Off-Farm Income and Risk Reduction in Agriculture: When Does It Matter?

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Abstract: Investment behavior is analyzed using a dynamic portfolio model including off-farm income. The correlation structure of off-farm income and asset returns and the ratio of off-farm income to wealth is shown to affect portfolio choice. Empirical analysis indicates that off-farm income tends to increase farm assets.

JEL classification: D51, D52, G12, J30

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1. Introduction

Farm households in developed countries receive a substantial part of their income from nonfarm sources such as wage income, nonfarm businesses and professional services. In the U.S., for example, income from off-farm sources accounted for 46% of income of all farm households in 1986 (Ahearn and Lee, 1991). Some of the other studies documenting the importance of off-farm income have been Fuller (1991, for Canada), Gebremehdin (1991, for Louisiana in the U.S.), Huffman (1991, for Canada and the U.S.), Rabinowicz (1992, for Sweden) and Spitze and Mahoney (1991, for Illinois in the U.S.).

The diversification of income sources of the traditional farm household has been seen to be part of the overall process of the movement of labor resources out of agriculture in developed countries (Huffman, 1991). Off-farm employment has also been an viewed as an important means of maintaining parity of incomes between farm households and nonfarm households (Ahearn, Johnson and Strickland, 1985; Gardner, 1992; Tweeten, 1991). Furthermore, off-farm income may also serve to stabilize total household income. This observation has been made by many researchers including Ahearn and Lee (1991), Fuller (1991), Gebremehdin (1991), Spitze and Mahoney (1991) and Bartlett (1991). Nevertheless, the economic consequences of risk reduction achieved through off-farm employment have largely been ignored in the literature with the exception for Sumner (1982).

The objective of this paper is to follow up on Sumner's (1982) observations by examining the implications on the investment behavior of farm households of the potential risk reducing features of off-farm income. We consider the portfolio investment problem with an agent who receives a stochastic stream of labor income. The investment alternatives consists of a risk free asset and a risky portfolio consisting of two risky assets such as a farm asset and a nonfarm financial asset (market security). The model is used to establish the conditions under which off-farm income might increase/decrease the weight to the farm asset in the portfolio.

Our model extends the results from from Bodie, Merton and Samuelson (1992) with only one risky asset. Furthermore, we consider a general correlation structure between the three sources of revenue; the market security investment, the farm investment and the off-farm labor income.

To illustrate and evaluate the theoretical arguments, we use time series data set from Sweden, aggregated at the level of a region to estimate the correlation and variance structure of the risky asset returns (farm and financial assets) and off-farm income. Given these values and the observed portfolio proportions, we follow French and Poterba (1991) in calculating the expected returns that would justify the observed holdings of assets.

2. The Composition of the Risky Portfolio

An agent has the choice of investing in a risk free asset (yielding a rate of return R), in a farm asset (yielding a rate of return q(t)) and in a non-farm financial asset (yielding a rate of return r(t)). The returns on the farm and the financial asset are risky and follow a stationary Ito process:

$$q(t) = \alpha_f dt + \sigma_f dZ_{ft} \quad \text{and} \tag{1}$$

$$r(t) = \alpha_p dt + \sigma_p dZ_{pt} \tag{2}$$

α_f and α_p are the instantaneous expected rates of the return on farm asset and financial asset.

σ_f and σ_p are the instantaneous standard deviations of the return on farm asset and financial asset.

Z_{ft} and Z_{pt} are standard Wiener processes and dZ_{ft} and dZ_{pt} are associated white noise with instantaneous correlation K_{pf}, i.e., that $E_t[dZ_{ft}dZ_{pt}] = K_{fp}dt$.

