PART TIME FARMING IN MANITOBA

A Thesis

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In Partial Fulfillment

of the Requirements for the Degree

Doctor of Philosophy

by

Alexander John Walter Pursaga

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A Thesis/Practicum submitted to the Faculty of Graduate Studies of The University of Manitoba in partial fulfillment of the requirements of the degree

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Abstract:

Part Time Farming in Manitoba

Part time farmers have long been a factor in the development of agriculture in Manitoba, yet working on the farm and off the farm has been officially discouraged by federal tax statutes, while at the same time the province has been encouraging the creation of more jobs in rural, and primarily farming, communities. This study makes use of a utility maximization approach to modeling part time farming behavior and applies this model to data derived from the Census responses of Manitoba farmers in 1986 and 1991.

The impact of a differential tax rate for on farm income and off farm income is modeled as well as the impact of output prices, autonomous transfers, general price levels and factor input prices, and the impact of the off farm wage. The comparative statics are calculated and a series of policy elasticities are computed for each policy instrument defined above.

The data support the use of a logarithmic form of estimation in which the Cobb Douglas functional form is applied to both utility and production. In addition, constant returns to scale is assumed which, while removing some of the reaction conditions from the analysis, enables the direct testing of the model with the data available.

The data support the use of estimated relationships for policy interpretations. The theoretical signs of the comparative static analysis and the reduced form of the model generally confirm the theoretically expected signs, but also indicate that shifts in utility function parameters may well explain the behavior of part time farmers in Manitoba inasmuch as the production function parameters are found to be stable.

The results of this analysis suggest that factor prices and output prices have considerable impact in adjusting the level of off farm effort as does the level of the off farm wage rate. In addition, the tax differential policy can be effective under certain conditions, but if utility function parameters change the effect may dissipate.

It is concluded that the policy of using the taxation system to discourage part time activity may need to be revisited and reconsidered as this analysis shows that it can have variable effects and even be counterproductive if other, less controllable policies are in place. Moreover, there are grounds to suggest that encouragement of part time farming is a useful policy target independently.

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By way of dedication, this work would not have been possible without the dedication and support of my wife Karen, my children, Janine, Joyanne, Justin and Jared, as well as the support of my mother and my sister Lillian. Our family was much larger when this project was commenced and the work that has been invested in this project is dedicated to the memory of my father and grandmother and their faith that this project would indeed be completed.

Above all, this work is a reflection of the economic issues faced by sixteen part time framers in Manitoba whose responses to the Census of Canada provided the basis for this work and the issues that it raises.

Chapter 1

Part Time Farming in Manitoba

1.1 Introduction

Agriculture has often been seen as an essential industry, to be protected in order to ensure a stable supply of food from which a nation might draw a strong and committed populace. As such, agricultural policies designed to support prices, make up for income shortfalls and provide support services to farmers are quite common. In Canada, as part of this process, a series of financial tools, including accelerated depreciation, tax exemptions, and allowance of "special" deductions, have been developed to protect the sector from external financial forces. The avowed purpose of these programs is to provide special status and consideration to farmers in order that farm incomes are maintained and expanded. Government policy attempts to safeguard farm incomes against the need to augment these incomes with part time off farm work. Given the existence of these "safeguards", it may be considered unwise, irrational and even contentious for a farmer to be involved in part time off farm work.

In establishing this "special" status for agriculture, the government has also sought to isolate agriculture from interaction with other sectors. The avowed fear has been that this special status would be seen as an advantage for those not primarily involved in agriculture in order to avoid paying taxes. Thus protecting the special status of agriculture has led government to curtail these benefits through various policies, but primarily through a differential tax system in which nominal rates are the same but the level of deductions are based upon bureaucratic determination.

In the middle of this struggle, a great technological shift in farming has taken place. The shift has introduced increased horsepower in machinery, specialized regimes in fertilizers, pesticides and herbicides, and advanced management techniques in production, marketing and finance. All of these have operated to make farming more capital intensive and land expansive, but less labor intensive. The result has been a serious and protracted decline in rural populations. In response many governments, mostly provincial, are actively involved in rural development initiatives in which the practice is to entice or induce businesses to locate in rural areas and hire local labor. These policies may include special tax concessions for the investors of capital, advertising and promotion assistance, and even special considerations under certain laws relating to labor standards. Regardless of the nature of these programs, they must all compete for labor in the local labor market and therefore are at least, in theory, drawing farmers into off farm activity.

This inherent multilevel and multi-policy dilemma suggests that a behavioral interpretation of pluriactivity is valuable not only for agricultural policy management but also for the setting of overall social and public policy priorities.

There are two types of pluriactives involved in agriculture. The first is the hobby farmer who uses the tax status of farming as an attempt to avoid taxes and the other is the part time farmer who is a farmer first, and an employee only secondarily, and whose distinctive behaviors are rarely studied. To the extent that the part time farmer is caught up in the efforts to protect the special status afforded to agriculture, the part time farmer will be a target of enforcement of the protective devices that secure and guard the special status of agriculture.

This thesis will look at the behavior of part time farmers in Manitoba in the light of a number of apparent controversies that surround those who choose to farm as a primary occupation and to work off the farm as well. This is an especially important choice as the *Income Tax Act* has within it a provision that mitigates against the choice of off farm work by farmers. Specifically, part time farmers run the risk of losing the ability to deduct losses from farming from their income and therefore are liable for a larger tax bill than those who choose to remain as full time farmers. In addition, eligibility for certain farm assistance programs is restricted to those deemed to be *bona fide* farmers. In Manitoba a part time farmer is not eligible to rent Crown land and is restricted from receiving benefits from certain disaster relief programs.

Although this "protection" has often been viewed as a good thing, it has rarely if ever been examined in terms of the policy itself and whether farmers are acting rationally if they work part time off of the farm. It is the task of this research to provide a theoretical foundation upon which to evaluate these claims.

1.2 Systemic Changes in Agriculture

In order to understand the role and significance of part time farming, the financial structure of agriculture is important. In the case of the average Manitoba farm, there has been a shift in asset composition from long term assets to more short term assets. The average Manitoba farmer had 13.67% of total assets in current form with 22.85% as intermediate assets in 1980. This represented 36.52% in shorter term assets. By 1993 this had shifted and current assets were held at 17.40% with intermediate assets at 31.27%. This amounted to 48.67% of total assets in 1993. Over this period, long term assets were reduced from 63.47% to 49.92% of total assets. This shift did not result in a major change in the overall level of assets. Over the period 1989-1993, the long term assets actually rose while the long term trend (1980-1993) was for a persistent decline. This pattern suggests that farm finances were restructured during this period, a trend which has persisted.

Non-farm assets have become a larger factor in the period since 1989 rising to 2.8% of total assets in 1991 and falling to 1.4% in 1993. Prior to the 1989 level of .07% there was no recorded non-farm capital in the overall farm accounting structure. In aggregate this represented $301,484,400 in 1991 and reflects the impact of agricultural held capital placed in other sectors of the economy beginning in the late 1980's and extending into the 1990's. The implication is that capital diversification in terms of investments made by agricultural investors off the farm in non-farm assets, is increasing.

For the period from 1989-1993, for the average Manitoba farm, while wages from non-farm income (off farm work for the operator) rose by 57.78%, other non-farm income sources (primarily off farm income from other family members as well as income earned from non-farm sources including capital gains on non-farm assets) were rising even faster (102.38%) than direct government payments (13.87%). While pension income increased by 30.00%, interest earned dropped by 15.00% over this period. Non-farm income rose from 40.52% of total farm income to 43.37% in 1993, while government support dropped from 36.87% to 29.83%. At the same time, market income rose from 22.60% to 27.12%.

If government support can be assumed to be linked to market performance, such that increasing support in a decreasing market is indicative of the "safety net" posture of those programs, then the data suggest that off farm earnings replaced about one third of the income share released by the relative decline in government support. In this transition, the average annual farm operator wage from part time activity rose from $9,380.00 in 1989 to $14,800.00 in 1993 while actual market returns to the same farm rose from $8,400.00 in 1989 to $14,100.00 in 1993. This suggests that bin both 1989 and 1993 more income was earned off the farm than on the farm.

In Manitoba, part time farming is a formidable force in the financial structure of the average farm and appears to be part of a process in which agricultural linkages are extending beyond the traditional sectors.

1.3 Types of Part Time Farmers

Initially it may be suspected that part time farmers are in some way inferior to full time farmers given that there is a vast reservoir of public policy dedicated to the maintenance and enhancement of farm incomes. If these policies and programs are truly effective, then only the irrational agent who does not maximize the benefits of agricultural programs or those who are either entering or exiting agriculture would be involved in part time activity. Alternatively, if the part time farmer is balancing the benefits of the potential returns to his stock of capital, then the full time farmer will be missing the potential income and personal gratification that would be due to his or her skills and experience if they were marketed beyond the farm gate. The mere existence of part time farming activity suggests that either the full time farmer or the part time farmer is acting in a significantly different and hence noteworthy fashion. The prevalence of part time farming in Manitoba and its persistence suggest that this behavior is fundamental and therefore worthy of investigation.

There are several sets of circumstances under which a part time farmer may actually be using the off farm activity in order to shore up agricultural production. Some farmers may be working off the farm in order to augment income. This group would seek income opportunities off the farm that brought benefits that would otherwise be unavailable. These benefits might include employer vested pension plans, dental coverage, and employer funded travel. In these cases the pluriactivity is income dependent and appropriate policies would focus on producer and / or input price stability and manipulation. This is the general purview of agricultural policy.

Another group of farmers may be considered to be "driven" to part time farming. For this group their household time and their farm time are highly extended and the harder that they work, the more difficult life appears to be for them. These situations may be brought on by drought, flood or unfair market practices. The essential point is that farmers who become part time farmers under circumstances such as these, may well find off farm work as a pathway to leaving agriculture altogether. Under these circumstances, price policies are not likely to be effective and some sort of social help is warranted either to assist in relocation or to bail out the operator. In this situation social goals that relate to overall food security and the need to keep farmers actively engaged in agriculture are important concerns. This kind of situation would fall into the realm of social policy.

Agricultural policy and social policy need not be adversarial, but appear to have had significant, but different, effects on the structure of agriculture in Canada and the United States. As Freshwater and Reimer (1995, pp.220-221) have noted:

> ...our preliminary analysis leads us to suggest that differences in U.S. and Canadian social and economic policies result in a bias in the United States in favor of large commercial farms and farms where off farm income is an ancillary source of income in the United States. In Canada, socioeconomic policy is biased in favor of smaller full time farms and limited resource farm families.
>
> While social and economic programs are important in studies of changes in structure in a single nation, they are particularly significant in international comparisons. Harmonization of trade policy in conjunction with unacceptably high government and consumer outlays is leading to pressures to dismantle existing commodity based farm supports. If alternative forms of support for farm families are to be provided, one approach is to ensure that existing social and economic policies provide adequate protection.

These conclusions may arise more from the price policy focus of United States agricultural policy as opposed to the multifaceted Canadian approach. However, it is clear that in the United States, the scope for part time farming as a means of augmenting income is much larger, whereas in Canada part time activity is more generally focused on survival.

While there is reason to be concerned about the interaction between agricultural and social policy there is also an investment interpretation that is worthy of consideration. It may well be possible that part time farmers are neither augmenting income nor struggling to survive. Indeed they may well be seeking to improve their farming practices by working off the farm.

One situation exists in which farmers work off the farm in order to accumulate experience and training so that they can undertake new enterprises.

On these farms, the part time activity can be used to improve the technology of the entire farming operation such as through the development of computer skills, the implementation of new management practices, and the development of mechanical skills. Extension work and formal training may be most appropriate under these conditions.

Finally, some part time farmers may be involved in off farm effort because they are lacking farming skills and are therefore overly dependent on factor inputs. Production practices may be wasteful and management may be inappropriate. In these cases research and development policies that are focused on production improvement may be more useful than the other components of agricultural policy.

Essentially the part time farmer then is also caught in a dilemma to the extent that off farm work involves taking a tax risk that could result in all of the gains of off farm income being removed or reduced in the taxation process. Thus the tax risk is a real and pressing danger for all part time farmers regardless of their motivation.

Conceptually the impact of pluriactivity is a barometer of the overall health and stability of agricultural activity. Further analysis is necessary in order to provide guidelines for more judicious policy application.

1.4 The Analytic Plan

The thesis of this study is that part time farmers are rational agents maximizing the return to their efforts by judiciously working both on and off the farm in order to raise income. It is assumed that farm income enables, if not empowers, utility for the operator, and by extension, for the entire family. In this approach all farmers have the primary objective to raise incomes from whatever source and with whatever techniques that are available to them. Therefore, this decision to work off the farm is primarily the result of the balancing of income sources for which analytic policy analysis can be used to guide the administration of agricultural policy. This guidance is crucial as the current situation is typified by a crossing of dilemmas. On the one hand, the government wishes to protect agriculture, while on the other hand, the farmer wishes to protect income levels in order to maintain his lifestyle. Both use traditional methods of supporting their objectives and yet rational pursuit of these objectives can lead to conflicting messages. The diligent administration of taxation policy can be seen as treating part time farmers as felons, while those who work off the farm may be seen as testimony to the ineffectiveness of agricultural policy. Either may be true or both may be false, or there may be various combinations of motivation. Thus for part time farmers to be viewed differently requires that detailed examination of part time behavior be pursued.

In the next chapter a brief review of the various approaches that have been taken to part time framing will be presented in order to gain a perspective on what an alternative view might be. This view will be one that is neither academic, historical, or legal, but rather one that approaches the question as a choice made by rational individuals. In the following chapter, a model based on rational economic objectives, in this case utility maximization, will be developed and the comparative static results defined in terms of operational conditions that face a representative agent. In Chapter 4, the model will be set for estimation and the data will be reviewed. Also in this chapter, the policy elasticities will be analyzed and the policy implications will be drawn out. In the final chapter, the analytic thrust of this research will be drawn to conclusion and evaluated in terms of operational response that could be taken to the part time farmer. Much of what will have been analyzed is the product of a singular clause in federal tax statutes that may be well served if it is revisited. Additional research avenues will also be suggested.

Chapter 2

Review of the Literature

2.1 Perspectives on Part Time Farming

Part time farming has come to be known by several different names and has been the focus of considerable debate. To some the issue of part time farming represents pluriactivity or multiple job holding. To others the allocation of effort to more than one occupation represents moonlighting or skimming. When the special status of agriculture is involved, the part time farmer is sometimes seen as a drain on the agricultural policy system and at other times seen as a harbinger of essential skills that are necessary for rural stability and development. This study has no pretensions of resolving this debate, but no study of this issue would be complete without acknowledging these prevalent beliefs.

2.2 Academic Perspectives

Paarlberg (1974 , p.3.) argues that full time farmers are the focal point of the "agrarian creed" which itself is a further subset of the larger "agrarian ideology". This agricultural fundamentalism stands on the premise that agriculture is a basic preoccupation of mankind and that rural life is morally superior to urban life. Part time farmers are seen by some as deviants and the continuation of this activity is seen as a basic threat to democracy. Numerous agricultural and fiscal policies have been predicated on this interpretation with specific exclusions from benefits for part time farmers or others not considered to be *bona fide* farmers.

Due to this philosophical basis, many accusations have been leveled at part time farming activity which have summarily been refuted. Ahearn and Lee (1991) have argued against the assertion that part time farmers are a weak link in the food security chain of developed countries such as the United States. Carol Kramner (1990) has rebuked the notion that part time farmers lower the safety and quality of food products. Kada (1980) has shown that part time farming activity has no appreciable impact on the quality of farm family life in Japan or in the United States.

These larger scale accusations are readily refuted, but there are potential small scale impacts that can be demonstrated and may result in inefficient resource use.

Findeis, Lass, and Halberg (1991, p.26) contend that a farmer will reduce effort and the use of factor inputs on the farm in pursuing a second income. This approach does not include transactions costs involved in securing off farm employment such as travel time or the costs associated with certification needed to perform the tasks that constitute the off farm job. Krishnan (1990, pp.362-367) has shown that family structure as well as transactions costs may have a bearing on part time activity. In this approach, leisure includes at home chores. Given that skills may be unevenly distributed within the farming sector across individuals, there may well be institutional limitations to seeking off farm employment as well as those imposed by geography and family structure. In a market in which employers compete for the skills of workers, such family pressures may force employers to carry additional search costs and possibly to bid up wages in the local community. (Helmberger and Chavras, 1996, pp. 22-23).

The traditional method of modeling the part time allocation decision focuses on factors germane to the agricultural operator or household, and has been most prominently developed by Wallace Huffman (1991). This approach treats the operator and spouse as one decision unit that combine their time available to maximize utility. Children and other unattached individuals in the household, such as the elderly, are ignored both as sources of effort and as potential burdens on the total supply of effort. Therefore children helping with chores which expands the productivity of the farm are neglected. Similarly the needs of children and other inactives for care and nurturing is also neglected as a potential stumbling block for the productive effort of either parent. The restrictions include both time and budget constraints. In the time constraint, all time is assumed to be allocated either to home time, on farm work, or off farm employment. The budget constraint includes net farm income, off farm income, autonomous income and the expenditures made by the household on commercial goods. The transactions costs involved in pursuing the off farm work are included. Using a production function that transforms time, human capital, and household characteristics into farm output and off farm work, the Kuhn-Tucker conditions are used to generate a sequential solution. The supply of labor and farm inputs are set first. This is done by solving for the demand functions for farm effort and factor inputs and then utilizing the first order conditions and the equilibrium value of the off farm wage. The farm production function is then solved with these preset levels to determine the level of farm production. The budget constraint is evaluated to determine the demand for home time and for commercial goods. The first order conditions are then used to solve for the values of home time or leisure and purchased consumption goods. The final supply function for off farm labor is solved by substitution into the time constraint (Huffman, 1991, pp.256-258).

The model is then solved for the time worked off the farm as the dependent variable when the solution variables are all entered. The reduced form of the model is estimated when the off farm hours are set to zero and the off farm wage is then interpreted as the dependent variable and also as the reservation wage when there is no off farm work. The reservation wage is that wage that will encourage the first hour of off farm work. This model is recursive if there is any off farm activity (Bewley, 1986). The participation decisions are modeled using a PROBIT technique and the final supply equation is modeled using a suitable flexible functional form (Sumner, 1991). In it's reduced form the model is estimated using the observed wage as the dependent variable for a semi-logarithmic functional form.

There have been a great many applications of this model (Sumner 1982, Gould and Saupe, 1989 Huffman and Lange 1989, Lass and Gempeshaw 1992). Most recently, Huffman and Evenson (2001) have used the reduced form of this model to evaluate United States structural changes and have concluded that part time farming is a major factor in structural change and that public agricultural support programs essentially make no difference to the part time farmer.

Kimhi (2000) has also indicated that part time farmers are not necessarily preparing to exit agriculture, as taking a full time job off the farm is unlikely to result in farm exit behavior amongst Israelis. However, Weiss (1997) had found that an increase in the off farm wage increases the likelihood of working off the farm, but a decrease does not necessarily mean that the part time farmer will move back towards full time farming.

These models require that the time constraint be used as the last step in the estimation procedure and the allocation of time for each household participant is made without regard to the internal demands on time made by other family members. The contention is that time is the governor of the system to the extent that time spent on the farm plus time spent off the farm must equal the total time available and that the residual is time available for family responsibilities, leisure, and rest. Any transaction time spent in traveling to and from an off farm job or in maintaining qualifications through further study are linked with the off farm time.

This approach assumes an inherent flexibility in agriculture which may not be realistic. To the extent that the decision process as modeled is sequential it implies that the operator may actually adjust processes as they are in play. A farmer, when modeled in this fashion, might be expected to adjust acreage in response to local conditions and therefore realign effort on the farm and off the farm. The reality of current agricultural practice is that farmers are largely dependent on the weather for production and yields vary widely. The actual output is often completely unknown until the produce is weighed and/or counted. Thus a farmer cannot hold production constant and adjust time allocations as the traditional model suggests. In fact, the essential decisions that are made are largely set at one point in time, even for livestock operators if they wish to grow the feed for their animals. If mark-up margins were sufficient, a judicious operator might well be able to "buy" time by giving up some short term income in order to reap longer term gains, but the mark-up margins are narrow throughout agriculture generally and rarely permit such flexibility. The implication that the decision rules that the agent uses are sequential appears to be the major shortfall of these studies and a simultaneous systems approach is worthy of consideration.

Lass, Findeis, and Hallberg (1991) have found that individual characteristics, family structure, farm production characteristics, the relative condition of farm family finances, location issues, soil type and average precipitation are also factors in time allocation. In this context, the impression is left that a change in any one of these factors may permit the operator to reallocate effort and to rearrange the overall pattern of production and hence income generation. This also appears to be somewhat misleading as adjustment in all of these areas takes considerable time and cannot be expected to be harmonized with production decisions. Thus a simultaneous approach appears to be more realistic and more insightful.

There have been several studies of part time farming activity that have focused on the factors affecting the decision to work off of the farm. The major conclusion of all of these studies is that increases in off farm activity are due to increases in the marginal returns to off farm work relative to the marginal returns to on farm labor (Bollman 1979, Huffman 1980, Sumner 1982, Simpson and Kapitany 1983, Gould and Saupe 1989, Lass and Gempeshaw 1992, and Weersink 1992). In each of these studies there has been little or no investigation directed at what factors are likely to cause any particular agent to participate in off farm activity. There have been few, if any, investigations of even the most obvious and often assumed factors for part time farming, such as trying to pay down debt incurred in land purchases as a farmer starts out, using part time activity off the farm to aid in farm expansion or diversification, or using part time activity to ease the transition or exit from farming. Loyns and Kraut (1991) argued that relative income effects are significant because all farmers interpret their own performance in the light of the potential performance that they would achieve in other businesses.

These empirical studies have tended to focus on the estimation of an off farm demand wage only using a semi-log format. Amongst the major findings of these efforts are the result that enterprise mix is not as important as the initial decision to work off the farm, that family characteristics are not as important as the education of the spouse where both operator and spouse worked off the farm, and that health benefits were a significant motivator of off farm work in the United States. (Lass, Findeis, and Halllberg, 1991, pp. 254-258)

However, in the more traditional areas of econometric estimation, there have been conflicting results. This has been particularly noticeable in the search for income or wealth effects. Huffman (1980) attempted to identify these effects and discovered that earned income had a positive and significant effect on the off farm demand wage, while unrealized income due to appreciation on capital assets was negative. This implies that off farm income generates an attractiveness of its own which may in fact be more than just the appeal of an alternative source of cash. It may well be that farmers involved in part time activity tend to view off farm income as a cash flow to cover over temporary financial shortfalls, while permanent income is found in the on farm capitalization of assets.

Another area in which many of the studies have fallen short is in establishing a decision response to various policy issues. Weersink, Nicholson, and Weerahewa (1996) have addressed this. They use a detailed study of the reasons that respondents provide for their own part time activity as the basis for their model. This data is used to determine a reservation wage[1] as a marginal value of farm labor at that point where there is no off farm labor and there is a technologically determined time allocation between on farm work and leisure. They then jointly optimize the off farm activity of the operator and spouse. This process establishes a number of groups of part time agents. There are "dual career" farms where both operator and spouse work off the farm. The second category is "traditional part time" where only the operator works off the farm. Thirdly, there is a group labeled "dual career part time" where only the spouse works off the farm. The final category is "traditional" where neither the operator or the spouse works off the farm. The dependent variable for the demand equation is off farm income divided by off farm hours and the dependent variable in the supply equation is annual hours supplied. This model is applied to dairy farmers in Canada and the United States.

1

The reservation wage is the minimum wage at which the agent will enter the workforce and offer the first unit of off farm work. The theoretical approach is that if the reservation wages can be measured for a number of part time farmers, then there will be an off farm labor supply curve that passes through that point and describes the behavior of all part time farmers. Therefore factors that influence that curve by shifting it or rotating it also shift and or rotate the relationship and therefore can be addressed by policy.

