T_i) - X_{1i}\beta_1\big) - \Phi_2[EU(\pi_{ei}|S_i, \theta_i, t_i, T_i) - X_{1i}\beta_1,\ X_{2i}\beta_2$$
$$- U(\pi_{0i}(\theta_i, (1 - t_i), T_i)), \rho]$$

(16) $P_{oy} = \Pr(z_i = 0, y_i = 1)$

$$= \Phi(\ X_{2i}\beta_2 - U(\pi_{0i}(\theta_i, (1 - t_i), T_i)) - \Phi_2[EU(\pi_{ei}|S_i, \theta_i, t_i, T_i)$$
$$- X_{1i}\beta_1,\ X_{2i}\beta_2 - U(\pi_{0i}(\theta_i, (1 - t_i), T_i)), \rho]$$

(17) $P_{oo} = \Pr(z_i = 0, y_i = 0)$

$$= 1 - \Phi\big(EU(\pi_{ei}|S_i, \theta_i, t_i, T_i) - X_{1i}\beta_1\big) - \Phi\Big(\ X_{2i}\beta_2 - U(\pi_{0i}(\theta_i, (1 - t_i), T_i)\Big)$$
$$- \Phi_2[EU(\pi_{ei}|S_i, \theta_i, t_i, T_i) - X_{1i}\beta_1,\ X_{2i}\beta_2 - U(\pi_{0i}(\theta_i, (1 - t_i), T_i)), \rho]$$

where $\Phi(.)$ and $\phi_2(.)$ are the cumulative density function of the standard normal distribution and the standard bivariate normal distribution with correlation coefficient ρ, respectively. Equation (10) and (12) allow us to derive several testable implications, and set out the determinants of entrepreneurial intention.

Similarly, the above model is also applied with Shaanxi farmers who seek to maximize the present value of benefits from farm production and expected benefits from a new business venture. Two decisions were made by the same Shaanxi farmer and those two decisions are interrelated. First, the Shaanxi farmer has to decide whether or not to buy or sell land use rights and second, the farmer decides whether or not to engage in entrepreneurial effort.

The first term in equation (5) can be represented as a utility maximization of farm profit; where U_i^* is a maximized utility function of Shaanxi farmer *i* growing crop farm, U_A is an alternative activity. Denoting z_i as the observed binary variable of farmer *i* equal to 1 if a farmer plan to sell land use rights, otherwise, it equals to 0. The model structure of Shaanxi farmers also follows equation (10) – (17). Finally, we are able to compare entrepreneurial results between Kentucky and Shaanxi farmers.

6. Dataset and Survey

The unique data for this study were collected through a survey from two regions. The first survey was conducted in Kentucky from the summer of 2005 through the fall of 2006 which is the time that tobacco farmers received their first buyout checks. During this period, tobacco farmers adjusted to the new environment and decided whether to involve in the entrepreneurial activities. Seven hundred two individuals in Kentucky were surveyed. 101 farmers planned to start new business; 568 farmers did not plan to start new business. Approximately 45 percent of farmers in both groups had income in the range of $30,000 – $79,999. The majority in both groups owned or rented the land size of less than 499 acres and finished college education. In addition, about 80 percent of tobacco farmers in both groups participated in social groups.

The similar farm household survey was conducted in Shaanxi province, Yangling district in November 2010. Each household was interviewed by either one or two graduate students from Northwest Agriculture and Forestry University. The survey itself dealt exclusively with entrepreneurial intention, attitude and transaction of land use rights. We specifically asked farmers if the Government made it legal for farmers to buy or sell land use rights, would you buy or sell land use rights?, and are you planning to start a new business?

The characteristics of these communities are as follows. On average there are about five people living in each household. The average farm size is 5mu (about 5/6th of an acre). Household income average is $23,796 RMB/year with approximately 41 percent of household income coming from farm activities. There are 295 farmers or about 41 percent who plan to start new business. Of all 730 farmers, there are 210 farmers who want to sell land use rights; 240 farmers want to buy land use rights and 280 farmers want to do nothing. Approximately 60 percent of Shaanxi farmers personally know people who started their own business in a community or elsewhere but only 16 percent of Shaanxi farmers participate in social groups.

