Does the "Horizon Problem" explain under-investment in Agricultural R&D?

RESEARCH NOTE

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Farmers have historically earned high rates of return from investing in agricultural R&D. Yet producer groups appear to under-invest in these activities. According to Campbell et al. (2007), "overall producer-funded R&D for prairie agriculture remains inefficiently low from the perspective of both producers and society as a whole". Known as the under-investment hypothesis, this behavior is perplexing. Why don't Canadian producer groups invest more?

THE "HORIZON PROBLEM"

In an influential article on the lifecycle of agricultural co-ops, Cook (1995) introduced the "horizon problem". Specifically, Cook states:

"*The horizon problem occurs when a member's residual claim on the net income generated by an asset is shorter than the productive life of that asset. . . . The horizon problem creates an investment environment in which there is a disincentive for members to contribute to growth opportunities*." (Cook, 1995, pgs. 1156-7)

> The horizon problem occurs when a residual claim on the net income generated by an asset is shorter than the productive life of that asset.

Investments in R&D take time to pay dividends. Often it is many years from initial outlay to practical application. The horizon problem implies that farmers are unable to collect benefits from investments in R&D because they have exited the industry by the time these ideas are profitably developed. In other words, farmers have no incentive to invest in R&D because they do not receive the benefits from this investment.

This research note investigates whether the horizon problem explains the observed under-investment in research for a representative Canadian commodity group. A decision-tree model is constructed to examine this proposition.

DECISION-TREE MODEL

Model Structure. A commodity group, for example Alberta Beef Producers or Ontario Grain Farmers, must choose between two mutually exclusive cash flow streams. Option 1 entails investing $10,000 in an annuity which has an annual rate of return of 7%. This annuity is an analogue for cash flow derived from a generic commodity advertising campaign. Option 2 involves investing $10,000 in an uncertain research project that takes 10 years to complete. Research projects have a high chance of success, but not 100%. Assume that the subjective probability that the research project is successful equals 85%. If successful, this project yields a perpetual annual rate of return of 40% (Alston et al., 2000).

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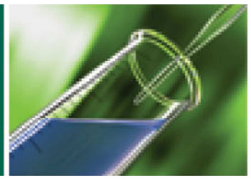

The median farmer only receives benefits from her R&D investment for three years. In other words, she won't be farming long enough to collect on her investment. This is the essence of the horizon problem.

Additional Assumptions. The model requires several additional assumptions:

1. The median farmer is the effective decision-maker in the commodity group and has an age of 52 (Statistics Canada, 2006).
2. All farmers retire at age 65.
3. Farms have no bequest value for the median farmer (i.e., a farmer sells the farm rather than transferring it to children).
4. Farm valuations are based on historical earnings only. This contravenes economic theory, but is an accurate description of most agribusiness transactions.

BASELINE SCENARIO

In the baseline scenario, the median farmer's internal annual rate of return from investing in the research project is 6.7%. Thus she chooses to invest in the annuity rather than in R&D.

This result suggests that the horizon problem is a compelling explanation for why producer groups under-invest in agricultural R&D. The median farmer only receives benefits from her R&D investment for 3 years (she retires at 65 and no returns are earned until she is 62). Commodity groups generally don't own any control rights over the final research output, so the farmer only receives payouts if she continues to farm. In other words, she simply won't be farming long enough to collect on her investment. This is the essence of the horizon problem.

SENSITIVITY ANALYSIS

The baseline scenario's conclusion is not robust to changes in key assumptions as demonstrated by sensitivity analysis around key parameters. Figures 1 through 4 present results under different parameter assumptions. (For all figures: Blue Dot = Invest in R&D; Red Dot = Invest in Annuity.)

Rates of Return. Figure 1 shows two sections demarcated by the thick black line. If the farmer is in the blue part, she should invest in the research project. The red section indicates that the money should be allocated to the annuity. For the median producer, there are two cut-offs. First, investing in a research project that yields a return less than 35% should not be undertaken. Second, she should invest in all projects that promise returns greater than 45%. Between these cut-offs, the choice depends on the relative returns for each option.