The model was estimated using a Heckman adjustment for selectivity bias based on a bivariate PROBIT model and produced a R^2 for the demand equation of .287 and .036 for the supply equation.

The major contribution of this study is that it attempts to identify the effects of both non-agricultural and agricultural policies on the part time allocation decision. By contrasting the performance between Canada and the United States, Weersink, Nicholson, and Weerahewa, are able to isolate the overall effects on their model of general programs, such as healthcare and supply management. However, these effects are restricted to activities within the categories of respondents and do not permit the sample group to move from one category to another. Moreover, the effects that are examined are done so only after a round about impact pattern is traced out. For example, they conclude that supply management raises the reservation wage because it stabilizes prices and reduces the uncertainty of on farm returns. This does not allow for a situation in which supply management does not stabilize prices or in which supply management generates new markets entirely. In essence, this approach deals with the expected impacts of policy rather than with its measured effects.

Although this study challenges the limitations of previous studies in not imposing a time rationing effect and attempts to investigate the transmission effects within the model of policies, it does not account for changes in categories of part time activity and relies solely on anticipated policy effects. Analysis of this behavior permitting cross-category adjustments and with a more direct assessment of policy initiatives is a logical continuation.

More recently, Kenneth Bessant, (2000) has conducted a cluster analysis in order to determine the distinctive clusters into which a part time farmer may fall and for which there may well be specific policy factors that make a difference in how that behavior can be expected to be observed. This was done on the basis of interviews with 743 male operators and six clusters were discovered. The study demonstrates how clusters can be analyzed but focuses on data reduction and agglomeration, thereby setting the background for rational behavior as a socially referenced approach. This would logically require that some attempt be made to determine if the social cohesiveness of the group or cluster is in any way a conditioning factor and that in turn rests on whether or not the individual members of the cluster indeed transact amongst themselves according to any particular set of conditions. If these clusters are in fact relevant then they represent another level of abstraction within which transactions may take place and therefore require modeling. Moreover, if there are clusters that are known to the part time farmers, then there may well be interactions amongst them that require further interpretation. For the purposes of this study, simplicity will be the target even to the extent that some realism may be lost as the objective is to perform an economic evaluation rather than one that is focused on sociological factors.

The academic approach to the part time farmer has tended to treat the decision to work off the farm as a sequential optimization in response to the intended effects of policy variables rather than in terms of their direct effects. Given the rather direct impact of the tax system on any decision structure, a simultaneous modeling approach that incorporates the policy variables directly is worthy of development.

2.3 Historical Perspectives

Statistics Canada has reported that almost two-thirds (63%) of Canadian farmers reported no off farm income in 1990, while among those who worked off the farm more than half (56 %) worked more than 190 days. This is considered the "benchmark" for being recorded as a "part time farmer" by Statistics Canada. The agency also reported that generally men tended to work off farm more than women (72 days to 63 days). In Manitoba, male and female operators worked almost the same amount of time off the farm, 63 days and 62 days respectively. It was also reported that three operator farms were less likely to have some off farm work (27%), while two operator farms had a 39% off farm employment level. For single operator farms 37% reported off farm income. These background data are highlight data that are drawn from individual responses and are not published by Statistics Canada. Most studies do not report this high a percentage. (Sumner, 1991, pp. 150-54.)

Table 2.1 shows the published data for the period from 1970 to 1990 (reported as Census 1971 to Census 1991) for Canada and Manitoba and indicates a rather stable number of farmers involved in part time activity at approximately 35%. For both Canada and Manitoba there is an approximate 10% increase in the number of days of off farm work. In terms of the amount of time spent working off the farm, the category 229-365 days, is the largest in Canada and the second largest in Manitoba.

J. A. Mage (1980) maintains that this is a trend with Manitoba part time farming activity consistently below the Canadian level since 1941 while British Columbia, Ontario, Nova Scotia, and Newfoundland are consistently higher than the Canadian mark. Other factors have also been discovered in detailed analysis of Manitoba part time farmers. Bessant, Rounds, and Monu (1993) conducted an analysis of both farm size and the age of farmers involved in part time activity of at least 229 days per year. Their analysis indicates that from 1971 to 1991 the percentage of farmers working off the farm has been increasing for all farm sizes and for all ages of operators with the most significant increase in the number of full time off farm workers of age 65. The conjecture is that this latter group is working off the farm in order to capture institutionalized pension benefits.

Although the trend to off farm work is increasing, it is certainly not new. Numerous records indicate that the reorganization of farm type work off the farm has also contributed to the rise of off farm activity, even though the actual work

Table 2.1 Percentage of Farmers reporting Days Worked Off Farm in Canada and Manitoba 1971-1991.

Number of Days Worked	1-24	25-96	97-228	229-365	Total
1971					
Canada	13.5	21.8	32.1	32.6	35.3
Manitoba	14.2	24.7	35.6	25.4	30.9
1976					
Canada	10.3	20.4	35.5	33.8	31.1
Manitoba	11.4	24.1	38.4	26.0	27.2
1981					
Canada	10.6	18.3	35.1	35.9	38.7
Manitoba	12.3	23.1	35.1	29.5	35.3
1986					
Canada	9.0	18.8	36.3	35.9	39.5
Manitoba	10.8	21.6	37.2	30.3	35.5
1991					
Canada	5.7	14.7	39.0	40.6	37.5
Manitoba	7.3	16.7	40.5	35.5	35.1

Source : Statistics Canada

may be the same as that performed on the farm. Custom spraying and harvesting for off farm contractors are prime examples. Implicit in much of the controversy surrounding part time farming has been the contention that a farmer should be able to make a living by simply farming his own land in the same fashion that a factory worker could be devoted to his manufacturing role. Anthony M. Fuller (1991, p.34) has concluded that "full time farming is the aberration in modern farm history and multiple job holding among farm households is the norm."

The practice of part time farming is common amongst Manitoba farmers and has been so for quite a long time. The current circumstance may be more critical given the structural changes in the Manitoba agricultural economy as noted previously, but the forces at play seem to be consistent such that farmers make the decision to work off the farm given their particular circumstances and the needs that they have to earn income which is adequate for their perceived needs. In essence, most of these studies have focused on social targets such as pensions and employee benefits, rather than the net contribution to utility that they might make. Certainly, a farmer seeking to retire might be better off with an employer funded pension, but not every employer offers such a scheme, especially for elder workers. Similarly, a younger worker might benefit form a dental plan if it were employer funded but not otherwise.

2.4 A Legal Perspective

One of the side effects of the development of agricultural policy in Canada has been the policy focus placed on rural development. In this regard, special provisions have been made for the treatment of farms, farmers, and farming usually through the *Income Tax Act* which according to Justice T.C.C.J. Bowman of the Tax Court of Canada, include:

> ...the right to use the cash basis of accounting, family farm rollovers, accelerated capital cost allowances on certain property, current deductibility of certain expenses that would otherwise be regarded as capital, block averaging, and the exemption from the requirement to make quarterly installments. (*Hover v. M.N.R.* : 93 DTC 100[2])[3]

One other major provision of the *Income Tax Act* has operated in conjunction with a rather large body of case law (141 cases from 1972 to 1993) to counterbalance some of these effects. In particular, Section 32 empowers the Deputy Minister of National Revenue to determine whether or not a taxpayer is a *bona fide* farmer and Section 31(1) establishes limits on tax deductibility of

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Citations in this sect)ion are in the following format (Name of Case: Appelant v Defendant : Year Dominion Tax Cases Page)

3

Each of these "benefits" is unique to agriculture in their combined effects. The cash basis of accounting allows for immediate write-offs of large unexpected losses, while accelerated depreciation provides large credits for capital goods which are indirectly funded by tax concessions. In combination these policies can reduce the variation in the ways that income is reported for tax purposes.

losses at $5000.00 per year where the taxpayer is considered not to have earned his income from farming or farming and some other business.

In case law, the major decision has been given by Justice Dickson in *Moldowan v. The Queen* (77 DTC 5213) where he observes that the Act established three classes of farmers in reference to section 13(1) which is the same as section 31(1) after the subsequent revision of the *Income Tax Act*:

> (1) a taxpayer, for whom farming may reasonably be expected to provide the bulk of income or the center of work routine. Such a taxpayer who looks to farming as his livelihood is free of the limitations of s. 13(1) in those years in which he sustains a farming loss.
>
> (2) the taxpayer who does not look to farming, or to farming and some subordinate source of income, for his livelihood but carried on farming as a sideline business. Such a taxpayer is entitled to deductions as set out in s 13(1) in respect of farming losses.
>
> (3) the taxpayer who does not look to farming, or to farming and to some subordinate source of income, for his livelihood and who carried on some farming activities as a hobby. The losses sustained by such a taxpayer on his non-business farming are not deductible in any amount.(77 DTC 5216)

This set of definitions subsequently led to a set of tests that were formalized by Justices Urie, Mahoney, and J.J. Marceau (dissenting) of the Federal Court of Appeal on May 21, 1985 in *The Queen v Graham* (85 DTC 5256) who established that to claim these types of deductions a taxpayer must be qualified, shown to have committed at least the same amount of personal time and financial capital to the farming operation as to any other sources, and have a reasonable expectation that farming would constitute the chief source of income.

Even though dissenting, Justice J.J.. Marceau commented:

> The limit placed by section 31 on the deductibility of farm loses is extremely difficult to explain as it is obviously meant to apply not only to "hobby farmers" who in any event would have difficulty in establishing that farming is for them a source of income, but also and even primarily to some serious and dedicated farmers engaged in farming as a business. Of course one must assume that the goal is to prevent abuses which in this area could be more difficult to detect. But it remains that no such limit appears to have been placed on the deductibility of any other type of business losses. The view I take of the nature and the scope of the limit is all the more dissatisfying to me and I wish I would not have felt bound to adopt it.(85 DTC 5267-5268)

The overall impact of these tests has been to establish a number of boundaries on how loses from part time farming or pluriactivity involving farming are treated for tax purposes, and because taxes are paid by persons, the process has led to the subsequent development of specific criteria for categorizing part time farmers:

- the farming enterprise must be sufficiently profitable to qualify as a chief source of income. (*Hughes v. M.N.R.* : 90 DTC 1021)
- farming must have a potential profit that is substantial in relationship to the other major source of income. (*Shipowick v. M.N.R.* :90 DTC 1356)
- farming must be "significantly profitable" in terms of its scale and scope. (*Beeline Enterprises Inc. v. M.N.R.* : 90 DTC 1904)
- farming activity can not be artificially shown to have been profitable by changing accounting procedures through inventory appreciation adjustments. (*Bigelow v. The Queen* : 90 DTC 6262)
- a business plan must exist that shows when the farming activity

will become profitable. (*Dand Auto Parts and A. J. Dand Limited V. The Queen*: 90 DTC 6533)

- profitability must have been shown before capital cost allowances are taken into account (*Hunt et. al. v. M.N.R.*: 91 DTC 28)

- income averaging can only be used when the chief source of income was farming over the entire period for which averaging is applied. (*Gunderson v. M.N.R.* : 91 DTC 524)

- diversification such as adding an additional agricultural related enterprise cannot be used to transfer losses unless both have a reasonable expectation of profitability. (*Falconer v. M.N.R.* : 1991 DTC 785)

- contracting out, or using hired labour, for an enterprise does not constitute sufficient dedication to be brought alongside another source of income (*Apfelbaum v. M.N.R.*: 91 DTC 800)

- farming activity must involve a significant amount of the taxpayers time. (*Strubble v. M.N.R.*: 91 DTC 1119)

- a balance of probabilities test is valid in determining if the main source of income for the taxpayer was from farming . (*Conway-Dymond Truck Line Ltd. v, M.N.R.* : 91 DTC 1100)

- using a family member (wife) as a principal taxpayer is not sufficient to utilize farming as a chief source of income . (*Howard et. al. v. M.N.R.* : 91 DTC 1577)

- the profits from another business cannot be used to maintain a farming business and subsidize it . (*Wurtz v. M.N.R.* : 91 DTC 2292)

- while there is clear discrimination it does not contravene any constitutional guarantees. (Hover v. M.N.R. : 93 DTC 100)

- transfer of ownership does not mean the transfer of tax status to the subsequent owner. (*First Farm Inc. v. The Queen* : 93 DTC 1238)

- corporate ownership of land does not involve corporate dilution of tax benefits. (*Porayko et. al. v. M.N.R.* : 93 DTC 1430)

These cases have imposed a capital management regime which is not found in any other industry. Moreover the principle concern is that the tests are applied indiscriminately to part time farmers as well as to those who would seek to enter agriculture only to take advantage of its tax provisions. Most recently in the case of *Miller v The Queen* Justice D.G.H. Bowman cautioned that :

> Agriculture in Canada and particularly in the western provinces is going through a difficult time. It will survive through the courage, sacrifices, initiative, optimism and dedication of people like Mr. Miller and his family. Section 31 was never intended to destroy such people but if it is applied indiscriminately to genuine farmers such as the Millers, it will. (*Miller v. The Queen*: 99 DTC 1104)

Clearly the legal perspective has only recently acknowledged that part time farming is a unique category that warrants careful management of legal tests, none of which particularly relate to economic choices in the current period.

2.5 Overview

The preceding review of academic, historical and legal perspectives points out a number of common elements in the overall approach to the issue of part time farming, both in terms of the decisions to work on the farm and how much time to allocate to off farm activity.

The record to date has largely dealt with sequential models that are solved according to a given hierarchy of choices and are not particularly realistic given the generally "locked in" nature of agricultural practices. While background factors are noted as having an effect, policy impacts are often left to be traced through a series of complex assumptions and assertions and are not directly placed into the model for analysis. Similarly, historical or social studies have tended to look at overall social targets as the goals in behavior and have not focused on an economic perspective based on utility maximization. Finally, the legal community, until recently, has largely focused on financial considerations and has not looked at the motivation of the individual operators to determine if pluriactivity is the result of a rational response to income opportunities or not.

The approach taken in this study is to focus on the agent as a utility maximizing agent making allocation decisions simultaneously on the based on variables which include taxation, output prices, autonomous transfers, general prices, input prices and off farm wages.

Chapter 3

The Model

3.1 Development of the Model

In approaching the development of a model that is representative of the part time farming decision, it is assumed that the agent maximizes utility that is derived from either goods consumed in the home or from time spent at leisure. The goods must be purchased according to the limitations imposed by a budget constraint and the time spent at leisure must be secured after time is allocated to work both on and off the farm. This is a comparative static model that typifies the allocation decision made by the part time farmer. The earnings are derived from the net aftertax profit on the farm and the net aftertax income earned off the farm, plus autonomous transfers from bank interest or government support payments. Time is allocated such that time spent working also includes time spent traveling to and from work and thus the off farm wage is actually a net wage.

Part time farmers in this model are assumed to derive utility only from goods and leisure. There are minimum technical requirements for the operation of the farm in order to earn a profit and also minimum institutional levels for wages that are paid by off farm employers as are set by government regulations. There are, however, no minimum income standards that are set for farm profitability[4] and therefore this model does not make provision for any minimum standards in any area.

In a similar fashion this model does not include the provision for the farmer to save money and thereby control the level of autonomous transfers that come into the income equation. Generally farmers are seen as having relatively low levels of savings and very high levels of capitalization. Farmers will tend to invest more in new machinery than in financial assets.

Another challenge in modeling is the fact that critical factors that may change the availability of an agent for effort on the farm or off the farm such as human capital or location. These are included only as background variables and not directly in any of the equations. In this context these are merely allowed to have their effect through otherwise intractable processes.[5]

Nevertheless, the approach that this model takes is descriptive of the basic

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Several aspects of agricultural finance have been developed to deal with this issue including the establishment of various agencies such as the Farm Credit Corporation. In each case these institutional mechanisms have been established and are empowered to provide minimal financial support levels for all farmers. It is access to these types of services that part time farmers risk when they take a job off the farm.

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In the case of the part time farmer these factors may be viewed as thresholds such that an agent will be able to take job off the farm only if he has a certain level of human capital such as a skill set that is in demand. Similarly an agent may only be able to work off the farm if he can reasonably be expected to go to the job and back to the farm without undue expense in terms of time or funds. In each of these cases there will be threshold level that an individual will evaluate in order to determine whether the off farm activity is warranted.

issues and trade-offs that an agent will make in adopting a part time farming position. This approach is able to incorporate the responses that the agent makes to many of these issues even if the process of that response is not defined. The minimum standards and thresholds in some cases may act to prevent an agent form pursuing off farm work even though the circumstances that the agent faces would suggest that part time activity would be beneficial. In these cases the agent may substitute the labor of family members or hired workers for on farm effort and pursue off farm activity. This modeling approach is descriptively appropriate and flexible in order to accommodate differences in individual circumstances[6]. Utility maximization is relevant for operator specific decision-making in terms of pluriactivity[7] and the utility function is assumed to be concave.

We may now set up the model for maximizing household utility subject to the budget and time constraints.

The problem is to maximize the utility function , $U(Y_h. T_h)$,

subject to the budget constraint

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This model is exclusively dedicated to looking at the behavior of part time farmers who work off the farm and not to individuals who enter farming on a part time basis from other occupations.

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For other forms of agricultural operation this may not be appropriate. In corporate agriculture profit maximization would be more reasonable as an over-riding approach. In cooperative agriculture, such as a Hutterite colony, output maximization will generally be more appropriate.

$P_h Y_h = m (P_f (F (X_f, T_f) - W_f X_f) + n (T_m W_m + V_h)$

and the time constraint

$T = T_h + T_f + T_m$,

where:

U = utility,

Y_h = household good consumption,

T_h = time spent at home in leisure,

m = the after tax factor in percentage terms found as the residual of the tax rate as applied to farm income, defined as (1 - tax rate on farm income),

P_f = the price of farm output,

F = the production function defined as $Y_f = F(X_f, T_f)$, where Y_f is output, assumed positive and variable, and others are as defined below,

X_f = farm inputs including hired farm labor,

T_f = the operators effort in on farm work,

W_f = the factor input cost,

n = the after tax factor found as the residual of the tax rate as applied to off farm income, defined as (1-tax rate on off farm income),

W_m = the off farm wage rate,

T_m = the off farm effort,

V_h = autonomous income derived from bank interest earnings and or transfers of funds directly to the household either by way of agricultural subsidy or social programming,

P_h = the price of household goods, and

T = the total time available for effort allocation, assumed to be constant and measured as time available per period of analysis.

In this model the variables Y_h , T_h , X_f , T_f, T_m are the choice variables and are assumed positive. Where P_h , P_f , W_f , V_h, W_m ,T , m and n are assumed to be given positive constant as exogenous variables or parameters.

The concave utility function, U, is assumed to be continuous and twice differentiable increasing in household goods, Y_h, and leisure, T_h. The production function, F, is assumed to be continuous and twice differentiable increasing in factor inputs, X_f, and farm effort, T_f. The agent is further assumed to spend all of the income that is derived such that there are no savings. Time is completely allocated and the amount of time available, T, is the same for all individuals. Leisure time, T_h , is calculated as the residual.

The Lagrange function for the constrained utility maximization is

$L\,(Y_h, T_h, X_f, T_f, T_m \;; P_h, m, P_f, W_f, n, W_m, V_h, T) =$

$$U(Y_h,T_h)-\lambda\left[m\left(P_f\,F\,(X_f,T_f)-W_f\,X_f\right)+n\;(W_m\,T_m+V_h)-P_h\,Y_h\right]$$
$$-\gamma\,(T-T_h-T_f-T_m)$$

where λ and γ are Lagrange multipliers. which may be interpreted as shadow prices, namely the marginal utility of an additional dollar of income and the marginal utility of an extra hour of time available for allocation to leisure, on the farm or off the farm, respectively. The function is assumed to be strictly concave. Here the assumption is that by maximizing L with respect to the choice variables Y_h, T_h, X_f, T_f, T_m, that utility will be maximized.

The first order conditions are obtained by maximizing L in equation 1 with respect to the choice variables Y_h, T_h, X_f, T_f, T_m subject to the budget and time restrictions. The conditions are:

$$1(a)\quad \frac{\partial L}{\partial Y_h} = \frac{\partial U}{\partial Y_h} - \lambda P_h = 0$$

$$1(b)\quad \frac{\partial L}{\partial T_h} = \frac{\partial U}{\partial T_h} - \gamma = 0$$

$$1(c)\quad \frac{\partial L}{\partial X_f} = P_f \frac{\partial F}{\partial X_f} - W_f = 0$$

$$1(d)\quad \frac{\partial L}{\partial T_f} = \lambda m P_f \frac{\partial F}{\partial T_f} - \gamma = 0$$

$$1(e)\quad \frac{\partial L}{\partial T_m} = \lambda n W_m - \gamma = 0$$

$$1(f)\quad \frac{\partial L}{\partial \lambda} = m\left[P_f F(X_f, T_f) - W_f X_f\right] + n(W_m T_m + V_h) - P_h Y_h = 0$$

$$1(g)\quad \frac{\partial L}{\partial \gamma} = T - T_h - T_f - T_m = 0$$

$$1(h)\quad \lambda\left(m\left[P_f F(X_f, T_f) - W_f X_f\right] + n(W_m T_m + V_h) - P_h Y\right) = 0$$

$$1(i)\quad \gamma\left(T - T_h - T_f - T_m\right) = 0$$

This model incorporates the nontraditional features of the behavior under study, because it in essence allows the agent to deliver a "verdict" on how effective agricultural policy devices are perceived to be. If agricultural policy were truly effective then every farmer would be a full time farmer[8]. If, however, such policies are not effective, then the agent will seek to blend farming with another occupation. The rational behavior of part time farmers can be influenced by policy control over the rate of taxation of farm income, the rate of taxation of off farm income, the level of farm output prices, the level of the off farm wage rate, the existence of direct transfers, the level of farm input prices, and the level of household goods prices.

Equation 1(a) provides an interpretation that the utility of an extra dollar of income is equal to the marginal utility of a dollar spent on goods consumed in the household. Similarly 1(b) establishes that the marginal utility of an extra hour of effort either on or off the farm, is equal to the marginal value of leisure time spent in the home. In a similar fashion 1(c) establishes that the marginal productivity of factor inputs used in production is equal to the ratio of the factor prices paid for those inputs to the output price. In essence, the value of the marginal product is equal to the factor price.

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This assumes that if the farm is too small or situated on poor land and cannot make a profit regardless of the effort, then that farmer would leave agriculture rather than persist in farming. This is an extension of rational choice in this model.

Equations 1(d) and 1(e) further establish that the ratio of multipliers is the ratio of the marginal utility of an extra hour of effort to the marginal utility of an extra dollar of income and also introduce the impact of the tax rates through the aftertax variables. Here the aftertax value of the marginal product of on farm labor is equal to the aftertax value of an hour of off farm effort.

Equations 1(f) and 1(g) in turn recover the restrictions that are modeled. In essence, the model has all of the traditional properties. Equations 1(h) and 1(i) recover the restrictions in terms of λ and γ and verify that the restrictions do not alter the nature of the objective function and hence allows for the interpretation of the Lagrangean objective function as a model of the original behavior.

The relationship between equation 1(d) and 1(e) is also indicative of the impact that a differential tax system policy can have on part time behavior. This establishes the relationship:

$$\lambda m P_f \frac{\partial F}{\partial T_f} = \gamma = \lambda n W_m \Rightarrow \frac{m}{n} = \frac{W_m}{P_f \frac{\partial F}{\partial T_f}} \tag{2}$$

which can also be written as:

2a) $$\frac{m}{n} = \frac{W_m}{P_f \frac{\partial F}{\partial T_f}} \Rightarrow \mathrm{mP_f}\left(\frac{\partial F}{\partial T_f}\right) = n W_m$$

that, at the margin, the after-tax return to an hour of effort on the farm would be equal to the after-tax return to an hour of effort off the farm. This holds as long as λ is positive, or as long as there is a positive marginal utility of income. This is the primary decision rule for a rational part time farmer.