7. Results

Using bivariate probit specification, a maximum likelihood was used for estimation. Estimates are exhibited in Table 2. Both rhos are significant at 10 percent, indicating that a bivariate probit model rather than two univariate probit is more appropriate.

In Kentucky, six variables have a significant relation with the decision of whether or not entrepreneurial activities are adopted. The income less than $29,999 is significant at 5 percent indicating farmer with low income is more likely to start a new business. This finding supports hypothesis H1 and the “push” hypothesis as farmers with low income are pushed into starting a new business. The result is consistent with the study by Pushkarskaya (2008) stating that low income significantly correlates with entrepreneurial intentions. Pushkarskaya found that farmers with household incomes less than $29,999 were two times more likely to start a new business than farmers with incomes greater than $30,000.

Knowing people who started their own business in a community has a positive relationship to the entrepreneurial decision, which supports hypothesis H5. The coefficient is positive and significant at 10 percent. Farmers who know other entrepreneurs are more likely to be supported in entrepreneurial activities in a community. Individuals will transfer business know-how, experience, expertise and advanced technology to each other which encourage learning and increase knowledge in human capital and thus productivity growth. However, participation in any social groups in their community has no significant influence on the farmer’s adoption decision.

Age of farmer is related to entrepreneurial decision. Farmers with ages under 54 are the most entrepreneurial adopter. Concerning ethnicity and livelihood disruption, results show that white farmers and farmers who experience death in their household within the last three years are more likely to create a new venture.

However, divorce within the last three years is not significantly correlated with entrepreneurial intentions.

In Shannxi, factors that are strongly associated with entrepreneurial decision are age, social network and human capital. Similar results have shown in Shaanxi study. Shaanxi farmers with ages under 54 are the most entrepreneurial adopter. Younger farmers are more likely to become entrepreneurs and take more risk relative to older farmers. In addition, social network is an important factor related to new business adoption. Shaanxi farmers who know other entrepreneurs are more likely to start entrepreneurial activities. Again, participation in any social groups in their community has no significant influence on the farmer's adoption decision.

Human capital is another factor affecting Shaanxi farmer's decision but it is not supported in Kentucky study. Shaanxi farmers who have a computer at home are more likely to start new business. However, income, death in a family and divorce are not significantly correlated with Shaanxi farmer's entrepreneurial decision.

It is interesting to note that tenure variable considered in this study have no significant influence on both Kentucky and Shaanxi farmer's entrepreneurial adoption decision.

8. Conclusions

The purpose of this paper is to compare the similarities of venture creation and the adoption of a new technology and investigate the factors influencing farmers' entrepreneurial adoption decision during the transition period of the local economy in Kentucky and Shaanxi. In general, decision-makers select technologies with the best-expected net benefits. Therefore, when a new technology is available decision-makers continuously evaluate whether or not to adopt; when the discounted expected benefits of adoption are greater than the cost, the technology will be adopted. Similarly, when the expected profit of new venture is greater than current activities, decision-makers will start new businesses.

Using the 2005-2006 survey data of tobacco farmers in Kentucky and the 2010 survey data of farmers in Shaanxi, the study shows that several factors have a significant impact on farmers' entrepreneurial intentions.

Social network factor is significantly associated with farmer's entrepreneurial decision both in Kentucky and Shaanxi. Farmers who know other entrepreneurs are more likely to start new business. Social relations play an important role in establishing a firm. The study suggests that knowing people who are entrepreneurs affect entrepreneurial intentions. Information from other entrepreneurs is similar to "learning by doing" in technology adoption. The relationship between entrepreneurs provides the resources that are crucial in starting and sustaining a new business. Even though, entrepreneurs have ability to run their business successfully, they also need complementary resources to produce and deliver their goods and service (Teece 1987). Thus, they need support, knowledge and access to distribution channels through social network. Moreover, the link and the interaction among entrepreneurs and their social network can enlarge the availability of resources that help maintain a new firm (Hansen 1995). However, participation in social groups in the community appears to have no impact.