The rate of return on a risk free asset is given by (3). B(t) is the time t price of the risk free asset and R is its continuous rate of return.

$$dB(t)/B(t) = Rdt \tag{3}$$

Off-farm earnings are risky and the change in off-farm income follows a stationary Ito process given by:

$$dV_t/V_t = \alpha_v dt + \sigma_v dZ_{vt} \tag{4}$$

where V_t represents off-farm income, α_v is the deterministic component of growth rate of off-farm income and σ_v is the instantaneous standard deviation of the growth rate. The correlation between the change in off-farm income and rates of return on the farm and financial asset is given by

$$E_t[dZ_{ft}dZ_{vt}] = K_{fv}dt \text{ and } E_t[dZ_{pt}dZ_{vt}] = K_{pv}dt.$$

The agent's objective, subject to a budget constraint, is to maximize the discounted lifetime expected utility given by

$$E_t \left[\int_0^T e^{-\delta s} U(C(s))ds\right] \tag{5}$$

where C is the rate of consumption. Letting W(t) be the household wealth at time t, the change in wealth over the period dt is given by

$$\begin{aligned} dW = & - C(t)dt + \omega_f[W(t) - C(t)dt]q(t)dt + \omega_p[W(t - C(t)dt]r(t)dt \\ & + (1 - \omega_f - \omega_p)[W(t) - C(t)dt]Rdt + (V_t dt + dV_t) \end{aligned}$$

where ω_f and ω_p are the proportions of savings invested in the farm asset and the financial asset respectively.

Substituting for the asset return and income dynamics,

$$\begin{aligned} dW = & \left[- C(t) + W(t)[\omega_f(\alpha_f - R) + \omega_p(\alpha_p - R) + R] + V_t(1 + \alpha_v)\right]dt \\ & + \left[\omega_f\sigma_f dZ_{ft} + \omega_p\sigma_f dZ_{pt}\right]W(t) + \sigma_v V_t dZ_{vt} + o(dt) \end{aligned} \tag{6}$$

Let J(W(t),t) be the value function satisfying the optimization problem. From standard stochastic dynamic programming methods, we obtain the following equivalent optimization problem (see Merton, 1971)

$$0 = \max_{C(t),\omega_f,\omega_p} \Big[e^{-\delta t}U(C(t)) + J_t$$
$$+ J_w(-C(t) + W(t)[\omega_f(\alpha_f-R) + \omega_p(\alpha_p-R) + R] + V_t(1+\alpha_v))$$
$$+ .5J_{ww}(\omega_f^2\sigma_f^2 + \omega_p^2\sigma_f^2 + 2\omega_f\omega_p\sigma_f\sigma_p K_{fp})W(t)^2 + .5J_{vv}\sigma_v^2V_t^2$$
$$+ J_{wv}(\omega_f\sigma_f K_{fv} + \omega_p\sigma_p K_{pv})\sigma_v V_t W(t)\Big] \quad (7)$$

The first order conditions to this problem are:

$$e^{-\delta t}U_c(C(t)) = J_w(W(t),t) \quad (8)$$

$$J_w W(t)(\alpha_f-R) + J_{ww}[(\omega_f\sigma_f^2 + \omega_p\sigma_f\sigma_p K_{fp})W(t)^2 + \sigma_f K_{fv}\sigma_v V_t W(t)] = 0 \quad (9)$$

$$J_w W(t)(\alpha_p-R) + J_{ww}[(\omega_p\sigma_p^2 + \omega_f\sigma_f\sigma_p K_{fp})W(t)^2 + \sigma_p K_{pv}\sigma_v V_t W(t)] = 0 \quad (10)$$

Re-arranging terms, (9) and (10) become

$$-(J_w/J_{ww})(\alpha_f-R)/\sigma_f - \omega_p\sigma_p K_{fp}W(t) - K_{fv}\sigma_v V_t = \omega_f\sigma_f W(t) \quad (11)$$

$$-(J_w/J_{ww})(\alpha_p-R)/\sigma_p - \omega_f\sigma_f K_{fp}W(t) - K_{pv}\sigma_v V_t = \omega_p\sigma_p W(t) \quad (12)$$