The structure of the taxation policy as applied to the part time farmer is rather unique. The major difference between the on farm tax rate and the off farm tax rate is the ability to deduct losses. In essence, the farmer will have a fairly good idea of the "tax risk" that he takes with respect to working off the farm in terms of his anticipated income. Because many farming decisions are made at a single point in time and are binding for an entire crop year, the agent can be expected to be very sensitive to what these rates are and the nature of the "tax risk". This also means that each agent has a unique on farm tax rate and a unique off farm tax rate that he faces.

The agent will balance the income flows and in so doing will ensure that the aftertax values of effort allocation returns are equal. This is the essence of equilibrium behavior and if $m = n$ in equation 2(a) then the marginal value product of on farm effort will be made equal to the wage rate paid for off farm work and the allocation decision will be based on the market signals contained in the off farm wage and the output price of farm production.

If, however, $m > n$ in equation 2(a), as is the policy intended case, where the after tax factor for on farm effort is greater than the after tax factor for off farm effort (tax on the farm is less than tax off the farm), then the agent would be induced or attracted towards full time farming behavior. This implies that the agent will change the contribution level that farm effort makes to production by increasing it in order to regain balance in this equation. Similarly if $m < n$ in equation 2(a) then the agent will tend to increase off farm activity by reducing the contribution that on farm effort makes to production. Therefore, equation 2(a) is the essential balancing equation that the rational agent will use and to the extent that it is controlled by the exogenous variables m, n, P_f and W_m, it is interpreted as an incentive favoring either on farm or off farm effort depending on the nature of the adjustment that the agent will make in response.

This later situation could also occur in a market where off farm employment is being directed by development incentives and there is a corresponding competition for labor in the local market area that drives up W_m while at the same time prices in the output sector, P_f, are being driven downward In the first case the development incentive may provide tax credits for rural employment or other such schemes that will increase the value of W_m. In a situation in which farm output prices are declining, the same relationship could emerge especially if the farmer is locked into an otherwise restrictive technology on the farm for which special tax consideration is not provided. If both occur at the same time, then the agent will face a stronger incentive to off farm work.

These tax rates are dependent on the performance of the farm operation, as the critical difference is in the level of deductibility of farming losses that the agent experiences.[9] As most operators farm for a living, losses are actual losses that must be made up somewhere. Loans and credit are available but there is also the opportunity to become a part time farmer.

From a policy administration perspective this would allow the government to use the tax differential as a policy tool to "stabilize" any perceived movement to part time farming. This policy structure also suggests several scenarios especially when m > n in equation 2(a), or when the off farm tax factor is less than the on farm tax factor (tax on the farm is less than tax off the farm). This situation implies that expanding off farm effort is irrational because the farmer should try to earn more per hour of effort on the farm by expanding output.[10] This situation may also exist if, and when, a former full time farmer becomes a part time farmer and is therefore unable to deduct the losses made in farming. While

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This situation can be quite complex as the agent lives where he works and many of the capital expenses are subject to accelerated depreciation as well as preferential taxes, yet these capital goods may also be used in the household. Similarly, because the agent can hire labor, the agent may well hire himself and pay a wage that is then also a deduction. These have often been seen as a provision that lure the "hobby farmers" into agriculture. In this model no provision to compensate for these effects has been made.

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However, if the skills and talents of the individual are not suited to expanding the productivity of farm work, or if the technology is unable to expand output because of restrictions imposed by factor inputs. This might occur if a new technology emerges that the individual does not have the skills to master and there is no provision for treatment of the capital under the terms of agricultural tax considerations. The most recent example was the introduction of personal computers when there was a lack of skill as well as a lack of consideration under the tax provisions.

there are options to leave farming entirely or to use political institutional pressure to gain transfers of funds and subsidies, the operation of the farm is unlikely to be able to overcome this on its own.

The agent must have a set of marketable skills in order to work off the farm.[11] This set of skills is gained through either formal education or experience, and is traditionally viewed as human capital. The impact of these skills can be in terms of securing a higher off farm wage rate than would otherwise be available to an agent. In such a case the tax differential would have to be higher in order to discourage off farm work and or such that the farmer would work more efficiently due to a skill set than a standardized technology would allow. Moreover, it is possible that those who work off the farm can purchase farm labor to do the tasks that they would otherwise perform and thereby increase the overall productivity of the farm while they themselves worked off the farm. Thus the skills and talents set (human capital) has a great deal to do with the part time farming decision and is essential to the understanding of economic behavior.

In this model, human capital is not seen as a factor to be allocated amongst various activities, but is allowed to influence the model as a background variable only. The value of the stock of human capital itself will allow the agent to

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This does not mean that there are jobs waiting for a farmer to take in order to become a part time farmer, but rather it is assumed that the agent has knowledge of what is available and accessible.

consider hiring other farm labor as a substitute for his or her own effort or as a complement to work along side of him or her if necessary. The balance of returns from the market suggest that he or she would earn more income by working off the farm than on it. Similarly an agent will also need to consider whether the set of skills that are marketable off the farm are sustainable, if they require the expenditure of effort and funds in order to maintain or upgrade certifications. If an agent requires these investments in order to maintain human capital, then the expenses involved will enter the equation if they are tax deductible but not otherwise. It is assumed throughout this model that the agent has taken and will take all required steps in order to maintain human capital such that the stock does not deteriorate and experience is always a net contributor to that stock.

Similarly it is expected that the agent will have more flexibility in pursuing off farm effort if the nature of the farming operation allows for discretionary time that might well be allocated off the farm. If the agent has more flexibility it is assumed that he or she will be more likely to pursue off farm work. This is a factor that will depend on the nature of the output markets to the extent that farmers will capitalize any extraordinary benefits that come from the markets. Thus if there is exceptional profit to be earned, then that exceptional profit will be turned into capital and the farmer will proceed on the basis that exceptional earnings will in fact be repeated. Thus the nature of differences in farm type will emerge from the nature of the output market pricing that the farmer operates in.

If the farm is located near a major urban center, then it is also considered more likely that the agent will pursue off farm work as the commuting costs and time will be reduced.

No account is taken of other background factors that may exists such as soil type, climate, managerial expertise, or political influence which may also be contributing background factors but are excluded from the model. Because it is a comparative static model the expectations are reflected in the planting[12] decisions and marketing positions that are taken and are assumed to be taken at the same time as decisions regarding off farm employment are made. In addition the farm size is assumed to be adjustable through rental of land and or leasing of owned land to others.

Each of the included factors may or may not have an impact as they are background variables and will reveal their effects through the analysis of data once an appropriate method of measurement is applied and an appropriate approach to estimation is undertaken.

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This approach in essence assumes that all land is allocated and there are no inefficiencies in the overall management of agricultural activity as each agent pursues their own self interest. Cases in which institutional uncertainties affect planting and land use are not considered here.

3.2 Second Order Conditions

The sufficient second order conditions for utility maximization require that the signs of the determinants of the bordered Hessian matrix alternate in sign, from positive to negative and back again, beginning with the first border preserving principal minor of order four being positive. In this model the first border preserving principal minor is the sub-matrix with four rows and four columns thus preserving the border of two restrictions. The Bordered Hessian, $H_{B,}$ is defined as follows:

$$H_B = \begin{bmatrix} 0 & 0 & -P_h & 0 & m\left(P_f \frac{\partial Y_f}{\partial X_f} - W_f\right) & m\left(P_f \frac{\partial Y_f}{\partial T_f}\right) & nW_m \\ 0 & 0 & 0 & -1 & 0 & -1 & -1 \\ -P_h & 0 & \frac{\partial^2 U}{\partial Y_h^2} & \frac{\partial^2 U}{\partial Y_h^2 \partial T_h^2} & 0 & 0 & 0 \\ 0 & -1 & \frac{\partial^2 U}{\partial Y_h^2 \partial T_h^2} & \frac{\partial^2 U}{\partial T_h^2} & 0 & 0 & 0 \\ m\left(P_f \frac{\partial Y_f}{\partial X_f} - W_f\right) & 0 & 0 & 0 & m\lambda P_f\left(\frac{\partial^2 Y_f}{\partial X_f^2}\right) & m\lambda P_f\left(\frac{\partial^2 Y_f}{\partial X_f^2 \partial T_f^2}\right) & 0 \\ m\left(P_f \frac{\partial Y_f}{\partial T_f}\right) & -1 & 0 & 0 & m\lambda P_f\left(\frac{\partial^2 Y_f}{\partial X_f^2 \partial T_f^2}\right) & m\lambda P_f\left(\frac{\partial^2 Y_f}{\partial T_f^2}\right) & 0 \\ nW_m & -1 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

We set:

a = $- P_h < 0$;

b = $m\ (P_f\,(\partial F/\partial X_f) - W_f) = 0$ by the first order condition 1 (c) above;

c = $m\ P_f\ (\partial F/\partial T_f) > 0$ as marginal productivity of input is positive;

d = $n\ W_m > 0$;

e = $\partial^2 U/\partial Y_h^2 < 0$ by the law of diminishing marginal utility;

f = $\partial^2 U/\partial Y_h \partial T_h > 0$ which is assumed and explained below;

g = $\partial^2 U/\partial T_h^2 < 0$ by the law of diminishing marginal utility;

h = $m\ \lambda\ P_f\, \partial^2 F/\partial X_f^2 < 0$ by the law of diminishing marginal productivity;

i = $m\ \lambda\ P_f\ \partial^2 F/\partial X_f\, \partial T_f > 0$ which is assumed and explained below;

j = $m \lambda P_f \partial^2 F / \partial T_f^2 < 0$ by the law of diminishing marginal productivity;

so that H_B may be written as:

$$H_B = \begin{bmatrix} 0 & 0 & a & 0 & b & c & d \\ 0 & 0 & 0 & -1 & 0 & -1 & -1 \\ a & 0 & e & f & 0 & 0 & 0 \\ 0 & -1 & f & g & 0 & 0 & 0 \\ b & 0 & 0 & 0 & h & i & 0 \\ c & -1 & 0 & 0 & i & j & 0 \\ d & -1 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} = \begin{bmatrix} 0 & 0 & a & 0 & 0 & c & d \\ 0 & 0 & 0 & -1 & 0 & -1 & -1 \\ a & 0 & e & f & 0 & 0 & 0 \\ 0 & -1 & f & g & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & h & i & 0 \\ c & -1 & 0 & 0 & i & j & 0 \\ d & -1 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

Sufficient conditions for utility maximization are:

$$H_B^1 = \begin{bmatrix} 0 & 0 & a & 0 \\ 0 & 0 & 0 & -1 \\ a & 0 & e & f \\ 0 & -1 & f & g \end{bmatrix} > 0;$$

$$H_B^2 = \begin{bmatrix} 0 & 0 & a & 0 & 0 \\ 0 & 0 & 0 & -1 & 0 \\ a & 0 & e & f & 0 \\ 0 & -1 & f & g & o \\ 0 & 0 & 0 & 0 & h \end{bmatrix} < 0;$$

$$H_B^3 = \begin{bmatrix} 0 & 0 & a & 0 & 0 & c \\ 0 & 0 & 0 & -1 & 0 & -1 \\ a & 0 & e & f & 0 & 0 \\ 0 & -1 & f & g & 0 & 0 \\ 0 & 0 & 0 & 0 & h & i \\ c & -1 & 0 & 0 & i & j \end{bmatrix} > 0 \text{ and}$$

$$H_B^4 = \begin{bmatrix} 0 & 0 & a & 0 & 0 & c & d \\ 0 & 0 & 0 & -1 & 0 & -1 & -1 \\ a & 0 & e & f & 0 & 0 & 0 \\ 0 & -1 & f & g & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & h & i & 0 \\ c & -1 & 0 & 0 & i & j & 0 \\ d & -1 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} < 0$$

Now,

$|H_B^1| = a^2 > 0.$

Further we have,

$|H_B^2| = h\,a^2 < 0$ as $h < 0$

and

$|H_B^3| = a^2\,(hj - i^2) + h\,(a^2 g + 2\,a\,f\,c + c^2 e) > 0,$

since

$a^2 > 0$; $(h\,j - i^2) > 0$, and $(a^2 g + 2\,a\,f\,c + c^2\,e) < 0$,

therefore $h\,(a^2 g + 2\,a\,f\,c + c^2\,e) > 0$.

These follow from: $a < 0$, $c > 0$, $d > 0$, $e < 0$, $f > 0$, $g < 0$, $h < 0$, $i > 0$, and $j < 0$.

It is assumed that $(h\,j - i^2) > 0$ which is consistent with concavity of the production function and we have:

$|H_B^4| = (a^2 g + 2\,a\,f\,d + d^2\,e)\,(h\,j - i^2) + h\,(c - d)^2\,(e\,g - f^2) < 0,$

since $(a^2 g + 2\,a\,f\,d + d^2\,e) < 0$;

$(h\,j - i^2) > 0$; $h < 0$; $c > 0$, $d > 0$ and

$(c - d)^2 > 0$; and $(e\,g - f^2) > 0$.

It is assumed that $(e\,g - f^2) > 0$ which is consistent with concavity of the utility function.

In this analysis the expression: $h\,(c - d)^2\,(e\,g - f^2) = 0$ holds because of the condition in equation 2. This is because $d = n\,W_m$ and $c = P_f\,\partial F / \partial T_f$. This equation argues that the agent will balance on farm and off farm work such that d

$= c$ and that implies that $(c - d)^2 = 0$ as well.

We see that all the second order sufficient conditions for constrained utility maximization are satisfied under the assumptions made.

3.3 Development of the Comparative Statics

In this section the comparative statics will be developed and set for the testing of the model and the refutable hypotheses that will follow. The model is a comparative static model such that there is no dynamic change that will take place and all characteristic decisions, once taken, are binding. A characteristic decision is one that once taken defines the nature of the operation. In this category are what crops to plant, what regime of soil management to follow, how to manage government programs, which types and levels of fertilizer, pesticide, and insecticide to use, and which particular marketing strategies should be employed. The agent is therefore a non learner and is unable to react to policy changes except on a periodic basis[13]. From a policy point of view, the parameters that are changeable are best handled in conjunction with other policy instruments in order to cause the intended effects. By pursuing a comparative static analysis, this

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The reaction functions will be step-wise depending on the nature of the policy change and any lags that are apparent in the policy change. For example, if supply prices are to be manipulated for a specific policy target, there may be counter-cyclical lags that will affect the timing of these adjustments. Moreover, there will also be market changes that can affect the policy impact and these may actually operate against the intended effect of the policy itself.

research will seek to identify the bundles of policy tools that can be used.

The order of the exogenous variables are grouped as P_h , W_f, P_f, W_m, V_h, T, m, and n which differs from the order of appearance in equation 1. The first order conditions are rewritten in terms of this structure as :

$$3(a) \quad \frac{\partial L}{\partial \lambda} = m\left[P_f F(X_f, T_f) - W_f X_f\right] + n(W_m T_m + V_h) - P_h Y_h = 0$$

$$3(b) \quad \frac{\partial L}{\partial \gamma} = T - T_h - T_f - T_m = 0$$

$$3(c) \quad \frac{\partial L}{\partial Y_h} = \frac{\partial U}{\partial Y_h} - \lambda P_h = 0$$

$$3(d) \quad \frac{\partial L}{\partial T_h} = \frac{\partial U}{\partial T_h} - \gamma = 0$$

$$3(e) \quad \frac{\partial L}{\partial X_f} = \lambda m P_f \frac{\partial F}{\partial X_f} - \lambda m W_f = 0$$

$$3(f) \quad \frac{\partial L}{\partial T_f} = \lambda m P_f \frac{\partial F}{\partial T_f} - \gamma = 0$$

$$3(g) \quad \frac{\partial L}{\partial T_m} = \lambda n W_m - \gamma = 0$$

Taking the total differentials for equations 3(a) to 3(g) we get:

$$4(a)\quad -P_h[dY_h]+m\left(P_f\frac{\partial F}{\partial X_f}-W_f\right)[dX_f]+m\left(P_f\frac{\partial F}{\partial T_f}\right)[dT_f]+$$
$$nW_m[dT_m]-Y_h[dP_h]-mX_f[dW_f]+mY_f[dP_f]+nT_m[dW_m]$$
$$+n[dV_h]+(X_fW_f-P_fY_f)[dm]+(T_mW_m+V_h)[dn]=0$$

$$4(b)\quad -1[\mathrm{dT}_h]-1[dT_f]-1[dT_m]+1[dT]=0$$

$$4(c)\quad -P_h[d\lambda]+\frac{\partial^2 U}{\partial Y_h^2}[dY_h]+\frac{\partial^2 U}{\partial T_h\partial Y_h}[dT_h]-\lambda[dP_h]=0$$

$$4(d)\quad -1[\partial\gamma]+\frac{\partial^2 U}{\partial T_h\partial Y_h}[dY_h]+\frac{\partial^2 U}{\partial T_h^2}[dT_h]=0$$

$$4(e)\quad P_f\frac{\partial^2 F}{\partial X_f^2}[dX_f]+P_f\frac{\partial^2 F}{\partial X_f\partial T_f}[dT_f]-1[dW_f]+\left(\frac{\partial F}{\partial X_f}\right)[dP_f]=0$$

$$4(f)\quad mP_f\left(\frac{\partial F}{\partial T_f}\right)[d\lambda]-1[d\gamma]+m\lambda P_f\frac{\partial^2 F}{\partial X_f\partial T_f}[dX_f]+$$
$$m\lambda P_f\frac{\partial^2 F}{\partial T_f^2}[dT_f]+m\lambda\frac{\partial F}{\partial T_f}[dP_f]+\lambda P_f\frac{\partial F}{\partial T_f}[dm]=0$$

$$4(g)\quad nW_m[d\lambda]-1[d\gamma]+\lambda n[dW_m]+\lambda W_m[dn]=0$$

Moving terms involving the exogenous variations dP_h, dW_f, dP_f, dW_m, dV_h, dT, dm and dn to the right hand side we get:

$$5(a)\quad -P_h[dY_h]+m\left(P_f\frac{\partial F}{\partial X_f}-W_f\right)[dX_f]+$$
$$m\left(P_f\frac{\partial F}{\partial T_f}\right)[dT_f]+nW_m[dT_m]=$$
$$Y_h[dP_h]+mX_f[dW_f]-mY_f[dP_f]-nT_m[dW_m]-n[dV_h]-$$
$$(X_fW_f-P_fY_f)[dm]-(T_mW_m+V_h)[dn]$$

$$5(b)\quad -1[dT_h]-1[dT_f]-1[dT_m]=1[dT]$$

$$5(c)\quad -P_h[d\lambda]+\frac{\partial^2 U}{\partial Y_h^2}[dY_h]+\frac{\partial^2 U}{\partial T_h \partial Y_h}[dT_h]=\lambda[dP_h]$$

$$5(d)\quad -1[\partial\gamma]+\frac{\partial^2 U}{\partial T_h \partial Y_h}[dY_h]+\frac{\partial^2 U}{\partial T_h^2}[dT_h]=0$$

$$5(e)\quad P_f\frac{\partial^2 F}{\partial X_f^2}[dX_f]+P_f\frac{\partial^2 F}{\partial X_f \partial T_f}[dT_f]=+1[dW_f]-\left(\frac{\partial F}{\partial X_f}\right)[dP_f]$$

$$5(f)\quad mP_f\left(\frac{\partial F}{\partial T_f}\right)[d\lambda]-1[d\gamma]+m\lambda P_f\frac{\partial^2 F}{\partial X_f \partial T_f}[dX_f]+m\lambda P_f\frac{\partial^2 F}{\partial T_f^2}[dT_f]=$$
$$-m\lambda\frac{\partial F}{\partial T_f}[dP_f]-\lambda P_f\frac{\partial F}{\partial T_f}[dm]\quad -m\lambda\frac{\partial F}{\partial T_f}[dP_f]-\lambda P_f\frac{\partial F}{\partial T_f}[dm]$$

$$5(g)\quad nW_m[d\lambda]-1[d\gamma]=-\lambda n[dW_m]-\lambda W_m[dn]=0$$

In order to study the impacts of each exogenous variable individually, we consider seven cases with only one exogenous variable changing in each case. We may write these equations in matrix form as 6(a) to 6(h).

The impact of a change in P_h is given by solving the matrix equation 6(a), where we take $dP_h \neq 0$, $dW_f = dP_f = dW_m = dV_h = dT = dm = dn = 0$. This indicates the effect on each of the choice variables of a change in the exogenous P_h.

$$6(a)\quad \begin{bmatrix} 0 & 0 & -P_h & 0 & 0 & m\left(P_f \dfrac{\partial F}{\partial T_f}\right) & nW_m \\ 0 & 0 & 0 & -1 & 0 & -1 & -1 \\ -P_h & 0 & \dfrac{\partial^2 U}{\partial Y_h^2} & \dfrac{\partial^2 U}{\partial Y_h \partial T_h} & 0 & 0 & 0 \\ 0 & -1 & \dfrac{\partial^2 U}{\partial Y_h \partial T_h} & \dfrac{\partial^2 U}{\partial T_h^2} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & P_f \dfrac{\partial^2 F}{\partial X_f^2} & P_f \dfrac{\partial^2 F}{\partial X_f \partial T_f} & 0 \\ m\left(P_f \dfrac{\partial F}{\partial T_f}\right) & -1 & 0 & 0 & mP_f \dfrac{\partial^2 F}{\partial X_f \partial T_f} & mP_f \dfrac{\partial^2 F}{\partial T_f^2} & 0 \\ nW_m & -1 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} d\lambda \\ d\gamma \\ dY_h \\ dT_h \\ dX_f \\ dT_f \\ dT_m \end{bmatrix} = \begin{bmatrix} Y_h[dP_h] \\ 0 \\ \lambda[dP_h] \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

The impact of a change in W_f is given by solving the matrix equation 6(b), where we take $dW_f \neq 0$, $dP_h = dP_f = dW_m = dV_h = dT = dm = dn = 0$.

$$
6(b)\quad
\begin{bmatrix}
0 & 0 & -P_h & 0 & 0 & m\left(P_f \frac{\partial F}{\partial T_f}\right) & nW_m \\
0 & 0 & 0 & -1 & 0 & -1 & -1 \\
-P_h & 0 & \frac{\partial^2 U}{\partial Y_h^2} & \frac{\partial^2 U}{\partial Y_h \partial T_h} & 0 & 0 & 0 \\
0 & -1 & \frac{\partial^2 U}{\partial Y_h \partial T_h} & \frac{\partial^2 U}{\partial T_h^2} & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & P_f \frac{\partial^2 F}{\partial X_f^2} & P_f \frac{\partial^2 F}{\partial X_f \partial T_f} & 0 \\
m\left(P_f \frac{\partial F}{\partial T_f}\right) & -1 & 0 & 0 & mP_f \frac{\partial^2 F}{\partial X_f \partial T_f} & mP_f \frac{\partial^2 F}{\partial T_f^2} & 0 \\
nW_m & -1 & 0 & 0 & 0 & 0 & 0
\end{bmatrix}
\begin{bmatrix} d\lambda \\ d\gamma \\ dY_h \\ dT_h \\ dX_f \\ dT_f \\ dT_m \end{bmatrix}
=
\begin{bmatrix} mX_f\left[dW_f\right] \\ 0 \\ 0 \\ 0 \\ +1\left[dW_f\right] \\ 0 \\ 0 \end{bmatrix}
$$

The impact of a change in P_f is given by solving the matrix equation 6(c), where we take $dP_f \neq 0$, $dW_f = dP_h = dW_m = dV_h = dT = dm = dn = 0$.