The adoption decision depends on the age of farmer. Younger farmers both in Kentucky and Shaanxi are more likely to adopt venture. This is consistent with previous studies indicating that increasing age reduces the probability of adoption.

However, some adoption factors are statistically significant in one region but not significant in another region. The analysis illustrates that the livelihood disruption such as death of the household member and ethnicity strongly influence a decision to start a new business in Kentucky but not in Shaanxi. The analysis in Kentucky supports the hypothesis that farmers with low income are “pushed” into entrepreneurial activities. In contrast, a human capital factor is strongly associated with Shaanxi farmer’s entrepreneurial decision. Research findings suggest that the policy maker should support entrepreneurial social network. The human capital development is very important to encourage entrepreneurial activities and opportunities especially in developing countries.

Figure 1: A Typical Diffusion Curve

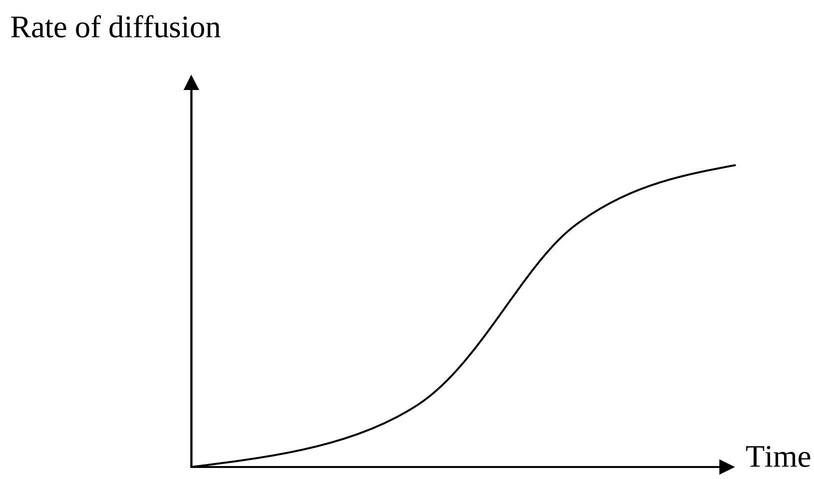

Table 1: List of the dependent and independent variables

Kentucky

Variables	**Survey questions**	**Coding**
Dependent Variable Technology adoption (start business)	Are you planning to start a new business?	1, if yes, 0 o/w
Independent Variable Economic factor		
Income	What is your household income?	
Income 1 Less than $29,999		1, if yes, 0 o/w
Income 2 $30,000-$79,999		1, if yes, 0 o/w
Income 3 $80,000-$119,999		1, if yes, 0 o/w
Income 4 More than $120,000		1, if yes, 0 o/w
Land size (own + rent)	How many acres do you own? How many acres do you rent?	
Land size Less than 499 acres		1, if yes, 0 o/w
Buyout check	What is the total $ amount you expect to receive in tobacco buyout check?	
Payment options	There were several payment options available for those who were to receive tobacco buyout checks. Which option did you choose?	1, if a single lump sum payment, 0 o/w
Independent Variable Human capital		
Education	What is your level of education?	1, if no high school education, 2, if high school education; 3, if college education, 4, if graduate education.
Computer	Do you have a computer at home?	1, if yes, 0 o/w
Internet access	Do you have internet access from you home?	1, if yes, 0 o/w