Using (12) in (11) and letting I_f be the inverse of the coefficient of variation of excess farm returns and I_p the same for excess stock returns,

$$\omega_f\sigma_f W(t) = (-J_w/J_{ww})I_f - K_{fv}V_t\sigma_v - (-J_w/J_{ww})I_pK_{fp} + \omega_f\sigma_f K_{fp}^2 W(t) + K_{pv}\sigma_v V_t K_{fp}$$

$$= \frac{(-J_w/J_{ww})(I_f - I_pK_{fp})}{(1 - K_{fp}^2)} - \frac{\sigma_v V_t(K_{fv} - K_{pv}K_{fp})}{(1 - K_{fp}^2)} \quad (13)$$

Similarly,

$$\omega_p\sigma_p W(t) = \frac{(-J_w/J_{ww})(I_p - I_fK_{fp})}{(1 - K_{fp}^2)} - \frac{\sigma_v V_t(K_{pv} - K_{fv}K_{fp})}{(1 - K_{fp}^2)} \quad (14)$$

where following Merton (1971), and Svensson and Werner (1993), the first terms in (13) and (14) are interpreted as the tangency portfolio and the second terms in (13) and (14) as the income hedge portfolio. Dividing (14) by (13), we obtain the ratio of optimal weights in the risky portfolio,

$$\omega_f/\omega_p = (\sigma_p/\sigma_f)\,\frac{(-J_w/J_{ww})(I_f - I_pK_{fp}) - \sigma_v V(K_{fv} - K_{pv}K_{fp})}{(-J_w/J_{ww})(I_p - I_fK_{fp}) - \sigma_v V(K_{pv} - K_{fv}K_{fp})} \quad (15)$$

Note that if off-farm income is either deterministic ($\sigma_v = 0$) or stochastic but uncorrelated with both farm and stock returns ($K_{fv} = K_{pv} = 0$), it has no impact on portfolio choice. In that case (15) reduces to

$$\omega_f/\omega_p = (\sigma_p/\sigma_f)\,\frac{(I_f - I_pK_{fp})}{(I_p - I_fK_{fp})} \quad (16)$$

Comparing (15) and (16), it is clear that whenever off-farm income is stochastic and correlated with either farm or stock returns, the composition of the risky portfolio is not independent of risk preferences.

We now derive the comparative statics of the optimal portfolio proportions with respect to V_t. From (13) and (14), we have

$$\omega_f\sigma_f W(t)(1 - K_{fp}^2) + \sigma_v V_t(K_{fv} - K_{pv}K_{fp}) = (-J_w/J_{ww})(I_f - I_pK_{fp}) \tag{17}$$

and

$$\omega_p\sigma_p W(t)(1 - K_{fp}^2) + \sigma_v V_t(K_{pv} - K_{fv}K_{fp}) = (-J_w/J_{ww})(I_p - I_fK_{fp}) \tag{18}$$

Dividing (17) by (18),

$$\frac{\omega_f\sigma_f W(t)(1 - K_{fp}^2) + \sigma_v V_t(K_{fv} - K_{pv}K_{fp})}{\omega_p\sigma_p W(t)(1 - K_{fp}^2) + \sigma_v V_t(K_{pv} - K_{fv}K_{fp})} = \frac{(I_f - I_pK_{fp})}{(I_p - I_fK_{fp})} \tag{19}$$

Expressing it in terms of the expected returns and standard deviations

$$\frac{\omega_f\sigma_f W(t)(1 - K_{fp}^2) + \sigma_v V_t(K_{fv} - K_{pv}K_{fp})}{\omega_p\sigma_p W(t)(1 - K_{fp}^2) + \sigma_v V_t(K_{pv} - K_{fv}K_{fp})} = \frac{[(\alpha_f - R)\sigma_p - (\alpha_p - R)\sigma_f K_{fp}]}{[(\alpha_p - R)\sigma_f - (\alpha_f - R)\sigma_p K_{fp}]} \tag{20}$$