$$
6(c)\quad
\begin{bmatrix}
0 & 0 & -P_h & 0 & 0 & m\left(P_f \frac{\partial F}{\partial T_f}\right) & nW_m \\
0 & 0 & 0 & -1 & 0 & -1 & -1 \\
-P_h & 0 & \frac{\partial^2 U}{\partial Y_h^2} & \frac{\partial^2 U}{\partial Y_h \partial T_h} & 0 & 0 & 0 \\
0 & -1 & \frac{\partial^2 U}{\partial Y_h \partial T_h} & \frac{\partial^2 U}{\partial T_h^2} & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & P_f \frac{\partial^2 F}{\partial X_f^2} & P_f \frac{\partial^2 F}{\partial X_f \partial T_f} & 0 \\
m\left(P_f \frac{\partial F}{\partial T_f}\right) & -1 & 0 & 0 & mP_f \frac{\partial^2 F}{\partial X_f \partial T_f} & mP_f \frac{\partial^2 F}{\partial T_f^2} & 0 \\
nW_m & -1 & 0 & 0 & 0 & 0 & 0
\end{bmatrix}
\begin{bmatrix} d\lambda \\ d\gamma \\ dY_h \\ dT_h \\ dX_f \\ dT_f \\ dT_m \end{bmatrix}
=
\begin{bmatrix} -mY_f\left[dP_f\right] \\ 0 \\ 0 \\ 0 \\ -(\partial F / \partial X_f)\left[dP_f\right] \\ -m\lambda(\partial F / \partial T_f)\left[dP_f\right] \\ 0 \end{bmatrix}
$$

The impact of a change in W_m is given by solving the matrix equation 6(d), where we take $dW_m \neq 0$, $dW_f = dP_f = dP_h = dV_h = dT = dm = dn = 0$.

$$6(d)\quad \begin{bmatrix} 0 & 0 & -P_h & 0 & 0 & m\left(P_f \frac{\partial F}{\partial T_f}\right) & nW_m \\ 0 & 0 & 0 & -1 & 0 & -1 & -1 \\ -P_h & 0 & \frac{\partial^2 U}{\partial Y_h^2} & \frac{\partial^2 U}{\partial Y_h \partial T_h} & 0 & 0 & 0 \\ 0 & -1 & \frac{\partial^2 U}{\partial Y_h \partial T_h} & \frac{\partial^2 U}{\partial T_h^2} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & P_f \frac{\partial^2 F}{\partial X_f^2} & P_f \frac{\partial^2 F}{\partial X_f \partial T_f} & 0 \\ m\left(P_f \frac{\partial F}{\partial T_f}\right) & -1 & 0 & 0 & mP_f \frac{\partial^2 F}{\partial X_f \partial T_f} & mP_f \frac{\partial^2 F}{\partial T_f^2} & 0 \\ nW_m & -1 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} d\lambda \\ d\gamma \\ dY_h \\ dT_h \\ dX_f \\ dT_f \\ dT_m \end{bmatrix} = \begin{bmatrix} -nT_m[dW_m] \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ -n\lambda[dW_m] \end{bmatrix}$$

The impact of a change in V_h is given by solving the matrix equation 6(e), where we take $dV_h \neq 0$, $dW_f = dP_f = dW_m = dP_h = dT = dm = dn = 0$.

$$6(e)\quad \begin{bmatrix} 0 & 0 & -P_h & 0 & 0 & m\left(P_f \frac{\partial F}{\partial T_f}\right) & nW_m \\ 0 & 0 & 0 & -1 & 0 & -1 & -1 \\ -P_h & 0 & \frac{\partial^2 U}{\partial Y_h^2} & \frac{\partial^2 U}{\partial Y_h \partial T_h} & 0 & 0 & 0 \\ 0 & -1 & \frac{\partial^2 U}{\partial Y_h \partial T_h} & \frac{\partial^2 U}{\partial T_h^2} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & P_f \frac{\partial^2 F}{\partial X_f^2} & P_f \frac{\partial^2 F}{\partial X_f \partial T_f} & 0 \\ m\left(P_f \frac{\partial F}{\partial T_f}\right) & -1 & 0 & 0 & mP_f \frac{\partial^2 F}{\partial X_f \partial T_f} & mP_f \frac{\partial^2 F}{\partial T_f^2} & 0 \\ nW_m & -1 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} d\lambda \\ d\gamma \\ dY_h \\ dT_h \\ dX_f \\ dT_f \\ dT_m \end{bmatrix} = \begin{bmatrix} -n[dV_h] \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

The impact of a change in T is given by solving the matrix equation 6(f), where we take $dT \neq 0$, $dW_f = dP_f = dW_m = dV_h = dP_h = dm = dn = 0$.

$$6(f)\quad \begin{bmatrix} 0 & 0 & -P_h & 0 & 0 & m\left(P_f \frac{\partial F}{\partial T_f}\right) & nW_m \\ 0 & 0 & 0 & -1 & 0 & -1 & -1 \\ -P_h & 0 & \frac{\partial^2 U}{\partial Y_h^2} & \frac{\partial^2 U}{\partial Y_h \partial T_h} & 0 & 0 & 0 \\ 0 & -1 & \frac{\partial^2 U}{\partial Y_h \partial T_h} & \frac{\partial^2 U}{\partial T_h^2} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & P_f \frac{\partial^2 F}{\partial X_f^2} & P_f \frac{\partial^2 F}{\partial X_f \partial T_f} & 0 \\ m\left(P_f \frac{\partial F}{\partial T_f}\right) & -1 & 0 & 0 & mP_f \frac{\partial^2 F}{\partial X_f \partial T_f} & mP_f \frac{\partial^2 F}{\partial T_f^2} & 0 \\ nW_m & -1 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} d\lambda \\ d\gamma \\ dY_h \\ dT_h \\ dX_f \\ dT_f \\ dT_m \end{bmatrix} = \begin{bmatrix} 0 \\ +1[dT] \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

In this model we take T as fixed and do not analyzed it further. This assumption in effect neutralizes the possibility that the agent may hire more effort on the farm than the total amount of time that is needed in order to accomplish other tasks than maintain the farm production function. However, in such a case another form of farm organization may be more appropriate such as a corporate structure in which the objective would no longer be utility maximization. For the family farm this restriction is valid and realistic.

The impact of a change in m is given by solving the matrix equation 6(g), where we take $dm \neq 0$, $dW_f = dP_f = dW_m = dV_h = dT = dP_h = dn = 0$.

$$
6(g)\quad
\begin{bmatrix}
0 & 0 & -P_h & 0 & 0 & m\left(P_f \frac{\partial F}{\partial T_f}\right) & nW_m \\
0 & 0 & 0 & -1 & 0 & -1 & -1 \\
-P_h & 0 & \frac{\partial^2 U}{\partial Y_h^2} & \frac{\partial^2 U}{\partial Y_h \partial T_h} & 0 & 0 & 0 \\
0 & -1 & \frac{\partial^2 U}{\partial Y_h \partial T_h} & \frac{\partial^2 U}{\partial T_h^2} & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & P_f \frac{\partial^2 F}{\partial X_f^2} & P_f \frac{\partial^2 F}{\partial X_f \partial T_f} & 0 \\
m\left(P_f \frac{\partial F}{\partial T_f}\right) & -1 & 0 & 0 & mP_f \frac{\partial^2 F}{\partial X_f \partial T_f} & mP_f \frac{\partial^2 F}{\partial T_f^2} & 0 \\
nW_m & -1 & 0 & 0 & 0 & 0 & 0
\end{bmatrix}
\begin{bmatrix} d\lambda \\ d\gamma \\ dY_h \\ dT_h \\ dX_f \\ dT_f \\ dT_m \end{bmatrix}
=
\begin{bmatrix} \left[P_f Y_f - X_f W_f\right][dm] \\ 0 \\ 0 \\ 0 \\ 0 \\ \left[\lambda P_f \left(\frac{\partial F}{\partial T_f}\right)\right][dm] \\ 0 \end{bmatrix}
$$

The impact of a change in m is given by solving the matrix equation 6(h) , where we take $dn \neq 0$, $dW_f = dP_f = dW_m = dV_h = dT = dn = dP_h = 0$.

$$
6(h)\quad
\begin{bmatrix}
0 & 0 & -P_h & 0 & 0 & m\left(P_f \frac{\partial F}{\partial T_f}\right) & nW_m \\
0 & 0 & 0 & -1 & 0 & -1 & -1 \\
-P_h & 0 & \frac{\partial^2 U}{\partial Y_h^2} & \frac{\partial^2 U}{\partial Y_h \partial T_h} & 0 & 0 & 0 \\
0 & -1 & \frac{\partial^2 U}{\partial Y_h \partial T_h} & \frac{\partial^2 U}{\partial T_h^2} & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & P_f \frac{\partial^2 F}{\partial X_f^2} & P_f \frac{\partial^2 F}{\partial X_f \partial T_f} & 0 \\
m\left(P_f \frac{\partial F}{\partial T_f}\right) & -1 & 0 & 0 & mP_f \frac{\partial^2 F}{\partial X_f \partial T_f} & mP_f \frac{\partial^2 F}{\partial T_f^2} & 0 \\
nW_m & -1 & 0 & 0 & 0 & 0 & 0
\end{bmatrix}
\begin{bmatrix} d\lambda \\ d\gamma \\ dY_h \\ dT_h \\ dX_f \\ dT_f \\ dT_m \end{bmatrix}
=
\begin{bmatrix} \left[-T_m W_m - V_h\right][dn] \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ -\lambda W_m [dn] \end{bmatrix}
$$

In order to assess the comparative static results for changes in each of the seven exogenous variables, Cramer's Rule will be applied. (Varian, p.59) This technique will be discussed in detail in the section where the comparative statics are computed.

It should be noted that the left hand side matrix is not always the bordered Hessian matrix used for the determination of global utility maximization. However, in this case the only difference is the exclusion of the positive multipliers m and λ in the sub-matrix referring to the production function elements of the left hand side matrix. The sign is not changed because these variables are positive.

In the sections which follow the comparative statics are grouped as classes of exogenous variables such that effects of m and n are viewed as taxation policy variables, P_f and V_h are viewed as price support and autonomous transfer policies that are designed to raise farm incomes and are the traditional purview of agricultural policy, household goods prices, P_h and farm input prices ,W_f, are the domain of general economic policy, usually within the framework of fiscal policy and industrial policy respectively, and the off farm wage, W_m, is considered as a part of regional development policy. In each case the effects on the marginal utility of income, λ, and the marginal utility of time, γ, are analyzed as are the impacts on the primary effort allocation decisions for leisure, T_h, for on farm effort, T_f, and for off farm effort, T_m. The impacts on consumption, Y_h, and factor usage, X_f, are analyzed at the end of each section.

3.4 Selection of a Functional Form

The selection of a functional form is required in order to provide greater precision in the results and to motivate the application of economic theory to the estimated parameters. It is may also be possible to use the selected functional form to assist in the signing of the comparative static results. The purpose of this study is to evaluate policy and therefore a functional form that provides a setting in which a specific statistic can be estimated and compared to observed data is desirable. A Cobb Douglas function for both the utility and the production functions is selected for the analysis as a matter of convenience in order to identify the parameters that are essential in as simple and as compact a form as possible, while permitting the background variables to have an impact.

For the utility function the form is:

$$7(a) \quad U = A^{*} Y_h^{\alpha} T_h^{\beta}$$

where utility is assumed to be a function of a autonomous scale parameter[14] A^* and the level of household consumption, Y_h and the level of leisure, T_h, where the parameters include the exponents α and β as well. These are interpreted as the

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In this analysis the value of $A^* = 1$ is assumed. The maximization is therefore U/A^* which does not affect the maximization of U as A^* is a monotonic transformation.

elasticities or responsiveness of the utility of the agent to each of Y_h and T_h,.

The derivatives that are appropriate for the first order conditions are:

$$\frac{\partial U}{\partial Y_h} = \frac{\alpha U}{Y_h} \quad ; \quad \frac{\partial U}{\partial T_h} = \frac{\beta U}{T_h} \qquad 7(a.1)$$

For the production function the form is:

$$7(b) \quad F = Y_f = B * X_f^{\theta} T_f^{\pi}$$

where production is assumed to be a function of an autonomous scale parameter B* and the production inputs, X_f, and on farm effort T_f where the parameters include elasticities or responsiveness of produced output to changes in these inputs are θ and π respectively. The corresponding derivatives are:

$$\frac{\partial F}{\partial X_f} = \frac{\theta Y_f}{X_f} \; ; \; \frac{\partial F}{\partial T_f} = \frac{\pi Y_f}{T_f} \qquad 7(b.1)$$

with the appropriate substitutions from 7(a.1) and 7(b.1) into 1(a) - 1(g) the following parametric first order conditions are defined:

$$8(a)\quad \frac{\partial L}{\partial Y_h} = \frac{\partial U}{\partial Y_h} - \lambda P_h = 0 \Rightarrow \frac{\alpha U}{Y_h} = \lambda P_h \Rightarrow U = \frac{\lambda P_h Y_h}{\alpha}$$

$$8(b)\quad \frac{\partial L}{\partial T_h} = \frac{\partial U}{\partial T_h} - \gamma = 0 \Rightarrow \frac{\beta U}{T_h} = \gamma \Rightarrow U = \frac{\gamma T_h}{\beta}$$

$$8(c)\quad \frac{\partial L}{\partial X_f} = P_f \frac{\partial F}{\partial X_f} - W_f = 0 \Rightarrow \frac{\theta Y_f}{X_f} = \frac{W_f}{P_f}$$

$$8(d)\quad \frac{\partial L}{\partial T_f} = \lambda m P_f \frac{\partial F}{\partial T_f} - \gamma = 0 \Rightarrow m P_f \frac{\pi Y_f}{T_f} = \frac{\gamma}{\lambda}$$

$$8(e)\quad \frac{\partial L}{\partial T_m} = \lambda n W_m - \gamma = 0 \Rightarrow n W_m = \frac{\gamma}{\lambda}$$

$$8(f)\quad \frac{\partial L}{\partial \lambda} = m\left[P_f F(X_f, T_f) - W_f X_f\right] + n(W_m T_m + V_h) - P_h Y_h = 0$$

$$8(g)\quad \frac{\partial L}{\partial \gamma} = T - T_h - T_f - T_m = 0$$

In the analysis which follows the policy variables will be signed in terms of their comparative statics. The general rule will be to interpret the signs of the determinants without reference to the functional form. However, in several specific cases the functional form and or its assumed properties will be used.

For ease of presentation, a number of substitutions are made and the entries are signed according to the assumptions of positive coefficients in the Cobb Douglas functional form. We shall assume: $0 < \alpha < 1, 0 < \beta < 1, 0 < \theta < 1$, and $0 < \pi < 1$.

The substitutions with the Cobb Douglas parameters are:

$$a = \quad - P_h < 0$$

$$b = \quad m\,(P_f\,(\partial F/\partial X_f) - W_f) = m\,(P_f\,\theta Y_f/X_f - W_f) = 0$$

$$c = \quad m\,P_f\,(\partial F/\partial T_f) = m\,P_f\,\pi\,Y_f/T_f > 0$$

$$d = \quad n\,W_m > 0$$

$$e = \quad \partial^2 U/\partial Y_h^{\,2} = \alpha\,(\alpha - 1)\,U/Y_h^{\,2} < 0$$

$$f = \quad \partial^2 U/\partial Y_h\,\partial T_h = \alpha\,\beta\,U/(Y_h\,T_h) > 0$$

$$g = \quad \partial^2 U/\partial T_h^{\,2} = \beta\,(\beta - 1)\,U/T_h^{\,2} < 0$$

$$h = \quad m\,\lambda\,P_f\,\partial^2 F/\partial X_f^2 = m\,\lambda\,P_f\,\theta\,(\theta - 1)Y_f/X_f^2 < 0$$

$$i = \quad m\,\lambda\,P_f\,\partial^2 F/\partial X_f\,\partial T_f = m\,\lambda\,P_f\,\theta\,\pi\,Y_f/X_f\,T_f > 0$$

$$j = \quad m\,\lambda\,P_f\,\partial^2 F/\partial T_f^2 = m\,\lambda\,P_f\pi\,(\pi - 1)\,Y_f/T_f^2 < 0$$

The computation of the comparative static results requires the calculation of the determinants and will involve several co-factors that cannot be signed in advance. However, there is one co-factor d-c which can be signed in advance using the first order conditions and particularly equation 2. This relates to the circumstance in which the tax differential and the opportunity cost to the farmer of working on the farm at the net off farm wage rate, is compared to the overall revenue that is returned from farming. In this circumstance the agent evaluates effort at the less volatile off farm wage relative to the tax differential. It is this situation in which the agent evaluates own effort spent at farming against alternative income sources. However, because of the relationship in equation 2 it follows that at equilibrium this value is zero as all balances are assumed to have been made and all adjustments that are due to the notional tax rates and aftertax factors are in place.

The functional form also has an impact on the comparative statics left hand side variables and the following are the values used with substitutions:

$A = Y_h$, $M = \lambda$

$B = m X_f$,

$C = - m Y_f$, $F = - \theta Y_f / X_f$, and $G = - m \lambda \pi Y_f / T_f$

$D = - n W_m$, $I = - \lambda n$

$N = - n$

$H = P_f Y_f - X_f W_f$, and $J = \lambda \pi Y_f / T_f$ and

$K = - T_m W_m - V_h$ and $L = - \lambda$.

In preparing the material that follows the comparative statics that relate to the marginal utility of income and the marginal utility of time will be dealt with first and the allocation of time to leisure , on farm work and off farm work will be focused on secondly. In each case the conditions that apply to production, utility and profitability will be interpreted and patterns drawn out.

The first step is the evaluation of the sign of the numerator which when combined with the sign of the denominator, the same sign as the second order condition for utility maximization, will indicate the direction of the effect.

In applying Cramer's Rule[15] we define the determinant of the denominator matrix as $|\Delta|$ which is equal to $(a^2 g + 2 a f d + d^2 e)(h j - i^2) + h (c - d)^2 (e g - f^2) < 0$[16]. The comparative static for each of the endogenous variables as impacted by changes in each of the exogenous variables is then found by taking the determinant of the numerator matrix $|N|$ as a ratio of $|\Delta|$. This technique defines the impact given that all other effects are assumed to be zero, thus it is important to search for patterns in the comparative static results that indicate whether one effect, with all others being held constant is complementary or compensatory to another effect. If one effect is complementary to another then either policy instrument may be used. If they are compensatory then a change in

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For solving systems of linear equations of the following form:

$$\begin{pmatrix} a_{11} & \cdots & a_{1n} \\ \vdots & & \vdots \\ a_{n1} & \cdots & a_{nn} \end{pmatrix} \begin{pmatrix} x_1 \\ \vdots \\ x_n \end{pmatrix} = \begin{pmatrix} b_1 \\ \vdots \\ b_n \end{pmatrix}$$

which may be written as Ax =b. To find the component of x_i of the solution vector to this system of linear equations, replace the i[th] column of matrix A with the column vector b to form matrix A_i. Then x_i is the determinant of A_i divided by the determinant of A:

$$x_i = \frac{|A_i|}{|A|}$$

(Varian, p. 477). In this analysis $A_i = N$ and $A = \Delta$.

16 Where $h (c - d)^2 (e g - f^2) = 0$ as $c - d = 0$ and therefore $(c - d)^2 = 0$.

one direction in one exogenous variable may have an opposite effect to a change in the other exogenous variable in the opposite direction. This is an empirical question to be answered by thorough analysis, but it must have a theoretical basis that is demonstrated through the comparative statics in order to be useful in policy analysis.

3.5 The Impact of Taxation Policy

In this section the impact of m , the aftertax factor on farm income and n, the after tax factor on off farm income will be analyzed as components of the taxation policy that includes audit and review functions as applied to part time farmers. This policy option is completely within the control of the government.

3.5.1 The Impact on λ of the On Farm Aftertax Factor m

For the comparative static that relates the marginal value of an extra dollar of income to the on farm after-tax rate, we have $\partial\lambda / \partial m$, where the numerator matrix has a determinant which can be factored to a form such as:

$$[-H\,(e\,g - f^2)] + J\,(a\,f + e\,d)\ \ (h\,j - i^2) \qquad (9)$$

where for H the level of profit $(e\,g - f^2) > 0$, $J > 0$, $a < 0$, $f > 0$, $e < 0$, and $(h\,j - i^2) > 0$ we have for the case of a profitable farm it follows that $-H$ will be negative and the overall expression $(-H\,(e\,g - f^2)) < 0$. Then for the second expression to also be negative with $h\,j - i^2 > 0$ requires that

$a\,f + e\,d$ be negative which it is by the definitions and assumptions used above.

Under the first set of conditions the determinant will be signed negative and the overall comparative static will be positive implying that the marginal utility of an extra dollar of income will increase if the aftertax rate for on farm effort is increased provided that the farm is profitable.[17] If the farm is not profitable then the relationship that must hold for the relationship to be negative is that $J\,(a\,f + e\,d)(h\,j - i^2) > - H\,(e\,g - f^2)$ for the determinant to be negative and the overall relationship to be positive. Otherwise the sign will be indeterminate.

The comparative static $\partial\lambda / \partial m < 0$.

3.5.2 The Impact on λ of the Off Farm Aftertax Factor n

For the comparative static $\partial\lambda / \partial n$ the numerator matrix has a determinant valued:

$$\left[- K + L\left(a\,f + e\,d\right)\right](h\,j - i^2) \qquad (10)$$

where for $K < 0$, $(h\,j - i^2) > 0$, $L < 0$, we have that

$- K + L\,[a\,f + e\,d] > 0$ and $- K + L\,[a\,f + e\,d]\,(h\,j - i^2) > 0$ will hold.

Thus we have that $\partial\lambda / \partial n < 0$. This implies that for the marginal utility of income will increase as the off farm, aftertax rate decreases.

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This depends on the value of $H = P_f Y_f - W_f\,X_f$ which is the profit of the farm.

3.5.3 The Impact on γ of the On Farm Aftertax Factor m

The comparative static for $\partial\gamma/\partial m$, relates to the impact that a change in the aftertax rate on the farm would have on the marginal utility of time and is based on the numerator matrix determinant:

$$-\left[-Hd(eg-f^2)\right]-aJ(ag+fd)(jh-i^2) \qquad (11)$$

where for H positive, $d > 0$, $e\,g - f^2 > 0$, $a < 0$, $J > 0$, $j\,h - i^2 > 0$, $h < 0$, $c > 0$, the signs depend upon the values of $a\,g + f\,d$.

The sign of $a\,g + f\,d$ will be positive and the determinant will be positive for the comparative static to be negative implying that for a profitable[18] farm the marginal utility of time may increase as the level of the on farm aftertax factor decreases. For a non profitable farm for the determinant to be positive requires that $-(-H\,d\,(e\,g - f^2)) < -\,a\,J\,(a\,g + f\,d)(j\,h - i^2)$ hold, otherwise it will be non positive and the comparative static sign will be indeterminate.

The comparative static $\partial\gamma/\partial m$ is indeterminate..

3.5.4 The Impact on γ of the Off Farm Aftertax Factor n

The comparative static $\partial\gamma/\partial n$ involves the evaluation of the determinant

$$\left[a\,L\,(ag + fd) - K\right]\left[hj - i^2\right] \qquad (12)$$

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[18] $H = Y_f P_f - W_f X_f$ which is the profit of the farm.

where $a < 0$, $L < 0$, $g < 0$, $f > 0$, $d > 0$, $K < 0$, and $h\,j - i^2 > 0$ produces the situation in which $a\ L\ (a\ g + f\ d\ ) -\ K$ determines the value of the determinant. This is always positive and therefore the determinant is positive and the overall comparative static is negative.

3.5.5 The Impact on T_h of the On Farm Aftertax Factor m

The comparative static result $\partial T_h / \partial m$ depends on the determinant:

$$-\left(\left[a^2 J + H\,(a\ f + e\ d)\right](h\ j - i^2)\right) \tag{13}$$

Given that $J > 0$ we have that $a^2 J > 0$ and $H\ (a\ f + e\ d)$ is positive only for a non profitable farm. Thus the overall expression is negative and the comparative static itself is positive.

This implies that for a non profitable farm the comparative static will be positive implying that the agent will take more leisure as the aftertax factor on the farm increases. It is also possible that even if the farm is profitable that this will occur but this condition holds only if $a^2\ J > H\ (a\ f + e\ d)$, otherwise the sign is indeterminate.