Independent Variable **Social network**		
social group participation	Do you belong to any social groups in your community (e.g., religious, service, clubs, etc.)?	1, if yes, 0 o/w
Knowing people who started their own business	Do you personally know people who started their own business in your community or elsewhere>	1, if yes, 0 o/w
Independent Variable **Distance and geography**		
rural or urban community	Would you describe the community you live in as rural, urban or suburban?	1, if urban, 0 o/w
distance from university or college	How far is the closest school from you home?	1, if less than 50 miles, 0 o/w
Independent Variable **Tenure**		
Own vs rent	How many acres do you own? How many acres do you rent?	1, if rent (acres) is greater than own (acres), 0 o/w
Independent Variable **Demographic**		
Age <35	What is your age?	1, if <35, 0 o/w
Age 35-54		1, if 35-54, 0 o/w
Age 55-64		1, if 55-64, 0 o/w
Age >64		1, if >64, 0 o/w
Ethnicity	What is your ethnicity?	1, if white, 0 o/w
Death	Have you experience death in your household within last three years?	1, if yes, 0 o/w
Divorce	Have you experienced divorced within last three years?	1, if yes, 0 o/w

Selection model

Variables	Survey questions	Coding
Dependent Variable Quit tobacco	Have you raised tobacco during last three years? Do you plan to grow tobacco in the future?	1, if had grown tobacco in the past three years, but does not plan to grow tobacco in the future, 0 o/w
Independent Variable		
The independent variables in a selection model include all independent variables in the main model plus the following variables;		
Business climate	In general, how would you describe the current business climate for farmers in your area compared to last year?	1, if getting better 0, if about the same -1, if getting worse
Tobacco acres	How many acres of tobacco did you raise last year?	
Tobacco sell	How many pounds of tobacco did you sell last year?	
Hay	Which of the farm activities listed below are you involved in?	1, if hay, 0 o/w
Beef	Which of the farm activities listed below are you involved in?	1, if beef, 0 o/w
Horses	Which of the farm activities listed below are you involved in?	1, if horses, 0 o/w
Vegetables	Which of the farm activities listed below are you involved in?	1, if vegetables, 0 o/w
Grains	Which of the farm activities listed below are you involved in?	1, if grains, 0 o/w

Shaanxi

Variables	Survey questions	Coding
Dependent Variable Technology adoption (start business)	Are you planning to start a new business?	1, if yes, 0 o/w
Independent Variable Economic factor		
Income	What was the total household income in the past year from all sources including farming, part time labor and remittances (best guess)?	
Land size (own + rent)	How many mu do you own? How many mu do you rent?	
Land size Less than 6 mus		1, if yes, 0 o/w
Independent Variable Human capital		
Education	What is your level of education?	0, if never went to school, 1, if some elementary school, 2, if completed elementary school, 3, if some middle school, 4, if completed middle school, 5, if some high school, 6, if completed high school, 7, if some university or college, 8, if completed college or university
Computer	Do you have a computer at home?	1, if yes, 0 o/w
Internet access	Do you have internet access from you home?	1, if yes, 0 o/w
Independent Variable Social network		
social group participation	Do you belong to any social groups in your community (e.g., religious, service, clubs, etc.)?	1, if yes, 0 o/w
Knowing people who started their own business	Do you personally know people who started their own business in your community or elsewhere>	1, if yes, 0 o/w
Independent Variable Distance and geography		
none		
Independent Variable Tenure		
Own vs rent	How many mu do you own? How many mu do you rent?	1, if rent (acres) is greater than own (acres), 0 o/w
Independent Variable Demographic		
Age <35	What is your age?	1, if <35, 0 o/w
Age 35-54		1, if 35-54, 0 o/w
Age 55-64		1, if 55-64, 0 o/w
Age >64		1, if >64, 0 o/w
Death	Have you experience death in your household within last three years?	1, if yes, 0 o/w
Divorce	Have you experienced divorced within last three years?	1, if yes, 0 o/w

Selection model

Variables	Survey questions	Coding
Dependent Variable Sell land use rights	If the Government made it legal for farmers to buy or sell land use rights, I would buy or sell land use rights?	1, if sell land use rights, 0 if buy land use rights
Independent Variable		
The independent variables in a selection model include all independent variables in the main model plus the following variables;		
Business climate	In general, how would you describe the current business climate for farmers in your area compared to last year?	1, if getting better 0, if about the same -1, if getting worse
Corn	Please list the top five crops you have grown in the past 12 months and sales in order of revenue	1, if corn, 0 o/w
Wheat	Please list the top five crops you have grown in the past 12 months and sales in order of revenue	1, if wheat, 0 o/w