Notice that the right hand side of (20) does not depend on the parameters of the stochastic process for off-farm income. The left hand side of (20) is, however, a function of the riskiness of off-farm income and also of the portfolio weights ω_f and ω_p. Letting λ denote the left hand side of (20), $\partial\lambda/\partial V_t$ is of the same sign as

$$\begin{aligned}
&[W(t)\omega_p\sigma_p(1 - K_{fp}^2) + \sigma_v(K_{pv} - K_{fp}K_{fv})]\sigma_v V_t(K_{fv}-K_{fp}K_{pv}) \\
&\qquad - [W(t)\omega_f\sigma_f(1 - K_{fp}^2) + \sigma_v(K_{fv} - K_{fp}K_{pv})]\sigma_v V_t(K_{pv}-K_{fp}K_{fv}) \\
&= W(t)\omega_p\sigma_p(1 - K_{fp}^2)\sigma_v V_t(K_{fv}-K_{fp}K_{pv}) - W(t)\omega_f\sigma_f(1 - K_{fp}^2)\sigma_v V_t(K_{pv}-K_{fp}K_{fv}) \\
&= W(t)\sigma_v V_t(1 - K_{fp}^2)\Big[\omega_p\sigma_p(K_{fv} - K_{fp}K_{pv}) - \omega_f\sigma_f(K_{pv} - K_{fp}K_{fv})\Big]
\end{aligned} \tag{21}$$

If the above expression is positive, then ω_f/ω_p must decrease in order to maintain the equality in (20). If (21) is negative then ω_f/ω_p must increase in order to maintain the equality in (20). It is, however, difficult to evaluate or interpret (21) since ω_p and ω_f are endogenous variables. To eliminate them, we multiply (16) by $(K_{fv} - K_{fp}K_{pv})$ and (15) by $(K_{pv} - K_{fp}K_{fv})$ and consider the difference,

$$[\omega_p\sigma_p(K_{fv} - K_{fp}K_{pv}) - \omega_f\sigma_f(K_{pv} - K_{fp}K_{fv})] =$$

$$\frac{(-J_w/J_{ww})(I_p - I_fK_{fp})(K_{fv}-K_{fp}K_{pv}) - V\sigma_v(K_{pv} - K_{fv}K_{fp})(K_{fv}-K_{fp}K_{pv})}{(1 - K_{fp}^2)}$$

$$- \frac{(-J_w/J_{ww})(I_f - I_pK_{fp})(K_{pv}-K_{fp}K_{fv}) - V\sigma_v(K_{fv} - K_{pv}K_{fp})(K_{pv}-K_{fp}K_{fv})}{(1 - K_{fp}^2)}$$

$$= \frac{(-J_w/J_{ww})(I_pK_{fv} - I_fK_{fp}K_{fv} - I_pK_{fp}K_{pv} + I_fK_{fp}^2K_{pv})}{(1 - K_{fp}^2)}$$

$$- \frac{(-J_w/J_{ww})(I_fK_{pv} - I_pK_{fp}K_{pv} - I_fK_{fp}K_{fv} + I_pK_{fp}^2K_{fv})}{(1 - K_{fp}^2)}$$

$$= \frac{(-J_w/J_{ww})(I_pK_{fv} + I_fK_{fp}^2K_{pv} - I_fK_{pv} - I_pK_{fp}^2K_{fv})}{(1 - K_{fp}^2)}$$

$$= \frac{(-J_w/J_{ww})(I_pK_{fv} - I_fK_{pv})(1 - K_{fp}^2)}{(1 - K_{fp}^2)} = (-J_w/J_{ww})(I_pK_{fv} - I_fK_{pv}) \qquad (22)$$

Using (22) in (21), $\partial\lambda/\partial V$ is of the same sign as $\sigma_vV_t(1 - K_{fp}^2)(-J_w/J_{ww})(I_pK_{fv} - I_fK_{pv})$ which in turn is of the same sign as $(I_pK_{fv} - I_fK_{pv})$. Hence we can conclude:

$$\partial(\omega_f/\omega_p)/\partial V_t \gtrless 0 \text{ as } (I_fK_{pv} - I_pK_{fv}) \gtrless 0$$

$$\text{or } \partial(\omega_f/\omega_p)/\partial V_t \gtrless 0 \text{ as } (K_{pv}/I_p) \gtrless (K_{fv}/I_f) \qquad (23)$$