3.5.6 The Impact on T_f of the On Farm Aftertax Factor m

For the comparative static $\partial T_f / \partial m$ the matrix in the numerator has determinant:

$$-hJ\left[af(d+c)+(ga^2+ced)\right] \qquad (14)$$

where $h < 0$, $a < 0$, $f > 0$, $J > 0$, $d > 0$, $c > 0$, $g < 0$, $a^2 > 0$,and $e < 0$ implies that the sign of the overall determinant will depend on the value of $a f (d + c) +(g a^2 + c e d)$. Given that $a f (d + c) <0$ and $(g a^2 + c e d) <0$, with $- h J >0$ it follows that the sign of the determinant will be negative and the overall comparative static will be positive.

These conditions will establish the agent will expend more effort on the farm if the aftertax factor on the farm increases. Implicit in this model is the bias that these are farmers first and employees secondarily.

3.5.7 The Impact on T_m of the On Farm Aftertax Factor m

For the comparative static $\partial T_m / \partial m$ the numerator matrix has determinant

$$\left[a^2 J + H\,(a\ f + e\ d)\right](h\ j - i^2) + h\ J\left[a\,(a\ g + f\ c) + c^2\ e\right] \qquad (15)$$

where $a^2 J > 0$ implies that $H (a f + e d) > 0$ will be required in order to sign the first expression. This will hold only for the non profitable farm because $(a f + e d)$ is negative. The second expression is based on the value of $(a g + f c)$ which is always positive. Thus we have that $a (a g + f c) < 0$ and $c^2 e <0$ but $h J < 0$ implies that $h J \ (a (a g + f c) + c^2 e) > 0$ and the overall determinant is positive and the overall comparative static is negative.

This implies that for a non profitable farm that off farm work will increase as the aftertax factor on farm income decreases. For a profitable farm this may still be the case, but only if H (a f + e d) < a^2 J, otherwise the sign will be indeterminate.

3.5.8 The Impact on T_h of the Off Farm Aftertax Factor n

For the comparative statics $\partial T_h / \partial n$ the numerator matrix has determinant:

$$\left[-L\,a^2 - K(a\,f + e\,d)\right](h\,j - i^2) \tag{16}$$

where L < 0, $a^2 > 0$, K < 0, a < 0, f > 0, e < 0, d > 0, and h j - $i^2 > 0$, we have that - L $a^2 > 0$, which suggests that for there to be a single sign that - K (a f + e d) will be positive. Thus the determinant will be positive and the overall comparative static will be negative.

This suggests that leisure taken will decrease as the aftertax off farm factor increases and that the agent will work more.

3.5.9 The Impact on T_f of the Off Farm Aftertax Factor n

For the comparative static $\partial T_f / \partial n$ we have the numerator matrix which has determinant:

$$-h\,\left(-L\left[a^2\,g + a\,f\,(d + c) + d\,c\,e\right]\right) \tag{17}$$

where for h < 0, L <0 , $a^2 > 0$, g < 0, a < 0, f > 0 , d > 0, c > 0, and e < 0, we have (a^2 g + a f (d + c) + d c e) < 0 and therefor also that

$- L (a^2 g + a f (d + c) + d c e) < 0.$

The sign will be positive as $- h > 0$. This in turn generates the result that $\partial T_f / \partial n < 0$ will hold. This means that T_f decreases as n increases. Part time farmers will work less on the farm as the aftertax value of off farm effort increases.

3.5.10 The Impact on T_m of the Off Farm Aftertax Factor n

For the comparative static $\partial T_m / \partial n$ the numerator matrix has determinant:

$$\left[a^2 L + K(a f + d e)\right](h j - i^2) + L h[a^2 g + 2 a f c + c^2 e] \qquad (18)$$

where $a^2 > 0$, $L < 0$, $K < 0$, $a < 0$, $f > 0$, $d > 0$, $e < 0$, $h j - i^2 > 0$, $h < 0$, $c > 0$, and $c^2 > 0$ we have $a^2 L - K (a f + d e) < 0$ and the sub-expression, $(a^2 L + K (a f + d e) (h j - i^2) < 0$ will also hold. For the second expression $(a^2 g + 2 a f c + c^2 e) < 0$ implies that for $L h > 0$ that $- L h (a^2 g + 2 a f c + c^2 e) < 0$ and the determinant will be negative and the overall comparative static will be positive.

The behavior with respect to off farm aftertax factors suggest that profitability is not a consideration and the agent will reduce leisure and effort on the farm and increase off farm effort in response to an increase in this variable. The results appear to be intuitive and there is also a compensatory relationship in the reactions between changes in effort allocation as a result of a change in the on farm aftertax factor as well as in response to changes in the off farm aftertax factor.

Thus the impact of the on farm aftertax factor and the off farm aftertax factor compensate for each other, but the nature of this compensatory relationship depends on whether the farm is profitable. Thus for a non profitable farm increasing the aftertax factor which in effect means lowering the on farm tax rate means that the agent will always increase leisure and decrease off farm work, while an increase in the aftertax factor off the farm will always increase off farm work, decrease on farm work and reduce leisure. Thus the balance between the on farm and off farm aftertax factors suggests that the non profitable farm will always see labor transferred off the farm if there is a perceived advantage in doing so and there may well be the same reaction even from a profitable farm. The implication is that judicious management of this differential is an important aspect of policy management of the part time farmer.

3.5.11 The Impact on Y_h of the On Farm Aftertax Factor m

The comparative static $\partial Y_h / \partial m$ is derived from the determinant of the numerator matrix which is evaluated as:

$$(a\,g + d\,f)\,H\,(e\,g - f^2) - a\,d\,J\,(h\,j - i^2) \qquad (19)$$

where all values are as before and $a\,d\,J\,(h\,j - i^2) < 0$ because $a < 0$ and $-a\,d\,J\,(h\,j - i^2) > 0$ holds. Thus for $a\,g + d\,f > 0$ and $e\,g - f^2 > 0$ the overall determinant depends on the value of H which measures the profitability of the farm. Thus for $H > 0$ the determinant is positive and the overall comparative static is negative.

This means that Y_h increases as m decreases or the consumption of household goods increases as the on farm aftertax increases for a profitable farm operation. This describes a situation in which the agent may substitute consumption goods for leisure time.

3.5.12 The Impact on Y_h of the Off Farm Aftertax Factor n

The comparative static $\partial Y_h / \partial n$ is of a single value if the numerator matrix determinant is single valued. This determinant has the value:

$$[K\,(a\ g + f\ d) - a\ d\ L](h\ j - i^2) \qquad (20)$$

where for $K < 0$, $L < 0$ it follows that for a single sign $K\,(a\,g + f\,d) - a\,d\,L$ will be positive as $a\,g + f\,d > 0$ and this implies that there is a positive determinant and the overall comparative static will be negative.

This further implies that the comparative static will be such that the consumption of household goods will increase as the aftertax factor off the farm decreases. This suggests a hoarding behavior.

3.5.13 The Impact on X_f of the On Farm Aftertax Factor m

For the comparative static $\partial X_f / \partial m$ the determinant of the numerator matrix is:

$$i\left(J\left[a\left(a\,g+f\,d\right)+c\left(a\,f+e\,d\right)\right]\right) \qquad (21)$$

where for $i > 0$,$J > 0$, $a < 0$, $a\,g + f\,d > 0$, $c > 0$ and $(a\,f + e\,d) < 0$ which implies that $c\,(a\,f + e\,d) < 0$ will sign the expression. Moreover as $J > 0$ it follows that $J\,(a\,(a\,g + f\,d) + c\,(a\,f + e\,d)) < 0$ will hold. As $i > 0$ then the overall expression will be negative and the comparative static will be positive.

This result implies that factor inputs will increase in usage as the aftertax factor for on farm income increases.

3.5.14 The Impact on X_f of the Off Farm Aftertax Factor n

For comparative static $\partial X_f / \partial n$, the numerator matrix has determinant:

$$i\left(L\left[a^2 g + a\,f\,(d+c) + d\,e\,c\right]\right) \qquad (22)$$

where $i > 0$, $L < 0$, $a^2 > 0$, $g < 0$, $a < 0$, $f > 0$, $d > 0$, $e < 0$,

and $c > 0$ implies that $a^2 g + a\,f\,(d + c) + d\,e\,c < 0$ which in turn implies that $L\,(a^2 g + a\,f\,(d + c) + d\,e\,c) > 0$.

For the determinant to have a single sign the determinant will be positive and the overall comparative static $\partial X_f / \partial n < 0$ will hold. This means that X_f increases as n decreases.

The impact of taxation policy is based on the allowance of certain deductions and is therefore readily controlled. The impact on part time farms of an increase in the aftertax factor for on farm effort is positive for household goods consumption and factor input use. The off farm aftertax rate has the opposite impact.

Taxation policy appears to be effective. Profitability is an important consideration in being able to sign the effects. There is a compensatory relationship between on farm and off farm aftertax factors that suggests that these policies may well act in a contrary fashion, dependent on the policy target that is set.

3.6 The Impact of Output Price and Autonomous Transfer Policy

The avowed intention of agriculture policy is to enhance incomes of farmers through the use of price policies that seek to reduce the variation in prices and also to use direct transfers in situations in which benefits are needed in order to service other aspects of government policy.[19]

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The autonomous transfer also includes interest earned and is also a possible policy venue for fiscal policies that are designed to alter interest rates. The policy is most often invoked when there is a change in government policy, but previous actions may have resulted in benefits that were capitalized into the agricultural policy system. One example is the abandonment of the Crow's Nest Pass Freight Rate , that provided a single transportation rate for grains to dockside regardless of where the grain was produced. When the policy was abandoned, farmers were sent payments to compensate for the benefits that they were deemed to have received. Disaster assistance programs and government subsidy programs arising from international marketing disputes may also be considered as a part of this type of transfer. Generally these transfers are autonomous because the agent need not do anything in order to earn it except qualify as a potential victim or beneficiary of the existing government program. Often this qualification is

3.6.1 The Impact on λ of Output Price Policy

In order to evaluate $\partial\lambda / \partial P_f$ the numerator matrix has determinant :

$$-(-g\,e+f^2)\left[-C\,(h\,j-i^2)\right] \tag{23}$$

for which $-(g\,e+f^2)=(g\,e-f^2)>0$, $C<0$, and $h\,j-i^2>0$.

Hence the determinant of the numerator is positive and the overall comparative static $\partial\lambda / \partial P_f < 0$. This implies that λ increases as P_f falls. There are no implications for profitability in this result.

3.6.2 The Impact on λ of Autonomous Transfers

For the comparative static $\partial\lambda / \partial V_h$ we have as a derivative:

$$-N\,(-g\,e+f^2)\,(-h\,j+i^2) \tag{24}$$

where $-g\,e+f^2<0$ and $-h\,j+i^2<0$, for $N<0$ and $-N>0$, it follows that $-N\,(-g\,e+f^2)(-h\,j+i^2)>0$ and therefore $\partial\lambda / \partial V_h < 0$ holds for the overall comparative static result.

This implies that λ increases as V_h falls, or the marginal utility of an extra dollar of income to the agent increases as autonomous transfers are reduced.

based solely on the ownership of the land which for most farm families is the ownership of their residence.

3.6.3 The Impact on γ of Output Price Policy

For the comparative static $\partial\gamma / \partial P_f$, the matrix determinant has the value of:

$$-(-g\,e + f^2)\left[-C\,(h\,j - i^2)\right]d \qquad (25)$$

where $-(-\,g\,e + f^2) = (g\,e - f^2) > 0$ and $C < 0$, $(h\,j - i^2) > 0$ implies that $-\,C\,(h\,j - i^2) > 0$ and with $d > 0$ the determinant is positive.

As d is always positive , under this condition , the determinant of the numerator will be positive and the overall comparative static for $\partial\gamma / \partial P_f$ will be negative. This implies that γ increases as P_f decreases or the marginal utility of an extra hour of effort increases as the price that farmers receive for their goods falls.

3.6.4 The Impact on γ of Autonomous Transfers

For the comparative static $\partial\gamma / \partial V_h$ the matrix has a determinant of the following form:

$$-N\,(-\,g\,e + f^2)(-\,h\,j + i^2)\,d \qquad (26)$$

where for $N < 0$, $-\,e\,g + f^2 < 0$, $-\,h\,j + i^2 < 0$, and $d > 0$ we have the overall determinant of the numerator positive.

This means that the comparative static for $\partial\gamma / \partial V_h$ is negative. This implies that γ increases as V_h declines or the marginal utility of an extra hour of effort increases as autonomous transfers of income decrease.

3.6.5 The Impact on T_h of Output Price Policy

For the comparative static $\partial T_h / \partial P_f$ the matrix for the numerator is has a determinant

$$(f\,a + e\,d)[-C(h\,j - i^2)] \tag{27}$$

where it follows that $f\,a + e\,d < 0$ as $a < 0$, $f > 0$, $e < 0$, and $d > 0$. Similarly we have $C < 0$ and so $-C\,(h\,j - i^2) > 0$. The determinant will be negative. This implies that the overall comparative static $\partial T_h / \partial P_f > 0$ or that T_h increases as P_f increases.

3.6.6 The Impact on T_f of Output Price Policy

For the comparative static ,$\partial T_f / \partial P_f$, the matrix in the numerator has determinant:

$$(G\,h - F\,i)(a^2\,g + 2\,a\,d\,f + d^2\,e) \tag{28}$$

where $G < 0$, $h < 0$, $F < 0$, $i > 0$, $a^2 > 0$, $g < 0$, $a < 0$, $d > 0$, $f > 0$, $d^2 > 0$, $e < 0$, we have: $(G\,h - F\,i) > 0$ and $(a^2\,g + 2\,a\,d\,f + d^2\,e) < 0$ which implies that $(G\,h - F\,i)\,(a^2\,g + 2\,a\,d\,f + d^2\,e) > 0$.

The determinant to be single signed is positive and that makes the overall comparative static $\partial T_f / \partial P_f < 0$. This means that T_f increases as P_f decreases.

3.6.7 The Impact on T_m of Output Price Policy

For the comparative static, $\partial T_m / \partial P_f$ the numerator matrix has determinant:

$$\left[a^2 g + d(a f + c e) + a f c\right](F i - G h)$$
$$+ C(a f + e d)(h j - i^2) \qquad (29)$$

where $a^2 > 0$, $g < 0$, $d > 0$, $a < 0$, $f > 0$, $c > 0$, and $e < 0$ imply that $a^2 g + d(a f + c e) + a f c < 0$. Given that $F < 0$, $i > 0$, $G < 0$, $h < 0$ it follows that $F i - G h < 0$ and therefore that $(a^2 g + d(a f + c e) + a f c)(F i - G h) > 0$. Similarly for $C < 0$ and $h j - i^2 > 0$, and $a f + e d < 0$ it follows that

$C(a f + e d)(h j - i^2) > 0$.

The determinant will be positive and the overall comparative static, $\partial T_m / \partial P_f < 0$ will hold. This means that T_m increases as P_f decreases. This model supports the conclusions that price policy will encourage leisure time. One alternative to price policy is an incomes policy based on direct transfers of funds which completely negates the market responses and may well have environmental and social repercussions as well as policy impacts on pluriactivity.

3.6.8 The Impact on T_h of Autonomous Transfers

For the comparative static $\partial T_h / \partial V_h$ the numerator matrix has a determinant:

$$N(a\,f+e\,d)(-h\,j+i^2) \tag{30}$$

and for which with $N < 0$, and $a\,f + e\,d < 0$ and $-h\,j + i^2 < 0$ the value of the determinant is negative and the overall comparative static $\partial T_h / \partial V_h > 0$ holds.

This means that T_h increases as V_h increases.

3.6.9 The Impact on T_f of Autonomous Transfers

For the comparative static, $\partial T_f / \partial V_h$, the numerator matrix determinant:

$$-N(d+c)(-e\,g+f^2)\,h \tag{31}$$

which has $N < 0$, $d > 0$, $c > 0$, $h < 0$, $e\,g + f^2 > 0 \rightarrow -g\,e + f^2 < 0$

then we have

$-N\,h\,(d+c)\,(e\,g - f^2) < 0$

The numerator will have a positive determinant and the overall comparative static $\partial T_f / \partial V_h$, < 0 holds. This means that T_f increases as V_h decreases. Thus an autonomous transfer will discourage on farm effort as it increases.

3.6.10 The Impact on T_m of Autonomous Transfers

For the comparative static, $\partial T_m / \partial V_h$ the numerator matrix has determinant:

$$-N\left[-(a\,f+e\,d)(h\,j-i^2)\right] \tag{32}$$

where $N < 0$, $a < 0$, $f > 0$, $e < 0$, $d > 0$, $h j - i^2 > 0$, it follows that

$a f + e d < 0$ and therefore $-(a f + e d)(h j - i^2) > 0$. As $-N > 0$ it follows that the determinant will be positive and the overall comparative static $\partial T_m / \partial V_h < 0$ or T_m increases as V_h decreases.

This supports the interpretation that as the level of government transfers amongst other autonomous transfers decreases that the amount of off farm work effort will increase.

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3.6.11 The Impact on Y_h of Output Price Policy

For the comparative static $\partial Y_h / \partial P_f$ the numerator matrix determinant has the value:

$$-(g\, a + f\, d)\left[-C\,(h\, j - i^2)\right] \tag{33}$$

where $g < 0$, $a < 0$, $f > 0$, $d > 0$, $C < 0$, $h j - i^2 > 0$ implies that $-(g a + f d) < 0$ and that $-C(h j - i^2) > 0$ and in order to have a single sign for the determinant the sign will be negative.

Thus the overall comparative static $\partial Y_h / \partial P_f > 0$ or as Y_h increases as P_f increases.

3.6.12 The Impact on Y_h of Autonomous Transfers

The numerator matrix for the comparative static, $\partial Y_h / \partial V_h$ has a determinant valued at:

$$-N(ga+fd)(-jh+i^2) \qquad (34)$$

which for $N < 0$, $g < 0$, $a < 0$, $f > 0$, $d > 0$, and $jh - i^2 > 0$ which means that $-jh + i^2 < 0$ we have the situation that $-N > 0$, $ga + fd > 0$ and $-jh + i^2 < 0$ or the numerator determinant for $\partial Y_h / \partial V_h$ is negative and the overall result is that $\partial Y_h / \partial V_h > 0$ or Y_h increases as V_h increases.

An autonomous transfer will unconditionally increase leisure and will decrease the tendency to work off the farm.

3.6.13 The Impact on X_f of Output Price Policy

For comparative static $\partial X_f / \partial P_f$ the numerator matrix has the determinant:

$$\left[F(c+d)^2\right](eg - f^2) + (a^2 g + 2adf + d^2 e)(Fj - iG) \qquad (35)$$

where for $F < 0$, $d > 0$, $c > 0$, $eg - f^2 > 0$, $a^2 > 0$, $g < 0$, $a < 0$, $f > 0$, $d^2 > 0$, $e < 0$, $j < 0$, $i > 0$ we have that $(Fj - iG) > 0$ and $(a^2 g + 2adf + d^2 e) < 0$ and therefore $(a^2 g + 2adf + d^2 e)(Fj - iG) < 0$.

For there to be a single sign it is therefore required that $[F(c + d)^2](eg - f^2) < 0$. This expression in turn depends on $F(c + d)^2 < 0$. Under this condition the numerator determinant will be negative and the overall comparative static, $\partial X_f / \partial P_f$, will be positive. This means that X_f increases as P_f increases.

3.6.14 The Impact on X_f of Autonomous Transfers

For comparative static $\partial X_f / \partial V_h$ the numerator has a determinant:

$$iN(d+c)(-eg+f^2) \qquad (36)$$

where $i > 0$, $N < 0$.and $-eg + f^2 < 0$ it follows that the sign of the determinant is positive and the overall comparative static $\partial X_f / \partial V_h < 0$ holds which means that X_f increases as V_h decreases.

In this model price policy and autonomous transfer of funds have very similar effects on the allocation of effort and relatively predictable effects on the level of household consumption and factor inputs. Price policy and autonomous transfers appear to be interchangeable from a policy perspective.

3.7 The Impact of General Price and Input Price Policies

General price policy is general economic management policy within which a government may choose to raise or lower taxes or pursue other related policies with the intention of raising or lowering the general price level, especially in a campaign against persistent price increase known as inflation. Because many of the products of Canadian agriculture are sold on the international market there are also impacts that derive from exchange rate policy and monetary policy itself. In modern times many governments have also chosen to pursue industrial policy, wherein they have taken initiatives to transfer certain amounts of public funds to support certain industries and allocate development to certain industrial sectors. Generally these sectors are encouraged to innovate and introduce newer technologies which can translate into increased prices if development incentives also restrict competition. Sometimes, industrial policy initiatives will motivate tariff protection or special use regulations in order to reduce competition and maintain price levels. When these targeted industries are found in agricultural supply sectors this involves raising the prices of factor inputs through government policy initiatives. There are a vast mixture of policies that have an effect on the supply price to agriculture.

In terms of the part time farming decision, general price policy may pull farmers into part time work as they struggle to afford household goods that they buy in an assumed competitive market. Similarly factor price policy may serve to push farmers into part time work if they see or extrapolate rising or falling farm input prices as a permanent component of their cost structure.

3.7.1 The Impact on λ of General Price Policy

Thus for the comparative static for $\partial\lambda / \partial P_h$ we have a matrix determinant valued at:

$$-\left[A(eg-f^2)+M(ag+df)\right](-jh+i^2) \qquad (37)$$

which for $A > 0$, $f^2 > 0$, $d > 0$, $f > 0$, $M > 0$, $g < 0$, $e < 0$, $a < 0$ we have

$e\,g - f^2 > 0$ and $a\,g + d\,f > 0$.

Similarly we have that $-(-j\,h + i^2)$ is always positive and therefore the determinant of the numerator for $\partial\lambda / \partial P_h$ is positive and the overall value of the comparative static is negative. This means that λ increases as P_h falls or the marginal utility of an extra dollar of income increases as the price of household consumption goods falls.

3.7.2 The Impact on λ of Input Price Policy

In a similar fashion we have the ability to evaluate $\partial\lambda / \partial W_f$ for which the numerator matrix determinant has the value of:

$$-(-ge+f^2)\left[B(h\,j-i^2)\right] \tag{38}$$

where we have $-(-e\,g + f^2) = e\,g - f^2 > 0$, $B > 0$, and $h\,j - i^2 > 0$

which implies that the overall expression is positive and the overall relationship for $\partial\lambda / \partial W_f$ is negative. Thus we have λ increase as W_f decreases or the marginal utility of an extra dollar of income increases as the price of factor inputs increases.

3.7.3 The Impact on γ of General Price Policy

For the comparative static $\partial\gamma / \partial P_f$ the matrix has a determinant valued at:

$$-(e\,g+f^2)\left[C(-h\,j+i^2)(h\,G-i\,F)(d+c)\right] \tag{39}$$

for which $-eg+f^2>0$, $C<0$, $-hj+i^2>0$, $hG-iF<0$ and $d+c>0$ it follows that the sign of the determinant will be positive and the overall comparative static will be negative.

For $\partial\gamma/\partial P_h<0$ this means that γ increases as P_h falls or the marginal utility of an extra hour of time available increases as the price of household goods falls. The converse will also hold.

3.7.4 The Impact on γ of Input Price Policy

For the comparative static $\partial\gamma/\partial W_f$ the determinant of the numerator matrix is:

$$-(-ge+f^2)(i^2B-jhB)d \tag{40}$$

where we have that $ge-f^2>0$ implies that $-ge+f^2<0$ and $-(-ge+f^2)>0$

Further we have that $i^2>0$, $B>0$, $j<0$, $h<0$ and $d>0$ imply that the determinant is positive and the overall comparative static for $\partial\gamma/\partial W_f<0$.

This implies that γ increases as W_f decreases or the marginal utility of an extra hour of effort increases as the price of farm inputs decrease.