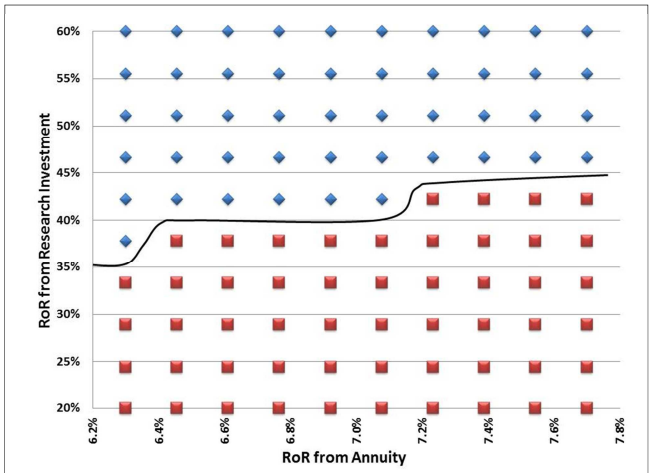

Fig.1: Rates of Return on the Two Investment Options

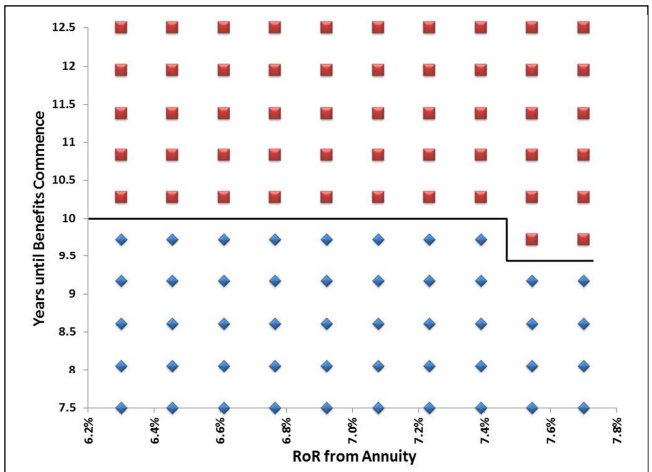

Fig.2: Research Duration and Rate of Return on Annuity

Research Lag. The most important assumption involves the amount of time it takes from initial research investment to profitable implementation. The baseline scenario assumes a 10 year lag. Figure 2 demonstrates how sensitive the results are to this assumption. A lag longer than 10 years means that the producer group should invest in the annuity. If the research takes less than 10 years, R&D investment is the optimal choice.

Probability of R&D Success. Perceptions of research success matter. If the median producer is uneasy about the likelihood of research success, she will prefer the annuity. Figure 3 presents results on the sensitivity to research success. These values are also useful for inferring decisions under risk aversion or hurdle rates.

Matching Grants. One element has been overlooked: matching grants. Provincial and federal governments often provide producer groups with matching grants for funds flowing towards R&D. The above results lend credibility to the horizon problem as an explanation for under-investment. Yet, this disappears when matching grants are considered.

Figure 4 shows the results if $0.50 is added to every dollar that the producer group invests in research. Including matching grants overwhelmingly favours the R&D option. In fact, the horizon problem is no longer a convincing explanation of producer group under-investment. Having government matching grants should provide sufficient incentives for the median farmer to invest in agricultural research.

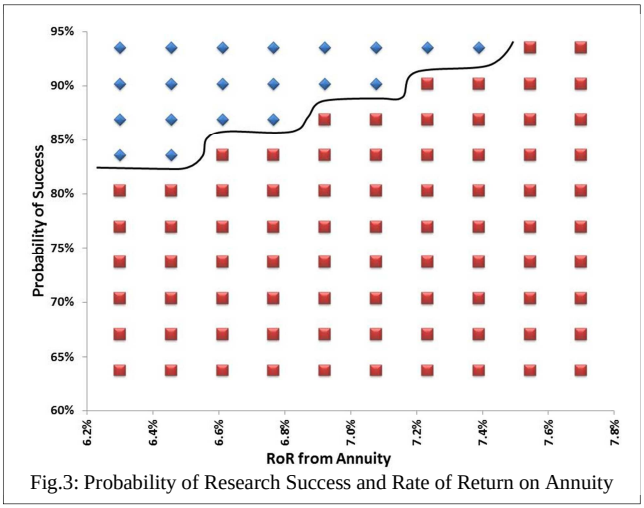

Fig.3: Probability of Research Success and Rate of Return on Annuity

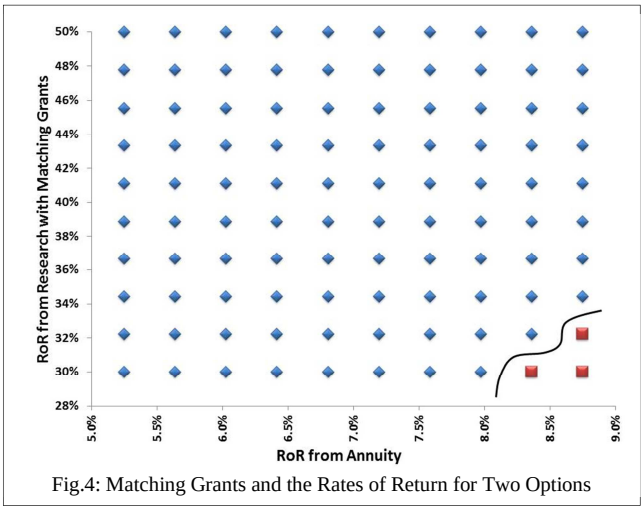

Fig.4: Matching Grants and the Rates of Return for Two Options

POLICY IMPLICATIONS

Two policy conclusions follow from this research. First, a combination of the horizon problem, risk aversion and hurdle rates may limit commodity groups' investment in R&D. As a result, continuing matching grant programs is necessary to prevent under-investment in R&D. Second, many farmers may not understand the magnitude of benefits from R&D investments. Consequently, information dissemination, targeted at commodity groups, is important for R&D funding.

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