To make the intuition transparent, it is useful to write this result in terms of the coefficients of variation. Let s_f and s_p be the coefficients of variation of excess farm and stock returns. Then

$$\partial(\omega_f/\omega_p)/\partial V_t \gtrless 0 \text{ as } K_{pv}s_p \gtrless K_{fv}s_v \qquad (24)$$

Thus, as off-farm income increases, an investor reduces the portfolio weight of the *riskier* asset where the notion of riskiness is the individual coefficient of variation multiplied by the correlation of that asset's returns with off-farm income. Hence, for example, it is possible that even though the farm asset has a higher coefficient of variation than the financial asset, an increase in labor income increases the allocation to the farm asset since its returns are much less correlated with off-farm income than returns from stocks. The correlation structure of off-farm income with risky asset returns has implications for determining the portfolio weights.

Changes in the level of off-farm income have no effect on mean asset returns. The change in composition of the risky portfolio is therefore entirely due to the effect of off-farm income on the riskiness of individual assets. As off-farm income increases, total risk is decreased by increasing ω_f/ω_p if $K_{fv}s_f < K_{pv}s_p$ or by decreasing ω_f/ω_p if $K_{fv}s_f > K_{pv}s$.

3. Expected Returns and Off-farm Income

Our empirical strategy is to compute the effect of off-farm income on required expected farm returns when portfolio proportions are unchanged. The relationship of these effects with respect to the impact of off-farm income on portfolio choice is examined in this section.

From (9) and (10), the ratio of expected excess returns consistent with an empirically observed ω_f and ω_p is given by:

$$\frac{(\alpha_f-R)}{(\alpha_p-R)} = (\sigma_f/\sigma_p)\,\frac{(\omega_f\sigma_f + \omega_p\sigma_p K_{fp})W(t) + K_{fv}\sigma_v V_t}{(\omega_p\sigma_p + \omega_f\sigma_f K_{fp})W(t) + K_{pv}\sigma_v V_t} \qquad (25)$$

Hence, if off-farm income changes, then the ratio of excess expected returns at which portfolio proportions remain unchanged must also change. From (25),

$$\partial[(\alpha_f-R)/(\alpha_p-R)]/\partial V_t \gtrless 0 \quad \text{as} \quad [\omega_f\sigma_f(K_{fp}K_{fv}-K_{pv}) - \omega_p\sigma_p(K_{fp}K_{pv}- K_{fv})] \gtrless 0 \qquad (26)$$

Using (13) and (14) to substitute for $\omega_f\sigma_f$ and $\omega_p\sigma_p$,

$$\partial[(\alpha_f-R)/(\alpha_p-R)]/\partial V_t \gtrless 0 \quad \text{as} \quad -(I_f K_{pv} - I_p K_{fv}) \gtrless 0$$

$$\text{or } \partial[(\alpha_f-R)/(\alpha_p-R)]/\partial V_t \lessgtr 0 \quad \text{as} \quad \partial(\omega_f/\omega_p)/\partial V_t \gtrless 0 \qquad (27)$$

which shows that off-farm income increases (or decreases) portfolio weight to the farm asset under exactly the same conditions as when it decreases (or increases) the ratio of expected excess returns at which the investor holds an unchanged portfolio. This result is the rational for examining the impact of off-farm income on the ratio of expected excess returns. For convenience in interpretation, we take the financial asset returns and the risk free rate as parameters so that (27) becomes

$$\partial\alpha_f/\partial V_t \lesseqgtr 0 \quad \text{as} \quad \partial(\omega_f/\omega_p)/\partial V_t \gtreqless 0 \tag{28}$$

When portfolio proportions are held fixed, they cannot adjust to the change in off-farm income. If, for example, $K_{fv}s_f < K_{pv}s_p$, then with an increase in off-farm income, investors would desire to change their portfolio composition in favor of the farm asset. However, if this cannot happen, expected farm asset returns fall so that the initial portfolio composition is willingly held by the investor. The fall in expected farm asset returns is attributable to the reduced relative riskiness of the farm asset owing to higher off-farm income.