3.7.5 The Impact on T_h of General Price Policy

The comparative statics for $\partial T_h / \partial P_h$ involve the matrix determinant

$$-A\,(e\,d + a\,f)(h\,j - i^2) - M\,d\,a\,(h\,j - i^2) - h\,M\,f\,(c + d)^2 \qquad (41)$$

where $A > 0$, $h\,j - i^2 > 0$, $c > 0$, $d > 0$, $a < 0$, $M > 0$ implies that

$-M\,d\,a\,(h\,j - i^2) > 0$ and also $-h\,M\,f\,(c + d)^2 > 0$ implies that

$-A\,(e\,d + a\,f)(h\,j - i^2) > 0$ must hold. Given that $e\,d + a\,f < 0$

this produces a positive sign for the determinant of the matrix

and a negative comparative static such that leisure will increase as the

price of consumption goods falls.

3.7.6 The Impact on T_f of General Price Policy

For the comparative static $\partial T_f / \partial P_h$ the numerator matrix has determinant of value:

$$-(d + c)\left[M(d\,f + a\,g) + A\,(g\,e - f^2)\right]h \qquad (42)$$

where $-(d + c) = -d - c < 0$ as $d > 0$ and $c > 0$, $M > 0$, $A > 0$,

$g\,e - f^2 > 0$ and $d\,f + a\,g > 0$. It follows that as $-h > 0$ that the determinant

is positive.

The comparative static will be negative such that farm effort will increase as the price of household goods falls.

3.7.7 The Impact on T_m of General Price Policy

For the comparative statics $\partial T_m / \partial P_h$ the numerator matrix has determinant:

$$A\left[a\ f + e\ d\right](h\ j - i^2) \qquad (43)$$

where $A > 0$, $a f + e d < 0$ and $h j - i^2 > 0$. The sign of the overall determinant is negative.

This implies that the comparative static will be positive implying that the time worked off the farm will increase as the general price level increases.

3.7.8 The Impact on T_h of Input Price Policy

For the comparative static $\partial T_h / \partial W_f$ the matrix for the numerator has a determinant:

$$(f\ a + e\ d)(-B(h\ j - i^2) \qquad (44)$$

where $f > 0$, $a < 0$, $e < 0$, $d > 0$, $B > 0$, and $h j - i^2 > 0$ we have

$(f a + e d) < 0$ and $- B (h j - i^2) < 0$ and so we have a positive determinant

and the overall comparative static $\partial T_h / \partial W_f$ is negative.

This means that T_h increases as W_f decreases. The overall comparative static result is negative implying that leisure will increase as the price of inputs decreases.

3.7.9 The Impact on T_f of Input Price Policy

For the comparative static $\partial T_f / \partial W_f$ the numerator matrix has determinant:

$$-i\left(a^2 g+2d\,f\,a+d^2 e\right) \tag{45}$$

where $i > 0$, $a^2 > 0$, $g < 0$, $d > 0$, $f > 0$, $a < 0$, $d^2 > 0$, $e < 0$, $h < 0$

we have $(a^2 g + 2\,d\,f\,a + d^2 e) < 0$ and therefore that $-\,i\;(a^2 g + 2\,d\,f\,a + d^2 e) > 0$.

This would then ensure that $\partial T_f / \partial W_f < 0$ holds and that means that T_f increases as W_f decreases.

3.7.10 The Impact on T_m of Input Price Policy

For the comparative static $\partial T_m / \partial W_f$ the numerator matrix determinant has value:

$$B(a\,f+ed)(h\,j-i^2) \tag{46}$$

where $B > 0$, $a < 0$, $f > 0$, $e < 0$, $d > 0$, $(h\,j - i^2) > 0$, then for $a\,f + e\,d < 0$ it follows that the determinant will be negative and the comparative static will be positive.

This implies that the time worked off the farm will increase as output prices increase.

3.7.11 The Impact on Y_h of General Price Policy

The comparative statics for $\partial Y_h / \partial P_h$ involve taking the determinant of the numerator matrix which has a value of

$$A\,(a\;g + f\;d)\;(j\;h\text{-}i^{\,2}) + d^{\,2}\;M\;\;(j\;h\text{-}i^{\,2})$$
$$+\;h\;g\;M\;\;(c + d)^{\,2} \qquad (47)$$

where $A > 0$, $a < 0$, $g < 0$, $f > 0$, $d > 0$, $d^2 > 0$, $M > 0$, $h\,j - i^2 > 0$,$h < 0$, and $(c + d)^2 > 0$ and we have that $h\,g\,M\,(c + d)^2 > 0$ and $d^2\;M\,(h\,j - i^2) > 0$ which implies that $A\,(a\,g + f\,d\,)(h\,j - i^2) > 0$ must also hold.

The overall determinant will be positive and the comparative static relationship will be negative implying that goods purchases increases as the price of household goods falls. This also affirms the downward sloping demand curve.

3.7.12 The Impact on Y_h of Input Price Policy

The comparative statics for $\partial Y_h / \partial W_f$ involve taking the determinant which has value:

$$-\,(g\;a + f\;d)\left[-\,B\,(h\;j - i^2)\right] \qquad (48)$$

and for which we have $g < 0$, $a < 0$, $f > 0$, $d > 0$, $c > 0$, $i > 0$, $B > 0$ and $h\,j - i^2 > 0$ which leads to $-\,B\,(h\,j - i^2) < 0$. As well $-\,(a\,g + f\,d) < 0$ determines the sign of the overall determinant to be positive.

This produces a negative comparative static such that household goods consumption increases as the price of factor inputs decreases.

3.7.13 The Impact on X_f of General Price Policy

For the comparative static $\partial X_f / \partial P_h$ the numerator matrix has determinant:

$$i\,(d+c)\left[-A\,(e\,g-f^2)+M\,(a\,g+d\,f)\right] \tag{49}$$

where $i > 0$, $d > 0$, $c > 0$, $A > 0$, $e\,g - f^2 > 0$, $M > 0$, $a < 0$, $g < 0$, $f > 0$, $d + c > 0$ implies that the sign of the determinant is dependent on the sign of $[-A\,(e\,g - f^2) + M\,(a\,g + d\,f)]$ which will be negative and the numerator will be negative.

The implications are that the overall comparative static $\partial X_f / \partial P_h > 0$ or X_f increases as P_h increases.

3.7.14 The Impact on X_f of Input Price Policy

For the comparative static $\partial X_f / \partial W_f$ the numerator matrix has determinant:

$$\left[(d+c)^2\right](e\,g-f^2)+j\left[g\,a^2+2\,d\,(a\,f+d\,e)\right] \tag{50}$$

where $(d + c)^2 > 0$, $e\,g - f^2 > 0$, $j < 0$, $g < 0$, $a^2 > 0$, $d > 0$, $a < 0$,

$f > 0$, $d^2 > 0$, and $e < 0$ implies that $g\,a^2 + 2\,d\,(a\,f + d\,e) < 0$ and

$j\,(g\,a^2 + 2\,d\,(a\,f + d\,e)) > 0$.

The determinant will be positive and the comparative static $\partial X_f / \partial W_f < 0$ which implies that X_f increases as W_f decreases which is consistent with a downward sloping demand curve.

General price and input price policy in this model imply that many basic economic properties and principles are preserved.

3.8 The Impact of Off Farm Wage Policy

Regional development policy is designed to provide alternative employment opportunities in rural areas and is often administered by provincial governments. In this system employers are encouraged to invest in rural communities in order to create jobs. To the extent that governments provide grants and special tax considerations for rural firms, these subsidies will be reflected in the wage offer that is available to the part time farmer. Generally, it is assumed that if these grants are tied to employment targets that the management of these firms will seek to use the wage offer as an incentive to attract workers.

3.8.1 The Impact on λ of Off Farm Wage Policy

To evaluate $\partial\lambda/\partial W_m$ we have a numerator matrix determinant:

$$\left[D\,(e\,g - f^2) - I(a\,f + e\,d)\right](h\,j - i^2) \tag{51}$$

where we have $D < 0$, $e\,g - f^2 > 0$, $I < 0$ and therefore a requirement that for $(D\,(e\,g - f^2) - I\,(a\,f + e\,d))$ to be single valued it must be negative. Given that $h\,j - i^2 > 0$ this further implies that the determinant is negative.

The overall comparative static $\partial\lambda / \partial W_m > 0$ which implies that λ increases as W_m increases or the marginal utility of an extra dollar of income increases as the off farm wage increases if the opportunity cost of leisure is less than the expenditure on household goods and there is no incentive to off farm work.

3.8.2 The Impact on γ of Off Farm Wage Policy

For the comparative static $\partial\gamma / \partial W_m$ the numerator matrix determinant has the value:

$$-(-hj + i^2)[dD(-ge + f^2) - aI(ag + fd)] \qquad (52)$$

where $(-hj + i^2) = (hj - i^2)(-1) < 0$, $d > 0$, $D < 0$, $(-ge + f^2) = (ge - f^2)(-1) < 0$, $a < 0$, $I < 0$, $g < 0$ and $f > 0$ implies that $dD(-eg + f^2) < 0$ and $-aI(ag + fd)$ will be negative if $ag + fd < 0$.

If this holds then the numerator determinant is negative and the overall determinant $\partial\gamma / \partial W_f > 0$. This implies that γ increases as W_m or the marginal utility of an extra hour of effort increases as the off farm wage rate increases.

3.8.3 The Impact on T_h of Off Farm Wage Policy

For the comparative static $\partial T_h / \partial W_m$ the numerator matrix has a determinant

$$[-Ia^2 - D(fa + ed)](hj - i^2) \qquad (53)$$

where for $I < 0$, $a^2 > 0$, $D < 0$, $f > 0$, $a < 0$, $e < 0$, $d > 0$, $hj - i^2 > 0$ we have that $-\ I\ a^2 > 0$ and for the expression $(-\ I\ a^2 - D\ (f\ a + e\ d)) < 0$ it follows that the determinant will be negative.

The overall comparative static will be positive implying that leisure will increase as the off farm wage increases.

3.8.4 The Impact on T_f of Off Farm Wage Policy

For the comparative static $\partial T_f / \partial W_m$ the matrix in the numerator has a determinant:

$$-\left(I\left[a^2 g + a\ f\ d + c\,(a\ f + d\ e)\right]\right)h \tag{54}$$

where $I < 0$, $a^2 > 0$, $g < 0$, $a < 0$, $f > 0$, $d > 0$, $c > 0$, $e < 0$, and $h < 0$ implies that $a^2 g + a\ f\ d + c\ (a\ f + d\ e) < 0$. This further implies that $I\ (a^2 g + a\ f\ d + c\ (a\ f + d\ e)) > 0$ and given that $-\ h > 0$ it follows that the determinant is positive.

The overall comparative static $\partial T_f / \partial W_m < 0$ holds. This means that T_f increases as W_m decreases.

3.8.5 The Impact on T_m of Off Farm Wage Policy

For the comparative static $\partial T_m / \partial W_m$ the numerator matrix has a determinant:

$$\begin{aligned}&\left[a^2\ I - D\,(a\ f + e\ d)\right](h\ j - i^2)\\ &+ h\ I\,(a^2\ g + 2\ a\ f\ c + c^2\ e)\end{aligned} \tag{55}$$

where for $a^2 > 0$, $I < 0$, $D < 0$, $a < 0$, $f > 0$, $e < 0$, $d > 0$, $h j - i^2 > 0$, $h < 0$, $c > 0$, $g < 0$ and $c^2 > 0$ we have $a^2 g + 2 a f c + c^2 e < 0$ and $h I > 0$ so $h I (a^2 g + 2 a f c + c^2) < 0$. Also $[a^2 I + D (a f + e d)] < 0$ which has $a^2 I < 0$ and $D < 0$ implies that $D (a f + e d) > 0$ if $a f + e d < 0$ and

$- D (a f + e d) < 0$.

In this case the determinant of the numerator is negative and the overall comparative static $\partial T_m / \partial W_m > 0$ holds which is consistent with a upward sloping labor supply curve. This means that T_m increases as W_m increases.

3.8.6 The Impact on Y_h of Off Farm Wage Policy

For the comparative static $\partial Y_h / \partial W_m$ the numerator matrix has a determinant of value:

$$\left[- I\ a\ d + D\ (a\ g + f\ d)\right](h\ j - i^2) \\ - I\ h\ (a\ g + f\ c) \qquad (56)$$

where for $D < 0$, $a < 0$, $g < 0$, $f > 0$, $d > 0$, $h j - i^2 > 0$, $h < 0$, $J < 0$, $c > 0$, we have a situation where $- I a d < 0$ and $D (a g + f d) < 0$ requires that $a g + f d > 0$ as a behavioral condition which establishes that

$- I a d + D (a g + f d) < 0$ and the first sub-expression is negative. It is also required that $- I h (a g + f c) < 0$ which will hold if $a g + f c > 0$ which is generally the case.

The agent will have a negative determinant and a positive comparative static result: $\partial Y_h / \partial W_m > 0$ or Y_h increases as W_m increases.

3.8.7 The Impact on X_f of Off Farm Wage Policy

For the comparative static $\partial X_f / \partial W_m$ the numerator matrix has determinant:

$$i\,D\,(d+c)\,(-e\,g+f^2) \tag{57}$$

where for $i > 0$, $D < 0$, $-e\,g + f^2 < 0$, and $d + c > 0$ then the numerator determinant will be positive.

The overall comparative static $\partial X_f / \partial W_m < 0$ will hold. This implies that X_f increases as W_m decreases.

The level of the off farm wage rate can have an impact on the effort allocation decision of the agent. Most studies have looked only at the issues surrounding the labor supply function and most specifically at the impact of time spent off the farm based on the level of wage offered.

3.9 Summary

The results of this comparative static analysis are based on the evaluation of the determinants of the numerator matrices. These are summarized in Table 3.1 attached. Proper interpretation requires that the validity of the model be demonstrated in the results such that an expected sign is expected because the model predicts it to be so. Thus the refutable hypotheses are the signs as developed in this chapter, but the analytics follow on from the application of these hypotheses to the data.

Bruce Gardner (1987, pp.48-50) has suggested that agricultural policies and policies that affect agriculture should be grouped into three distinct categories based on their ability to change economic processes in a uniform way. This concept of isomorphism, is directly applicable to this research as there is an implicit expectation of all public policy that it be effective, in terms of meeting its stated objectives and also be efficient in terms of the costs that are associated with its delivery. [20] There are three types of programs that are categorized in this fashion.

Those that have limited isomorphism are those that establish exactly the same outcomes as any other policy. Programs that exhibit partial isomorphism are those that have only a few similar impacts. Programs that exhibit reverse isomorphism are those that operate in exactly the opposite fashion and in effect cancel each other out.

On the basis of the analysis of the theoretical issues involved in this model. There is a very close similarity in the impact of the taxation policy tools such that either on farm or off farm aftertax factors can be used to generate changes in the

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Deloitte &Touche management Consultants estimate that for typical program impacts almost 32% of program funds flow directly outside of agriculture and the majority of funds transferred directly are capitalized in farmers assets. (Deloitte & Touche, 1993, p.91)

Table 3.1 Expected Signs based on Comparative Static Results[A]

Endogenous	Exogenous						
	m	n	P_f	V_h	P_h	W_f	W_m
λ	–	–	–	–	–	–	+
γ	?	–	–	–	–	–	+
Y_h	–	–	–	+	–	–	+
T_h	+	–	+	+	–	–	+
X_f	+	–	+	–	+	–	–
T_f	+	–	–	–	–	–	–
T_m	–	+	–	–	+	+	+

[A] In this table the comparative static results are arranged and presented for each cell. The '-' describes a negative relationship, the ' +' describes a positive results and the '?' describes an indeterminate result.

extent of part time farming. To this extent they exhibit reverse isomorphism. Similarly output price policy and autonomous transfers are interchangeable and they may be said to exhibit limited isomorphism. However, general price and input price policy and off farm wage policy can lead to contradictory results and may be said to have partial isomorphism. The off farm wage as affected by regional development policy is generally partially isomorphic with respect to the impact of the off farm aftertax rate and partially reverse isomorphic with respect to the on farm aftertax rate. This suggests that regional development policy may in fact be a powerful influence although it may rest on many intricate processes in order to have its impact on the part time decision.

The general price and input price policy groups are dependent on the many parameters outside of the model and are extremely indirect as policy tools. The complexity of these issues are often noted and dismissed in terms of their impact on practical policy analysis. (Helmberger and Chavas, 1996, p.29)

The analysis in the next chapter will proceed to estimate the parameters of the model and evaluate the effects that have been developed above. The impacts will be computed. These will then be extended to evaluate the elasticities of each particular type of policy at the means using the estimates and the effects. In essence the analysis will proceed to draw out from the data the nature of reactions that part time farmers have exhibited in response to policy intrusions in each of these areas. This approach will then focus on identifying how the policy intrusion can be expected to perform in any circumstance. Thus the assumptions above are enabling assumptions in that they allow for minimal variation as policy impacts are assessed. A predictive posture based on a controlled analysis is the philosophical basis for the analysis which follows.

Chapter 4

Data, Estimation, Results, and Discussion

4.1 Data Issues

There are two major approaches to the development of an appropriate data set with which to test this model and obtain estimates of policy impacts. One approach is to look to a universally applicable data set such as the Census or a longitudinal data base that has been prepared for a multitude of applications. In these cases the data are prepared or constructed from the questions that have been asked or recorded. Another approach is to conduct a direct survey with the specific intention of evaluating a model such as the one developed above. In this case the variables are observed. Each approach poses problems of its own.

Using the Census approach exposes several difficulties, particularly with respect to the development of the core variables. In Canada the Census of Population is conducted in two forms. The long form asks detailed questions regarding family and economic factors. A shorter form, which is delivered to four out of five addresses, asks only basic questions. From a sampling framework this process allows Statistics Canada to make generally acceptable and valid assertions about the entire country without forcing the general population to provide exhaustive detail about their activities. In addition to the Census of Population, a separate Census of Agriculture is given out to all Census farms in Canada. The questions in this survey are detailed and deal with the operational elements of agriculture. Statistics Canada also maintains an Agricultural Population Linkage Database which combines the detailed information from all those Census farms which also received a long form from the Census of Population.

Within this database questions are asked about off farm effort, but the structure of the questions requires some heroic extensions of the data. The Census of Population establishes the occupational category for the respondent and also the number of hours worked last week and the number of hours worked in the last year. Yearly hours are computed as the product of the hours worked last week and the hours worked last year. All of the hours are lumped into either the agricultural category or the non agricultural category which leads to the assertion that the agent whose principal occupation was non agricultural, but who resided on a Census farm, was a part-time farmer. Under this construction no single agent can have both on farm and off farm hours.

It is possible to correct this by using a modifier developed from the Census of Agriculture which asks the respondent to indicate how many days the agent worked off the farm in the last year. The approach that can be used is to compute a correction factor which has the following form:

$$[\text{ImputedOperatorAgriculturalHours}] = [\text{AssignedAgriculturalHours}] * \left[1 - \left(\text{OffFarmDaysWorked} / 365\right)\right] \quad (58)$$

and the residual is used to establish the non-agricultural hours. The same adjustment is made for individuals assigned to the non agricultural occupations and has the following form:

$$[\text{Imputed Operator Non-Agricultural Hours}] = [\text{Assigned Non-Agricultural Hours}] * \left(\text{Off Farm Days Worked} / 365 \right) \quad (59)$$

and the residual is then assigned to agricultural hours. This construction allows for and assigns the hours worked off the farm and on the farm to the same agent who can then be described as a part time farmer. One of the dangers in this approach is that it leads to a potential cascade of errors. If the assignment of an occupation is incorrectly entered, the entire system will be incorrect. Similarly any misrepresentations made in last week's work due to vacations or other aberrations can lead to extensive errors in measurement. Moreover, given that the Census of Agriculture form may be filled in by someone other than the agent directly, perhaps by an accountant or farm manager, there is considerable room for data confounding.

Given that longitudinal databases on part-time farming are not generally available this approach is the most comprehensive and potentially the most useful. The calculation of background variables that are central to this research requires that further data adjustments occur.

Another possibility for error can arise in the capital valuation process. Recorded figures drawn from a set of books maintained according to generally accepted accounting practices would record as assets seed and fuel on any particular day in which a balance is struck for recording on a Census form. These assets will be recorded if paid for and not otherwise. The assets are also inputs and as a result the data will be biased, in an unaccountable fashion depending on how the data were assembled and how both seed and fuel were managed within the enterprise.

A secondary problem with the recorded data occurs in the calculation of total capital. The Census forms asks for data that can be reported directly and as such total capital must be imputed based on a number of direct assumptions. The total capital is assumed to be the holdings of capital plus the earnings from financial capital that is held by the enterprise either as a cushion for operating purposes or as some other form of investment. The interest earned is reported and not the actual capital holdings which are capitalized by dividing by a prime interest rate. The use of the prime interest rate, while fairly indicative of general interest rates, exposes the measurement of total capital to a further source of error. Moreover, the total capital must then be adjusted to account for the capital that is being rented. It is assumed that buildings and equipment are owned or at least that their expenses are accounted for in the books of the operation, while rented land is not. As a result total capital is:

$$
\begin{aligned}
&[\text{Total capital}] = \\
&[\text{Total Value of Farm Capital}] + [\text{Quota Value}] + \\
&\left[\text{Interest Earned} \big/ \text{Prime Discount Rate}\right] \\
&- [\text{Rent Correction Factor}]
\end{aligned}
\tag{60}
$$

and the rent correction factor is:

$$
\begin{aligned}
&[\text{Rent Correction Factor}] = \\
&[\text{Value of Land and Buildings Owned}] * \\
&\left(1 - \frac{\text{Area Owned}}{\text{Total Farm Area}}\right)
\end{aligned}
\tag{61}
$$

In each case the possibility of error is large and the miss-specification of the relationships involved is potentially increased. Moreover, given the difficulties in establishing the levels of hours of effort worked on the farm and off the farm and the appropriateness of a total capital measure, the remaining core variables are also somewhat suspect.

Human capital as a background variable is calculated as a residual given the total implicit capital (returns to the enterprise divided by the prime interest rate) less the value of nonhuman capital which is the total capital listed above. Thus nonhuman capital measurement levels further compound the errors.

Human capital is defined as the bundle of skills and talents that an individual possesses which can be combined with nonhuman capital in order to command resources to be employed in a specific economic task (Walsh, 1931, Schultz, 1971,Mincer, 1974). Like all forms of capital, it must be produced through purposeful action and must be maintained in order to retain its usefulness (Becker, 1975). Economists have been interested in its effects and impacts because as capital, the possibility exists that the flows of benefits will exist long after the capital is created and its usefulness will extend over long periods of time and perhaps even across a number of individuals (Porath, 1967). In this way human capital is disembodied knowledge and may well be useful in explaining otherwise seemingly irrational behavior (Becker 1962).

The primary interest in part time farming from a human capital perspective rests on whether or not the agent can command a higher wage because of a larger amount of human capital and whether or not that higher wage will in turn affect the resource utilization on the farm (Hart and Moutos, 1995). The critical question is then how to measure it and apply it in the conduct of economic research.

The traditional approach to human capital is to view it as experience as measured by age or age squared. Another technique is to measure educational attainment or the degree of post-secondary education that is possessed by a representative sample of the population. There is no theoretical basis for this approach and most studies show that there is little or no relationship between these measures and any economic variables that are the subject of investigation.

Most recently, Bollman (1998) has used both of these proxies and found that the linkage between human capital and development is only slightly positive and indicative of several confounding linkages. He concludes that:

> ...for both rural communities and communities in rural regions, I find that communities with a higher share of their population with a lower educational attainment **and** communities with a higher share of their population with a higher educational attainment are both associated, weakly, with higher employment growth. Some rural communities with lower skilled workers were able to attract jobs and some rural communities with higher skilled workers were able to attract jobs. (P.17)

There are three distinctly different theoretical approaches that can be used in the measurement of human capital:

- Human capital as a Life Cycle return to education and training;
- Human capital as an asset subject to pricing as would be any capital asset under the Capital Asset Pricing Model; and
- Human capital as a residual as is used in many macroeconomic treatments of the issue.