Table 2: Bivariate Probit Estimate of Entrepreneurial Adoption Decision

	Bivariate Probit (Outcome equation)				
	Kentucky	**Shaanxi**		**Kentucky**	**Shaanxi**
	b/se	**b/se**		**b/se**	**b/se**
entrepreneur					
low income	0.484**	0.022	know entrepreneurs	0.290*	0.325***
	(0.2201)	(0.1649)		(0.1573)	(0.1181)
medium income	0.033	-0.118	urban	0.104	
	(0.1742)	(0.1496)		(0.1563)	
high income	0.108	0.124	distance	0.107	
	(0.2009)	(0.1668)		(0.2035)	
land	0.163	-0.132	rent	-0.068	-0.158
	(0.1270)	(0.1078)		(0.1628)	(0.2658)
buyout checks	-0.000		age<35	0.402*	1.824***
	(0.0000)			(0.2324)	(0.2984)
payment option	0.288		age35-54	0.464**	0.884***
	(0.1947)			(0.1863)	(0.2561)
education	0.123	0.030	age55-64	0.260	0.004
	(0.1423)	(0.0324)		(0.1935)	(0.2703)
computer	0.064	0.651***	white	-0.525**	
	(0.1727)	(0.2445)		(0.2237)	
internet	0.100	-0.186	death	0.313**	0.034
	(0.1443)	(0.2806)		(0.1261)	(0.1460)
social group	-0.142	-0.056	divorce	0.214	-0.331
	(0.1743)	(0.1443)		(0.2048)	(0.2852)
			constant	-1.650***	-1.296***
				(0.3137)	(0.3058)

Note: *p<0.1; **p<0.05; ***p<0.01

Bivariate Probit (Selection equation)

	Kentucky	Shaanxi		Kentucky	Shaanxi
	quit tobacco	sell LUR		quit tobacco	sell LUR
	b/se	b/se		b/se	b/se
low income	-0.161	-0.160	white	0.166	
	(0.2504)	(0.1587)		(0.3036)	
medium income	-0.122	-0.117	death	0.181	-0.014
	(0.1908)	(0.1455)		(0.1391)	(0.1483)
high income	0.111	-0.021	divorce	0.241	-0.079
	(0.2095)	(0.1621)		(0.2252)	(0.2064)
land	0.123	-0.014	business climate	-0.516***	-0.074
	(0.1516)	(0.1079)		(0.1400)	(0.0801)
buyout checks	0.000		tobacco acres	-0.001	
	(0.0000)			(0.0032)	
payment option	0.329		tobacco sell	-0.000	
	(0.2042)			(0.0000)	
education	0.259	0.071**	hay	0.292*	
	(0.1621)	(0.0314)		(0.1748)	
computer	-0.046	0.256	beef	0.556***	
	(0.1783)	(0.2449)		(0.1799)	
internet	0.061	-0.049	horses	0.146	
	(0.1490)	(0.2773)		(0.1780)	
social group	0.522***	-0.070	veget	-0.112	
	(0.1946)	(0.1479)		(0.2078)	
know entrepreneurs	0.039	0.019	grains	0.084	
	(0.1614)	(0.1167)		(0.1344)	
urban	-0.103		corn		0.091
	(0.1781)				(0.1490)
distance	0.626**		wheat		-0.215
	(0.2862)				(0.1311)
rent	0.090	-0.318	constant	-3.218***	-0.769**
	(0.1766)	(0.2806)		(0.4832)	(0.3166)
age<35	0.028	0.199	athrho	0.196*	0.111
	(0.2508)	(0.2685)		(0.1013)	(0.0709)
age35-54	-0.185	0.036	rho	0.1938	0.1106
	(0.1951)	(0.2350)		(0.0975)	(0.07)
age55-64	-0.026	0.059	Log Likelihood	-494.3992	-784.0258
	(0.1916)	(0.2478)	N	692	690

Note: *p<0.1; **p<0.05; ***p<0.01

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