4. Empirical Illustration

In the computations reported below, we consider the impact of off-farm income with reference to a benchmark model where V_t is set at zero. Let α_{fa} be the expected farm return consistent with the current holding of assets in this benchmark case. α_{fa} is compared with α_{fb} which is defined to be the expected farm return consistent with the same holding of assets and a level of off-farm income $V_t > 0$. Using (25) for the case V_t=0 and V_t>0 the The expected return differential to be empirically estimated is defined as:

$$(\alpha_{fa} - \alpha_{fb}) = (\alpha_p - R)(\sigma_f/\sigma_p)\left[\frac{(\omega_f\sigma_f + \omega_p\sigma_p K_{fp})}{(\omega_p\sigma_p + \omega_f\sigma_f K_f)_p} - \frac{(\omega_f\sigma_f + \omega_p\sigma_p K_{fp}) + K_{fv}\sigma_v(V_t/W(t))}{(\omega_p\sigma_p + \omega_f\sigma_f K_f)_p + K_{pv}\sigma_v(V_t/W(t))}\right] \tag{29}$$

From (28), we know that the return differential is positive (negative) if off-farm income reduces(increases) the relative riskiness of the farm asset relative to the financial asset.

Data for calculating (29) was obtained for seven agricultural regions with differences in regional economic and natural growing conditions of Sweden for the period 1961-1990. We consider the returns to farm asset as a weighted average of returns from agriculture and forestry. The inclusion of forestry is motivated by the fact that forestry is an integrated part of the agricultural firm in many areas of Sweden. From the Swedish Farm Economic Surveys (Royal Swedish Board of Agriculture, 1960 to 1975; Statistics Sweden, 1977a to 1991a), we obtain the data necessary to compute regional averages for current real rates of return, i.e., excluding capital gains. Capital gains are computed from an index of real estate prices for farms in different parts of Sweden(Statistics Sweden, 1961b to 1991b). Off-farm income figures were collected from the Survey of Farmer's Assessed Incomes, Expenditures and Net Earnings (Statistics Sweden, 1961c to 1991c).

Information on financial asset holdings of Swedish farmers was collected from a special survey conducted in 1986 (Statistics Sweden, 1990d), while the value of farm asset investments were computed from information in the Farm Economic Survey for the same year (1986) and for the corresponding region. Data on financial asset returns was obtained from Frennberg and Hansson (1992). Conditional variance and covriances were computed from the residuals of a vector autoregressive (VAR) system consisting of farm asset returns, financial asset returns and growth rate of off-farm income as endogenous variables (table 1).[1]

The seven regions exhibit differences in correlation structure. In regions GSS and GMB, K_{fv} is larger than K_{pv}. In regions GNS, SS and SSK, K_{fv} is smaller than K_{pv}. Finally, in SSK and NLD, the two correlations are

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[1] For a more detailed description of data and the estimation of the VAR-system see Andersson, Ramamurtie and Ramaswami (1993)

about the same. The contrast between the regions with respect to the correlations may reflect differences in off-farm income characteristics between regions such as the relative importance of the agricultural sector.

Table 1: Correlations between the percentage change in off-farm income, rates of return on agricultural assets and the market portfolio.

	REGIONS						
Correlations	GSS	GMB	GSK	GNS	SS	SSK	NLD
K_{fv}	0.25166	-.01896	-0.12348	-0.26940	0.032831	0.09002	0.1567
K_{pv}	-0.20590	-0.25794	0.10934	0.01105	0.12835	0.08354	0.1553
K_{fp}	-0.16068	0.18574	0.021327	0.00379	-0.04156	-0.00229	0.0823

Notes:
1) The correlations displayed are estimated from a VAR system with one lag. The results were very stable even if the system was estimated with two or three lags of the endogenous variables.
2) The regions are represented by their abbreviated names, like GSS, GMB etc.