Each of these produces a unique measure of human capital that can then be used to evaluate the impact of human capital on the part time : full time decision to farm. In the Life Cycle Model an agent is assumed to fully understand his "life cycle" earnings and to invest in formal schooling at the beginning of his life in order to return a positive monetary rate of return throughout his entire lifetime.

The model argues that in the end all human capital will be reduced to zero value when the agent dies and that there will be a maximum value of that human capital before the agent retires beyond which the usefulness of that human capital will diminish at a rapid rate.

This results in a measure of human capital as follows:

62 $$K_t = \frac{\Delta Y_t}{ir^* s_t}$$

Where s_t is the ratio of consumption to earnings in time t, r^* is the rate of return per year of schooling to earnings, i is the prevailing market interest rate, ΔY_t is the change in earnings from time t-1 to time t, and K_t is the value of human capital stock at any particular time t.

The Capital Assets Pricing Model argues that any asset has a variation in returns which the diligent and prudent will struggle to minimize and in so doing will pick a balanced portfolio that will minimize overall risk. Human capital is assumed to be risky in the traditional sense and hence is balanced against returns to non human capital as follows:

63 $$K_t = \frac{I^* - wL^* - R_N N^*}{R_0 + \frac{\sigma_{ae}}{\sigma_{ee}}(R_e - R_0) - R_N}$$

Where: K_t is the measure of human capital, I* is gross income; w is the wage rate paid to the farmer on the farm and is assumed to be equal to the wages paid to any hired farm labor, L* is the number of hours worked on the farm by the farm operator, R_N is the return to nonhuman capital goods and is assumed to be constant across all farms because of the relatively high standardization in capital holdings amongst all kinds of farm enterprises and the relatively efficient market in nonhuman farm capital goods that exist, N* is the current "book" value of nonhuman capital, R_0 is the risk free rate of return, $\sigma_{ae} / \sigma_{ee}$ is the enterprise β or the slope of the portfolio balance line, and R_e is the overall return to the enterprise itself.

The residual method (Postner, 1990) argues that the return to any enterprise in a competitive environment is the same as would be earned if there were an endowment of capital invested in a bank at the risk free rate of return. This endowment of generalized capital, T* is then discounted at the risk free rate R*, to yield the current level of income I* or conversely it follows that I*/ R* = T*. From this is subtracted the level of nonhuman capital N* and the balance is a current valued measure of human capital K_t.

The life cycle parameters require that there exist an age-earnings and an education-earnings contour such that earnings increase with age and education separately and when taken together. There is no evidence for that in agriculture as most of the wages paid back to the agent are essentially the residual over and above the costs of the enterprise and therefore earnings as a salary are elusive.

The pricing of capital as a current period substitute for nonhuman capital requires data on the age of the nonhuman capital as well as the state of repair. Unless one considers all capital to be completely sold off and repurchased, the market value will not be appropriate and scheduled depreciation is likely to lead to major difficulties in interpreting the value of human capital especially in aggregate. The only method that is feasible, because it is interpretable more readily, is the residual approach which was used in this research. It should be noted that this approach permits negative human capital values, although capital valuation generally does not permit this. In the case of human capital, it may be argued that such a value is a true reflection of either the inappropriateness of certain skills or the fact that these skills are not properly applied in agriculture. Given the human capital cannot be traded, there is no market pricing that can be applied. Thus a negative capital value, due to being miss-allocated or miss-applied, cannot be abandoned or stranded in the market. This further suggests that an agent with negative human capital, if it is due to mistake as described above, should be expected to leave agriculture entirely.

This latter suggestion places inordinate emphasis on the result of the residual method. The data on nonhuman capital values that are used in the calculation may well be biased and inaccurate due to their method of valuation. Thus a capital good may have a very low book value although its true economic value may be quite substantial. One of the mainstays of agricultural policy has been the accelerated capital cost write downs of farm equipment. If this is allocated to expenditures, the accounting definition of capital value may result in a bias in the economic meaning of the residual that favor negative values.

Further the data on nonhuman capital also required extensive transformation and as such may well compound errors even further. This method is chosen because of its appropriateness to the data set but has limitations in application. Essentially, human capital will be negative if nonhuman capital is inappropriately measured or weighted due to tax considerations if a residual approach is used. However, if that measure is not exclusively negative but sometimes positive, then it may well be more representative of the true stock value of human capital than any other measurement that has been advanced to date.

In addition there is a need to determine the nature of isolation under the hypothesis that the more distant an individual from a source of off farm activity, the less will be the chance that he will in fact become a part time farmer. This system is maintained by Statistics Canada and assigns integer values for Census districts that are close to certain urban areas consistently across the country. The higher the integer assigned the more isolated is the farm. The system is referred to as the Beale code.

The Beale codes are adapted for each Census District as the most common and practical element for defining the relationship between geographical distance and settlement patterns in Canada (Ehrensaft and Beeman, 1992). In the context of this research, the assumption is that the more isolated a part time farmer is, the less likely it is that the farmer will participate in part time work off the farm. In this model, the isolation factor was not statistically significant.

The codes are defined in the Table 4.1. In Manitoba, Winnipeg is the major city with over two thirds of the population. Winnipeg is also situated in the middle of very productive farmland which may also contribute to part time framing because of the mere proximity of off farm activity. Thus, there is an anticipated bias that the part time farmers will be congregated around Winnipeg. The use of any published data depends entirely on the direct nature of the questions asked and how they are manipulated. The strengths of this approach are formidable. The Census system is administered throughout the entire country on the same date and reflects as comprehensive a picture of fundamental economic activity as can be developed. Canada has an internationally renowned statistical collection and analysis agency and the data that are collected are carefully protected and managed.

The alternative of collecting information directly can pose more direct questions dealing with the number of hours worked off farm and on farm, as well as provide more direct observations on the nature of capital assets held and, particularly, a separation of inputs and assets on the balance sheet. However, there is no way to establish the confidence within the Statistics Canada data that

Table 4.1 Definition of codes:

Code	Major Metro Area	Census Metropolitan Area
0	Central counties of large metropolitan areas.	1,000,000+
1	Fringe counties of large metropolitan areas.	1,000,000+
2	Medium metropolitan.	250,000-999,999
3	Small metropolitan.	50,000 -249,000
4	Non-metropolitan urbanized, adjacent to a metropolitan region	20,000-49,999
5	Non-metropolitan urbanized, not adjacent to a metropolitan region	20,000-49,999
6	Non-metropolitan less urbanized, adjacent to a metropolitan region	2,500-19,999
7	Non-metropolitan less urbanized, not adjacent to a metropolitan region	2,500-19,999
8	Non-metropolitan rural, adjacent to a metropolitan region	No places with population over 2,500
9	Non-metropolitan rural, not adjacent to a metropolitan region	No places with population over 2,500
10	Northern hinterland	Census divisions entirely or in major portion above the following parallels by region.

(Ehrnesaft and Beeman, 1992, p. 200)

the reporting is done consistently and in a timely fashion. The essential trade-off is between more direct questioning and more accurate reporting.

The development and maintenance of a data set that is precisely geared towards the testing of part time farming behavior or the development of a long term set of model farms which includes the essential data for evaluation of part time activity is the preferable approach although such an enterprise would require many years of development. For this research the Census data are expedient and available. These data are confidential to the respondents and Statistics Canada and no data from respondents directly is used in this research. In the preparation of this report only manipulated data that corresponds to the economic concepts is used.

4.2 Estimating Equations

The objective is to try to isolate each of the endogenous variables as functions of the exogenous variables and parameters only and thereby estimate the parameters of the model. The behavioral relationships are represented by the first order conditions and they are presented here for convenience:

64 $$\frac{\partial L}{\partial \lambda} = m\left[P_f F(X_f, T_f) - W_f X_f\right] + n(W_m T_m + V_h) - P_h Y_h = 0$$

65 $$\frac{\partial L}{\partial \gamma} = T - T_h - T_f - T_m = 0$$

66 $$\frac{\partial L}{\partial Y_h} = \frac{\alpha U}{Y_h} - \lambda P_h = 0$$

67 $$\frac{\partial L}{\partial T_h} = \frac{\beta U}{T_h} - \gamma = 0$$

68 $$\frac{\partial L}{\partial X_f} = P_f \frac{\theta Y_f}{X_f} - W_f = 0$$

69 $$\frac{\partial L}{\partial T_f} = \lambda m P_f \frac{\pi Y_f}{T_f} - \gamma = 0$$

70 $$\frac{\partial L}{\partial T_m} = \lambda n W_m - \gamma = 0$$

The critical result of this analysis is that the ratio of the marginal utility of an extra hour of effort to the marginal utility of an extra dollar of income ,γ/λ links that utility function to the production function and in turn to the evaluation of the attractiveness of an off farm wage offer, W_m to the agent operator. We have from equation 66 and equation 67:

$$U = \frac{\lambda P_h Y_h}{\alpha} \Rightarrow \lambda = \frac{\alpha U}{P_h Y_h};$$

$$U = \frac{\gamma T_h}{\beta} \Rightarrow \gamma = \frac{\beta U}{T_h}; \text{ therefore}$$

$$nW_m = \frac{\gamma}{\lambda} \Rightarrow nW_m = \frac{\frac{\beta U}{T_h}}{\frac{\alpha U}{P_h Y_h}} \Rightarrow \frac{Y_h}{T_h} = \left(\frac{\alpha}{\beta}\right)\frac{nW_m}{P_h} \qquad (71)$$

From equation 68:

$$mP_f \frac{\pi Y_f}{T_f} = \frac{\gamma}{\lambda} = nW_m \Rightarrow \frac{Y_f}{T_f} = \left(\frac{1}{\pi}\right)\frac{nW_m}{mP_f} \qquad (72)$$

From equation 70:

$$\frac{\theta Y_f}{X_f} = \frac{W_f}{P_f} \Rightarrow \frac{Y_f}{X_f} = \left(\frac{1}{\vartheta}\right)\frac{W_f}{P_f} \Rightarrow \theta P_f Y_f = W_f X_f \qquad (73)$$

Combining equations 72 and 73 yields:

$$\frac{\frac{Y_f}{X_f} = \left(\frac{1}{\vartheta}\right)\frac{W_f}{P_f}}{\frac{Y_f}{T_f} = \left(\frac{1}{\pi}\right)\frac{nW_m}{mP_f}} \Rightarrow \frac{T_f}{X_f} = \frac{\pi}{\theta}\frac{mW_f}{nW_m} \qquad (74)$$

Thus equations 71 and 74 constitute the fundamental relationships between the variables in this model from which two equations can be drawn for the purpose of estimating the parameters of the model.

The recovered parameters will permit testing of the refutable hypotheses developed through the comparative statics exercise and the development of sensitivity or influence analysis based on how agents are expected to behave given various policy options. The model also permits the assessment of the impact of background variables on the estimates themselves.

In this case, it is assumed that there is constant returns to scale such that $\alpha + \beta = 1$ and $\theta + \pi = 1$ in both the utility and the production functions.

The data were financial data recorded as per the instructions for completing the Census. There is an explicit aggregation that is involved in entering these values that are based on the accounting principle of minimizing reported income. Thus the exact value of input may be overlooked or avoided in declaring the total receipts. The approximation for the physical units of output are based on taking the overall revenues and dividing that by a price index. The price index is the index of agricultural output prices and is based on a standardized basket of outputs in terms of the weighting patterns for the computation of the index. These data are in turn massaged and manipulated according to appropriate statistical adjustments necessary to reflect the nature of the markets in which the outputs are sold and not necessarily to reflect the nature of the production process itself. Thus the output measures are standardized and to the extent that they reflect the weighting patterns implicit in the output markets they also reflect the standardized surpluses that are involved in producing that output.

A secondary argument is that constant returns to scale is not unreasonable in production given that the capital requirements for agriculture are fairly stable and there are very few opportunities for physical output growth with non-standardized technologies. Farmers will experiment with new technologies, but the basic commitment is to a production process that is relatively standardized.

Farming output also has several unique features in that the outputs are determined largely by weather patterns and general climatic conditions that are beyond anything that the farmer can influence and hence that technology can adjust. Thus the yield is not under control and the result is that any apparent increased production or decreased production is more likely due to variations in the random effects of weather than in the purposeful combination of inputs that characterizes a particular technology.

Thus, to the extent that this model uses a representative production function for a representative part time farmer, then the assumption of constant returns to scale is warranted and convenient.

4.3 Econometric Issues

Equations 71 and 74 are linear in the transformed parameters and therefore are candidates for ordinary least squares regression. The objective is to determine the impact on the dependent variables that are actually combinations of various choices that each of the exogenous or previously determined variables can account for. The underlying assertion of the technique is that by changing the exogenous variable, specific behaviors can be changed.

In this model the independent variables are the prices of outputs and household goods, the wage rate that is offered in the local region, and aftertax factors that arise because of published tax rates. Initially, there would not appear to be sufficient variation in the model to permit estimation as all of the dependent variables will have been set.

However, the nature of the issue, part time farming, and the particular institutional environment in which it operates is such that there is considerable variation in the independent variables. The price of farm output is an index that is specific to the type of farm that is being operated. The wage rate is specific to the location in which the farm is located. The tax rates are specific to each operation because of the way that they are implemented. Each agent that pursues part time farming has a tax rate that he faces if he is considered to be a part time farmer where all income is taxed at the off farm rate and also a tax rate in which losses are deducted and the income tax is calculated accordingly. The greater the loss that the agent incurs the greater will be the perceived benefit from not being involved in off farm work. There is considerable variation in the effective impact of the output prices, local wages, and the aftertax factors for each individual. There is no meaningful variation in the household goods price nor in the farm output price.

The data that exist are for 1986 and 1991 will each be analyzed separately. The value of analyzing the data for two time periods is the ability to detect changes that may have occurred either because of the shifts in the organization of agriculture or in the nature of government policy. Over this period Manitoba was particularly stable in terms of agricultural policy, fiscal policy and industrial policy with little or no involvement in regional development policy that would alter wage rates through any form of direct subsidy or wage adjustment programs. Many of the programs that involved producer contributions to financial stabilization programs had not yet been introduced. Similarly tax rates were stable and social programs were universal to the extent that individual family characteristics did not involve any liability for benefits to be reduced. It appears that the part time farming decision made in Manitoba from 1986 to 1991 is a decision that is most adequately and accurately incorporated into this model.

The background variables are measured according to the regime developed above.

The choice of an estimation technique has certain limitations to the extent that it must be appropriate to identifying the estimated coefficients such that there is bias in the estimator, consistent estimation of the changes that are being investigated and efficiency in the manner in which the estimator is likely to behave. The basic principle is the maximum likelihood principle which argues that the parameters should be estimated in such a way as to maximize the likelihood of generating the same data set using the theoretical estimators. Thus it is desirable to have a normal distribution in order that the ordinary least squares estimator is the best estimator amongst estimators including those that are non-linear (Hayashi, 2000, page 52). This estimator is best in the sense that it is unbiased and efficient as it attains the Cramer-Rau lower bound.

The assumption of normality is essential for the use of the ordinary least squares regression technique, but there are also considerations that are necessary in order to apply the method correctly.

The independent variables must not violate strict exogeneity such that the error term is in anyway dependent on the observations themselves. This means that the error terms must be orthogonal to the regressors for each and every observation. This is particularly problematic because of the way in which the census is conducted. The Census takers have some freedom in their approach to handing out the detailed forms for the Census of Population. It is suspected by some that areas where farmhouses are clustered are more likely to get the long forms than farmsteads which are isolated. Thus there may well be spatial auto-correlation amongst the regressors as a result. Spatial auto-correlation suggests that neighboring observations are linked to each other and therefore are biased.

Inasmuch as all Census data are subject to this type of problem, the estimators must be adjusted. However, this is only a problem if the data are linked together in order of completion and not filed according to any other taxonomic system such as a census farm registration number or even alphabetically by the name of the owner. The data set that is to be used in this study is drawn out because of the nature of the part time farming decision and not based on location or any other property and therefore adjacent observations are not considered to be necessarily indicative of spatial auto-correlation.[21]

Thirdly, it is required that the data set have full rank and that the independent variables not be highly correlated with each other such that the precision of the estimators is reduced due to multi-colinearity. The estimating equations are basically equations with a ratio of dependent variables taken as a function of a ratio of independent variables. Clearly the level of household

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It is often commented that living near to Winnipeg would encourage part time farming as opposed to living anywhere else in the province. However as Rounds and Monnu have shown there are a very large number of part time farmers in smaller communities in rural Manitoba and hence there is no reason to expect that Winnipeg, although economically dominant would cause spatial clustering in the data set to be analyzed.

consumption is directly proportional to the level of the aftertax income. As more resources are available for consumption, this implies that those resources will be consumed as is forced by the model itself. Similarly, the movement in prices of farm commodities must be closely related to the movements in household consumption prices as well. Generally, however, multi-colinearity is a factor in all economic analysis and is not exceptional in this case.

The final assumption is that there be homoskedasticity and that there be no systematic relationship between the disturbance term and any of the explanatory variables.

The basic assumptions for the use of the ordinary least squares technique appear to be appropriate. Any violations are handled by appropriate mathematical transformations. The computer program SHAZAM makes adjustments in the estimation technique for hetero-skedasticity of an unspecified form.

The background variables must also satisfy these four restrictions. The human capital measure is neither more nor less likely to be correlated with the consumption levels for the household (Polachek and Siebert, p.24). Similarly, location is not necessarily linked to the level of consumption as location of agricultural enterprises is most often a function of soil types and operations are located where soil types are most suited for the particular operation that is undertaken. The assumptions of the ordinary least squares regression technique appear to be suitable and manageable for the estimating equations.

The basic estimating equations, 71 and 74 are reproduced here for convenience:

71 $$\frac{Y_h}{T_h} = \left(\frac{\alpha}{\beta}\right)\frac{nW_m}{P_h}$$

and

74 $$\frac{T_f}{X_f} = \frac{\pi}{\theta}\frac{mW_f}{nW_m}$$

Taking a linear version of these two equations we may write Equation 71 as:

75 $$\frac{\mathrm{Y_h}}{\mathrm{T_h}} = \Gamma_1 + \Gamma_{1,1}\left(\frac{nW_m}{P_h}\right) + \varepsilon_1$$

and

76 $$\left(\frac{T_f}{X_f}\right) = \Delta_1 + \Delta_{1,1}\left(\frac{mW_f}{nW_m}\right) + \varepsilon_2$$

We can unravel the basic parameters of the model by applying the following manipulations to equation 75:

$$\Gamma_{1,1} = \frac{\alpha}{\beta} = \frac{\alpha}{1-\alpha} \Rightarrow \alpha = (1-\alpha)\Gamma_{1,1} = \Gamma_{1,1} - \Gamma_{1,1}\alpha \Rightarrow$$
$$\alpha(1+\Gamma_{1,1}) = \Gamma_{1,1} \Rightarrow \alpha = \frac{\Gamma_{1,1}}{1+\Gamma_{1,1}}; \quad \beta = \frac{1}{1+\Gamma_{1,1}} \tag{77}$$

The same manipulations can be applied to equation 76 to unravel the functional parameters:

$$\Delta_{1,1} = \frac{\pi}{\theta} = \frac{\pi}{1-\pi} \Rightarrow \pi = (1-\pi)\Delta_{1,1} = \Delta_{1,1} - \Delta_{1,1}\pi \Rightarrow$$
$$\pi(1+\Delta_{1,1}) = \Delta_{1,1} \Rightarrow \pi = \frac{\Delta_{1,1}}{1+\Delta_{1,1}}; \quad \theta = \frac{1}{1+\Delta_{1,1}} \tag{78}$$

The model can then be tested by estimating two fundamental equations that provide estimates of the four fundamental parameters of the model. The data will then determine the nature of the applicable policy techniques.

4.4 Data Properties

Table 4.2.1 presents the summary statistics for the data that were used in the estimation of the model for 1986 and Table 4.2.2 presents the information for 1991. These data were drawn from a sample of 917 observations that were made on the 1986 and 1991 Census of all farmers in Manitoba. Of this group, the exclusions included those who had left agriculture altogether and who had no agricultural hours in 1991. Also excluded were those who had returned to full time farming and had no non-agricultural hours. Similarly exclusions were made for those who had no output or production in either 1986 or 1991. This set of exclusions was designed to retain only those part time farmers who were part time farmers in 1986 and in 1991.

On that basis the average household consumption level was $93,627.0 in 1986 which had almost doubled to $184,600.0 in 1991. The household consumption pattern was biased by at least one observation that recorded household consumption of $855,960.00. The minimum for 1986 was $31,368.00, while for 1991 it was $25,557.00. The maximum in 1986 was $581,770.00, which may have been due to one very large farm that was involved in this data set as a part time farmer. Clearly there is one observation in the data for which the practical definition of what constitutes a part time farmer is misleading to the extent that this agent is most likely a hobby farmer. One option to improve the results is to remove this observation from the data set[22]. Nevertheless, the gap was expanding between 1986 and 1991 in terms of household consumption.

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Removal of this outlier would reduce the range and variation of the mean statistic for this group and most likely would be beneficial in the estimation of the parameters from a purely statistical point of view. However, there is no specific reason that this observation should be removed except for its size. Merely having a really well paying off farm job does not violate the conditions set in this study for a part time farmer.

The leisure hours allocation was calculated as the number of hours per week times the number of weeks in a year or 8736 less the number of hours that were devoted to on farm and off farm effort. The average number of hours taken in leisure for part time farmers in 1986 was 5555.4 which rose slightly to an average of 5572.9 in 1991. The implication is that the part time farmers were actually taking more leisure in 1991 than in 1986. In terms of the distribution the minimum leisure hours taken in 1986 was 2912.0 which had risen to 3640.0 in 1991. At the same time, the maximum leisure hours taken in 1991 was 8456.0 compared to a maximum in 1986 at 7800.0. Thus leisure was increasing although there is a suspicion in this data set that several of the respondents may have retired from all effort allocation entirely.

In terms of the use of factor inputs, the 1986 average was 11075.0 units which dropped to 8924.8 in 1991. Over the five year period the use of inputs amongst this group of farmers had decreased slightly from 522.31 to 515.59 at the minimum and the maximum had decreased substantially from 99787.00 to 68865.0. To the extent that the use of factor inputs reflects the nature of productivity on the farm itself, this suggests that part time farmers were reducing their concentration on farming.

Time spent at farming dropped from 2338.5 hours in 1986 to 1511.3 hours in 1991. At the minimum this increased from 155.73 to 448.77, while at the maximum this dropped from 5026.2 to 3567.3. This pattern suggests that the average effort dedicated to farming was being reduced in a focused way. To the extent that this identifies a more homogeneous group from which policy implications can be drawn, then the reduction in variance reflected in the data suggests that as farmers this group is relatively cohesive.

In terms of off farm activity, this group increased their off farm effort dramatically going from 842.1 hours in 1986 to 1511.3 hours in 1991. This almost doubling was accompanied by a change in the minimum level of hours worked from 61.55 to 227.95 and a change in the maximum numbers of hours worked off the farm from 1890.4 to 3630.0. Thus the variation also doubled and one would suspect that the amongst this group there was at least an inclination to work more off the farm.