5. Results and Discussion

For the regional averages of portfolio proportions, wealth and off-farm income levels of 1986, we use (29) along with the computed correlations to calculate the expected return differential in each region. For three regions, the sign of the expected return differential can be predicted from the table of correlations. From (24) and (28) we have.

$$\partial\alpha_f/\partial V_t \lesseqgtr 0 \Leftrightarrow \partial(\omega_f/\omega_p)/\partial V_t \gtreqless 0 \Leftrightarrow K_{pv}s_p \gtreqless K_{fv}s_v \qquad (30)$$

In GSS, $K_{pv} < 0 < K_{fv}$, while in GSK and GNS, $K_{pv} > 0 > K_{fv}$. It is apparent from (30), that $\partial\alpha_f/\partial V_t > 0$ in Gss and $\partial\alpha_f/\partial V_t < 0$ in Gsk and Gns. In the other regions, K_{pv} and K_{fv} are both of the same sign which is insufficient information to sign the expected return differential. As can be seen from (26), additional information is needed about portfolio weights, standard deviation of returns as well as the correlation between farm asset returns and financial asset returns. Table 2 reports the expected return differential caused by off-farm income in each of the seven regions.

Table 2: Expected Return Differential and the Ratio of Off-farm Income to Wealth for Regional Averages of Off-Farm Income, Wealth and Portfolio Proportions

	REGIONS						
	GSS	GMB	GSK	GNS	SS	SSK	NLD
$(\alpha_{fa}-\alpha_{fb})$	-.20%	-.04%	.08%	.09%	.23%	.06%	.10%
$\frac{V_t}{W(t)}$	.045	.036	.047	.064	.099	.085	.14

Notes:
1) The computations use equation (29). The off-farm income, wealth and portfolio proportions are regional averages for the year 1986. The correlations and standard deviations are computed from the residuals from a VAR system for the period 1961-90.

From Table 2, we see that in regions GSS and GMB, an investor would hold the same portfolio of assets in the presence of off-farm income only if expected farm asset returns increased. For these investors, off-farm income increases the riskiness of farm assets as off-farm income is more strongly correlated with farm asset income than with financial asset income ($K_{fv} > K_{pv}$). The reverse occurs in the other five regions. The effect is easy to understand in GNS, GSK and SS where $K_{fv} < K_{pv}$ and so adding off-farm income reduces the riskiness of the farm asset.

In terms of magnitude, however, the effects of off-farm income seem modest. Does that mean that off-farm income is not of much significance in affecting risk and portfolio choice? Note that (25) can be written as

$$\frac{(\alpha_f-R)}{(\alpha_p-R)} = (\sigma_f/\sigma_p)\,\frac{(\omega_f\sigma_f + \omega_p\sigma_p K_{fp}) + K_{fv}\sigma_v(V_t/W(t))}{(\omega_p\sigma_p + \omega_f\sigma_f K_f)_p + K_{pv}\sigma_v(V_t/W(t))}$$

where $V_t/W(t)$ is the ratio of off-farm income to (marketable) wealth. The wealth effect operates on α_f in a direction opposite to the effect of off-farm income. If $V_t/W(t)$ is is high, the effect of off-farm income on the expected return differential is stronger. A high $V_t/W(t)$ ratio would typically be expected for highly leveraged farm operators and/or a combination with a high level of off-farm income. This situation would be likely to characterize agents entering the sector. Regional averages of $V_t/W(t)$ used in the computations are reported in table 2. To further illustrate the point the return differential is displayed in figures 1 and 2.

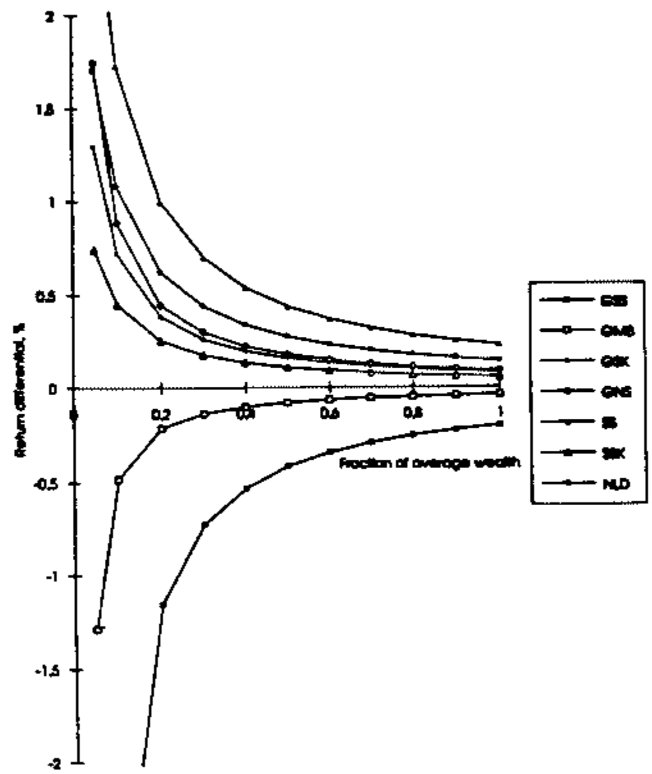

Figure 1: Expected Return Differential at Different Levels of Wealth Measured as a Fraction of Observed Average Wealth in the Regions Respectively.

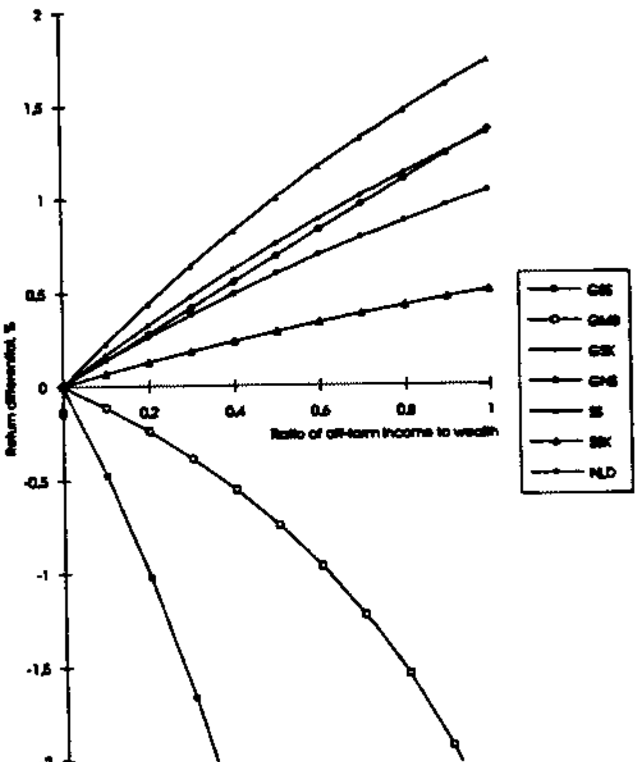

Figure 2: Expected Return Differential and the Ratio of Off-farm Income to Wealth.

From there it can be seen that the average levels of off-farm income are small relative to the average levels of wealth for Swedish farmers. The ratio ranges from .04% to a high of .1%. Clearly, for Swedish farmers with wealth levels close to the average levels, off-farm income does not appreciably affect risk very much. Nevertheless, the effect might be important for farmers with high levels of off-farm income relative to wealth. According to Ahearn and Lee (1991) the corresponding ratio in USA ranged from 0.13 –0.35 for 55% of the households indicating the risk reducing impact of off-farm income for a substantial portion of the farmers.

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