In terms of the exogenous variables, there was a period of inflation rising to an index value of 125.0 from 100.0 in 1986. At the same time the average factor price index dropped from 101.00 to 91.4, indicating that there was a potential for productivity improvements. However, at the same time, the farm output price levels dropped dramatically. The data were calculated by taking a specific output price index for each type of farming operation and calculating the output values on that basis. The result is that when all of the part time farming operations are combined and averaged, there is a composite output price. This is the implicit price level that must have occurred for the farmers to have received that specific level of income with that specific level of

Table 4.2.1 Data for Part Time Farming Model 1986

Name[A]	Number	Mean	Standard Deviation	Minimum	Maximum
$Y_{h(1986)}$	16	93267.00	129980.00	31368.00	581770.00
$T_{h(1986)}$	16	5555.40	1730.40	2912.00	8456.00
$X_{f(1986)}$	16	11075.00	27794.00	522.31	99787.00
$T_{f(1986)}$	16	2338.50	1687.80	155.73	5026.20
$T_{m(1986)}$	16	842.10	668.01	61.55	1890.40
$P_{h(1986)}$	16	1.00	0.00	1.00	1.00
$W_{f(1986)}$	16	1.01	0.00	1.01	1.01
$P_{f(1986)}$	16	187.46	386.86	64.60	1687.40
$W_{m(1986)}$	16	9.75	1.67	7.32	14.71
$V_{h(1986)}$	16	2054.80	9698.40	3235.10	19697.00
$m_{(1986)}$	16	0.43	0.12	0.21	0.62
$n_{(1986)}$	16	0.25	0.04	0.19	0.33
$Y_{f(1986)}$	16	14255.00	34705.00	86.70	109320.00
$K_{t(1986)}$	16	-309620.00	1641400.00	-6090700.00	1075800.00
$BC_{(1986)}$	16	7.63	1.41	5.00	9.00

A Y_h :expenditure on household goods in real 1986 dollars, T_h :leisure in hours, X_f :factor inputs in index units, T_f : on farm effort in hours, T_m : off farm effort in hours, P_h :consumer price index 1986=100, W_f : factor price index 1981=100, W_m :off farm wage rate in current dollars, V_h :autonomous income from bank interest and government payments, m : on farm aftertax rate, n : off farm aftertax rate, Y_f : real farm output in index units, K_t: value of human capital in real dollars, BC : Beale code.

Table 4.2.2 Data for Part Time Farming Model 1991

Name[A]	Number	Mean	Standard Deviation	Minimum	Maximum
$Y_{h(1991)}$	16	184600.00	278350.00	25557.00	855960.00
$T_{h(1991)}$	16	5572.90	1144.70	3640.00	7800.00
$X_{f(1991)}$	16	8924.80	19352.00	515.59	68865.00
$T_{f(1991)}$	16	1651.70	991.94	448.77	3567.30
$T_{m(1991)}$	16	1511.30	1004.20	227.95	3630.00
$P_{h(1991)}$	16	1.25	0.00	1.25	1.25
$W_{f(1991)}$	16	0.91	0.00	0.91	0.91
$P_{f(1991)}$	16	56.93	16.90	24.37	82.69
$W_{m1991)}$	16	11.54	2.16	8.67	17.40
$V_{h(1991))}$	16	10723.00	12429.00	0.00	44317.00
$m_{(1991)}$	16	0.39	0.14	0.20	0.62
$n_{(1991)}$	16	0.25	0.04	0.19	0.33
$Y_{f(1991)}$	16	11084.00	21256.00	710.71	76120.00
$K_{h(1986)}$	16	707870.00	4335900.00	-108723000.00	10317000.00
$B_{(1986)}$	16	7.63	1.41	5.00	9.00

A Y_h :expenditure on household goods in real 1986 dollars, T_h :leisure in hours, X_f :factor inputs in index units, T_f : on farm effort in hours, T_m : off farm effort in hours, P_h :consumer price index 1986=100, W_f: factor price index 1981=100, W_m :off farm wage rate in current dollars, V_h :autonomous income from bank interest and government payments, m : on farm aftertax rate, n : off farm aftertax rate, Y_f : real farm output in index units, K_t: value of human capital in real dollars, BC : Beale code.

aggregate output. In fact, the aggregate output dropped from 14255.0 to 11084.0, with an increase in the minimum level from 86.7 to 710.71 and a decrease at the maximum from 109320.0 to 76120. This suggests that part time farmers in Manitoba were focusing their production efforts over the sample period. At the same time there were increased levels of autonomous income transfers into the incomes of farmers rising from an average of $2,054.80 in 1986 to $10,723.00 in 1991. This measurement included interest payments made by financial institutions but not transfers made by governments through social programs. The result is that there was at least one individual agent that withdrew $44,317.00 in interest payments representing at the prime rate an investment of approximately $476015.03 that were funded at one point in time from some source, likely a source outside of agriculture itself. Thus, transfers were a substantial factor in the financial structure of these part time farmer's accounts and they indicated pools of resources generally being available to fund the farming operation and other consumption. The off farm wage rate rose from $9.75 per hour in 1986 to $11.53 in 1991. The range of the off farm wage grew over the period from a maximum minimum range in 1986 of $7.39 to a range of $8.73 in 1991.

The detailed descriptive data about the sample used to evaluate part time farming activity in Manitoba suggest that the part time farmers were generally increasing consumption and leisure while reducing farming effort and working more hours off the farm. The data suggest that these part time farmers were reducing factor inputs usage as well as output and were facing declining output prices and rising off farm wage rates. Autonomous transfers of funds through interest payments were important aspects of account management for these part time farmers and several of them were exhibiting behaviors consisting with retiring active farmers or hobby farmers.

Of particular interest, however, is the nature of the aftertax factors. If the potential tax risk is substantial enough to act as a deterrent to hobby farmer behaviors then it should be reflected in the average tax factors that people would face. This statistic was calculated using the three levels of taxation that were in place at the time for each of the three income groups. The deductions taken were only those allowed for minimum incomes for which no tax liability is due. This is a crude tax factor that does not allow for deductions that would include credits taken for dependent children and any special deductions that would be due to the taxpayer based on the nature of investments made. This is based on federal tax rates only as provincial tax rates are often seen as balancing the deductions that are taken from federal taxes. Thus it is a tax risk measure that a part time farmer would face in deciding to work off or on the farm.

For this group of farmers the 1986 on farm aftertax factor was 42.87% while the off farm tax factor was 25.36%. This means that the tax rate faced by this particular group of farmers was 57.13% for on farm effort and 74.64% for off farm effort for an apparent tax risk of 17.51%. By 1991 this had changed such that the average aftertax factor for on farm income was 39.01% and for off farm income was 24.88%. This means that the tax rate for on farm income was 60.99% and the tax rate based on off farm income was 75.12%. This produces a tax risk factor of 14.13% or a net reduction over the five year sample period of 3.38 %.

This is a marked reduction of 19.30% over the period. This is due to the increase in the general level of tax free allowances that was based on the rate of inflation. The tax free credit rose from $3,680.00 to $4,220.00 or 14.67 %. The impact on the "tax risk" that part time farmers face is based on the allowance of deductions and an average of 367 judgements a year are issued by the Tax Court of Canada that deal with part time farming and the specific allocation of deductions. It is the policing of the deductibility that is perhaps more significant than the level of the "tax risk" itself.

The background variables also revealed several interesting properties. The data on human capital was calculated using the residual method and revealed some negative values. In 1986 the mean value was $-309,620.00, with a minimum of $-6,090,700.00 and a maximum of $1,075,800.00. In 1991, the average was $707,870.00 with a minimum of $-10,7230,000.00 and a maximum of $103,178,0000. The absolute value of the human capital range had thus expanded considerably over the five year period and had become positive on average. This represented a shift in the net returns to the average operation even though the average profit had become negative. This is due to the fact that the nonhuman capital also declined drastically as all agriculturalists, when faced with low returns tend to avoid large capital purchases, thus the residual was calculated as generalized capital less a reduced nonhuman capital base. The negativity of the human capital values represent a major shortcoming in the modeling of part time behavior in this model as well as in most others.[23]

The data on location was the same for both 1986 and 1991 as the farms did not physically move. The Beale codes around Winnipeg are in the range of 4-7 but the average Beale code number was 7.62, implying that the impact of Winnipeg was largely not detected in the data.

This data set reveals that the definition of part time farming is a critical practical issue in the analysis of the data. The definition used in this analysis is that anyone who works off the farm and therefore self-selects themselves to be a part time farmer is in fact a part time farmer, yet the suspicion is that there are at least one and perhaps more hobby farmers in the data. A hobby farmer would be a person who works substantially off the farm and then uses the tax provisions to cross subsidize the off farm tax liability with on farm losses.

Such an individual would have very high off farm effort and very low on farm effort, but such a person would indeed be a part time farmer under the definitions used here. This is a major shortcoming in the data set and also a

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The negative values reflect current expense requirements for that capital that may result from misapplication, but also data problems that arise from the fact that the measurement of nonhuman capital from which the residual is taken is highly suspect being book values and biased by accelerated depreciation amongst other factors.

shortcoming in the model, that could only be overcome if there was a dynamic data set. Such data sets are not readily available and would be needed in order to assess this type of issue. As a result, for this study part time farmers may also include hobby farmers.

This confounding of the data can lead to severe policy misapplications to the extent that if the agent is a non farmer looking for a tax avoidance haven, then the agent is unlikely to evaluate the incentive to work off the farm in the same way that the part time farmer will. The hobby farmer will be expected to evaluate the hours taken in leisure at the return to effort on the farm rather than the off farm rate.

4.5 Estimation Approaches

There are two equations to be estimated which are non-linear in their parameters but linear in the variables. In order to estimate the relationships inherent in the data, a number of attempts were made to identify the most appropriate form with which to estimate the parameters of the utility and production functions.

Three separate approaches are possible as a linear model, as a logarithmic model, and as a difference model. In all three approaches the model was estimated with the background variables and without them as well as with the correction for heterskedasticity and without it. The data were also estimated with a constant and without one.

Table 4.3.1.1 presents the estimation of the utility equation in all of the combinations described above for the 1986 data. Specifically b Table 4.3.1.1.a presents the linear model. Table 4.3.1.1.b presents the results for the difference model. Table 4.3.1.1.c presents the results for the logarithmic model. Table 4.3.1.2.a, Table 4.3.1.2.b, and Table 4.3.1.2.c present the results for all the combinations above for the production function equation for 1986. Table 4.3.1.3 presents the results for the utility equation in 1991 and Table 4.3.1.4 presents the same results for 1991 according to this same presentation structure.

The results indicate that the model estimation approach chosen should be based on the logarithmic model when that decision is reached by inspection of these results. In the difference models for both equations and for both years there is no consistent pattern of significance in the constant or the major dependent variable in each equation. The implication is that the difference model is not able to account for the specific changes that would occur throughout the data set.

The linear models were also considered, but, as is seen in this set of results, the most appealing equations which allowed for the significance of the background variables only did so if the constant were removed. While the purpose of estimation was merely to estimate the parameters of the utility and production functions, the regressions without a constant are not directly interpretable. The use of the constant in the logarithmic case does have direct meaning because the ratio of the parameters is found in the constant and not in the elasticities that are attached to each independent variable. Thus the essential trade-off is between the background variables and the most reasonable estimate of the parameters involved. As there is no theoretical justification for the background variables in the model, mere statistical significance is not an appropriate selection criteria.

For both of the equations and in both of the estimation periods, the correction for heteroskedasticity reduced the standard error of estimate. In the utility function for 1986 and 1991 the constant and the coefficient for the major independent variable were significant and had the expected signs. Similarly in the production function the constant and the elasticity measure were significant when corrected for heteroskedasticity.

Thus the choice of the logarithmic approach to estimation was considered to be reasonable and was used for the estimation of the parameters of the utility and production functions.

Only the location variable, measured by the Beale codes was somewhat significant in the 1986 and 1991 estimations of the first equation. What is most surprising is that human capital had no impact. This may be explained by the fact that the technology of farming is relatively standardized and there is not much room for human capital to be applied effectively. This could also be a

Table 4.3.1.1.a Model for estimating utility function parameters α and β for 1986 data: linear version.

$$\left(\frac{Y_h}{T_h}\right) = \hat{\Gamma}_1 + \hat{\Gamma}_{1,1}\left(\frac{nW_m}{P_h}\right) + \hat{\Gamma}_{1,2}K_t + \hat{\Gamma}_{1,3}BC$$

Model[A]	Constant	$\left(\frac{Y_h}{T_h}\right)$	K_t	BC	R^2	F-value
Linear (Hetcov)[B]		-11400* (4416)	-.02825* (.003966)	8954.0* (2552)	.7980	25.847
Linear		-1140* (4271)	-.02825* (.003966)	8954.0* (2289)	.7980	25.847
Linear (Hetcov)		5175.1* (2076)			-.2417	1.996
Linear		5175.1* (3663)			-.2417	1.996
Linear (Hetcov)	38868 (5294)	-10488 (14250)	-.00068 (.00051)	-216.35 (463.8)	.1977	1.420
Linear	35987 (45940)	-12718* (34651)	-0.2639* (.00478)	5078.9 (5465)	.8078	16.815
Linear (Hetcov)	3074.9 (2634)	-15929 (17730)			.0165	.2340
Linear	106760 (33480)	-18885 (8078)			.2808	5.466

A Y_h : expenditure on household goods in real 1986 dollars, T_h :leisure in hours, P_h :consumer price index 1986=100, W_m :off farm wage rate in current dollars, n : off farm aftertax rate, K_t: value of human capital in real dollars, BC : Beale code.

B Hetcov is the correction for unspecified hetero-skedasticity in SHAZAM

***** Denotes significance at probability = .15

(Standard errors in brackets)

Table 4.3.1.1.b Model for estimating utility function parameters α and β for 1986 data: difference version.

$$\left(\frac{Y_h}{T_h}\right) = \hat{\Gamma}_1 + \hat{\Gamma}_{1,1}\left(\frac{nW_m}{P_h}\right) + \hat{\Gamma}_{1,2}K_t + \hat{\Gamma}_{1,3}BC$$

Model[A]	Constant	$\left(\frac{Y_h}{T_h}\right)$	K_t	BC	R^2	F-value
Difference (Hetcov)[B]		-6126 (5800)	.00554 (.00698)	-5041.2 (2094)	.0920	2.182
Difference		-6126 (12530)	.00554 (.00461)	-5041.5 (2104)	.0920	2.182
Difference (Hetcov)		-415880* (169700)			.0108	5.704
Difference		2281.7 (3186)			-.3600	0.058
Difference (Hetcov)	-55099 (60340)	-676580 (45800)	.00566 (.00549)	9065.9 (8899)	.2124	2.201
Difference	-97919 (77740)	-5960.5 (12260)	.00479 (.00455)	8524.1 (10190)	.01980	.0987
Difference (Hetcov)	-1361.5 (347900)	-.398540 (256100)			.0108	2.662
Difference	-39435 (15560)	-11596 (11510)			.0676	1.016

A **Y_h : expenditure on household goods in real 1986 dollars, T_h :leisure in hours, P_h :consumer price index 1986=100, W_m :off farm wage rate in current dollars, n : off farm aftertax rate, K_t: value of human capital in real dollars, BC : Beale code.**

B **Hetcov is the correction for unspecified hetero-skedasticity in SHAZAM**

* **Denotes significance at probability = .15**

(Standard errors in brackets)

Table 4.3.1.1.c Model for estimating utility function parameters α and β for 1986 data: logarithmic version.

$$\left(\frac{Y_h}{T_h}\right) = \hat{\Gamma}_1 + \hat{\Gamma}_{1,1}\left(\frac{nW_m}{P_h}\right) + \hat{\Gamma}_{1,2}K_t + \hat{\Gamma}_{1,3}BC$$

Model[A]	Constant	$\left(\frac{Y_h}{T_h}\right)$	K_t	BC	R^2	F-value
Logarithm (Hetcov)[B]	5.0977* (1.282)	-1.4430* (.3394)	.000001 (.000002)	-.33582 (.6289)	.6119	6.307
Logarithm	5.0977 (4.199)	-1.4430* (.3595)	.000001 (.000003)	-.33582 (.7309)	.6119	6.307
Logarithm (Hetcov)	4.4414* (.4923)	-1.4815* (.3358)			.6051	21.450
Logarithm	4.4414* (0.4275)	-1.4815* (.3199)			.6051	21.450

A Y_h : expenditure on household goods in real 1986 dollars, T_h :leisure in hours, P_h :consumer price index 1986=100, W_m :off farm wage rate in current dollars, n : off farm aftertax rate, K_t: value of human capital in real dollars, BC : Beale code.

B Hetcov is the correction for unspecified hetero-skedasticity in SHAZAM

* Denotes significance at probability = .15

(Standard errors in brackets)

Table 4.3.1.2.a Model for estimating production function parameters θ and π for 1986 data: linear version.

$$\left(\frac{T_f}{X_f}\right) = \hat{\Delta}_1 + \hat{\Delta}_{1,1}\left(\frac{mW_f}{nW_m}\right) + \hat{\Delta}_{1,2}K_t + \hat{\Delta}_{1,3}BC$$

Model[A]	Constant	$\left(\frac{mW_f}{nW_m}\right)$	K_t	BC	R^2	F-value
Linear (Hetcov)[B]		987.17 (8154)	-.000823* (.000358)	105.1 (118.1)	.1651	1.802
Linear		987.17 (27900)	-.000823* (.000478)	105.1 (419.2)	.1651	1.802
Linear (Hetcov)		9716.3* (5771)			-.0280	2.251
Linear		9716.3 (6457)			-0.280	2.251
Linear (Hetcov)	38868 (5294)	-10488 (14250)	-.000682 (-.000510)	-216.35 (463.8)	.1977	1.420
Linear	3886.8 (5567)	-10488 (32870)	-.000683 (.000528)	-216.35 (628.4)	.1977	0.985
Linear (Hetcov)	3074.9 (2634)	-15929 (17730)			.0165	0.234
Linear	3074.9 (3865)	-15929 (32900)			.0165	0.234

A X_f :factor inputs in index units, T_f : on farm effort in hours, W_f: factor price index 1981=100, W_m :off farm wage rate in current dollars, m : on farm aftertax rate, n : off farm aftertax rate, K_t: value of human capital in real dollars, BC : Beale code.

B Hetcov is the correction for unspecified hetero-skedasticity in SHAZAM

* Denotes significance at probability = .15

(Standard errors in brackets)

Table 4.3.1.2.b Model for estimating production function parameters θ and π for 1986 data: difference version.

$$\left(\frac{T_f}{X_f}\right) = \hat{\Delta}_1 + \hat{\Delta}_{1,1}\left(\frac{mW_f}{nW_m}\right) + \hat{\Delta}_{1,2}K_t + \hat{\Delta}_{1,3}BC$$

Model[A]	Constant	$\left(\frac{mW_f}{nW_m}\right)$	K_t	BC	R^2	F-value
Difference (Hetcov)[B]		-24303 (19440)	-.000256 (.000226)	215.48 (173.4)	.2911	2.424
Difference		-24303 (21250)	-.000256* (.000118)	215.48 (213.3)	.2911	2.424
Difference (Hetcov)		-6756.7 (5269)			.0024	1.622
Difference		-6756.7 (5305)			.0024	1.622
Difference (Hetcov)	-2809.1* (1661)	-6449.6 (12011)	-0.000273 (.000213)	401.5 (279.7)	.3475	2.130
Difference	-2809.1 (2760)	-6449.6 (27530)	-.000273* (.000119)	401.51 (280.7)	.3475	2.130
Difference (Hetcov)	-74.735 (826.7)	-5805.1 (12510)			0.0025	0.035
Difference	-74.735 (2396)	-5805.1 (31000)			0.0025	0.035

A X_f **:factor inputs in index units,** T_f **: on farm effort in hours,** W_f**: factor price index 1981=100,** W_m **:off farm wage rate in current dollars, m : on farm aftertax rate, n : off farm aftertax rate,** K_t**: value of human capital in real dollars, BC : Beale code.**

B Hetcov is the correction for unspecified hetero-skedasticity in SHAZAM

*** Denotes significance at probability = .15**

(Standard errors in brackets)

Table 4.3.1.2.c Model for estimating production function parameters θ and π for 1986 data: logarithmic version.

$$\left(\frac{T_f}{X_f}\right) = \hat{\Delta}_1 + \hat{\Delta}_{1,1}\left(\frac{mW_f}{nW_m}\right) + \hat{\Delta}_{1,2}K_t + \hat{\Delta}_{1,3}BC$$

Model[A]	Constant	$\left(\frac{mW_f}{nW_m}\right)$	K_t	BC	R^2	F-value
Logarithm (Hetcov)[B]	.45442* (.06637)	3.1616* (1.037)	-000001 (0.000011)	3.4131 (2.597)	.2352	1.230
Logarithm	.45442* (.08864)	3.1616 (2.531)	-000001 (0.000011)	3.4131 (2.842)	.2352	1.230
Logarithm (Hetcov)	7.9051* (2.137)	3.710* (1.010)			.1431	2.339
Logarithm	7.9051 (5.315)	3.710* (2.426)			.1431	2.399

A **X_f :factor inputs in index units, T_f : on farm effort in hours, W_f: factor price index 1981=100, W_m :off farm wage rate in current dollars, m : on farm aftertax rate, n : off farm aftertax rate, K_t: value of human capital in real dollars, BC : Beale code.**

B **Hetcov is the correction for unspecified hetero-skedasticity in SHAZAM**

* **Denotes significance at probability = .15**

(Standard errors in brackets)

Table 4.3.1.3.a Model for estimating utility function parameters α and β for 1991 data: linear version.

$$\left(\frac{Y_h}{T_h}\right) = \hat{\Gamma}_1 + \hat{\Gamma}_{1,1}\left(\frac{nW_m}{P_h}\right) + \hat{\Gamma}_{1,2}K_t + \hat{\Gamma}_{1,3}BC$$

Model[A]	Constant	$\left(\frac{Y_h}{T_h}\right)$	K_t	BC	R^2	F-value
Linear (Hetcov)[B]		-401.23* (98.61)	-0.000061 (0.000044)	423.79* (50.74)	.3562	42.109
Linear		-401.23* (132.6)	-0.000061 (0.000044)	423.79* (60.53)	.3562	42.109
Linear (Hetcov)		456.43* (86.85)			-2.1315	18.049
Linear		456.43* (107.4)			-2.1315	18.049
Linear (Hetcov)	2916.4* (608.0)	-517.57* (102.5)	-0.00037* (0.000015)	97.674 (85.94)	0.6831	8.623
Linear	2916.4* (828.9)	-517.57* (102.3)	-0.00037 (0.000034)	97.674 (102.7)	0.6831	8.623
Linear (Hetcov)	3560.8* (403.1)	-494.47* (113.9)			.6410	25.001
Linear	3560.8* (342.4)	-494.47* (98.98)			.6410	25.001

A Y_h : expenditure on household goods in real 1986 dollars, T_h :leisure in hours, P_h :consumer price index 1986=100, W_m :off farm wage rate in current dollars, n : off farm aftertax rate, K_t: value of human capital in real dollars, BC : Beale code.

B Hetcov is the correction for unspecified hetero-skedasticity in SHAZAM

* Denotes significance at probability = .15

(Standard errors in brackets)

Table 4.3.1.3.b Model for estimating utility function parameters α and β for 1991 data: difference version.

$$\left(\frac{Y_h}{T_h}\right) = \hat{\Gamma}_1 + \hat{\Gamma}_{1,1}\left(\frac{nW_m}{P_h}\right) + \hat{\Gamma}_{1,2}K_t + \hat{\Gamma}_{1,3}BC$$

Model[A]	Constant	$\left(\frac{Y_h}{T_h}\right)$	K_t	BC	R^2	F-value
Difference (Hetcov)[B]		-6126 (5800)	.00554 (.00698)	-5041.2 (2094)	.0920	2.182
Difference		-6126 (12530)	.00554 (.00461)	-5041.5 (2104)	.0920	2.182
Difference (Hetcov)		-415880* (169700)			.0108	5.704
Difference		2281.7 (3186)			- .3600	0.058
Difference (Hetcov)	-55099 (60340)	-676580 (45800)	.00566 (.00549)	9065.9 (8899)	.2124	2.201
Difference	-97919 (77740)	-5960.5 (12260)	.00479 (.00455)	8524.1 (10190)	.0198 0	.0987
Difference (Hetcov)	-1361.5 (347900)	-.398540 (256100)			.0108	2.662
Difference	-39435 (15560)	-11596 (11510)			.0676	1.016

A **Y_h : expenditure on household goods in real 1986 dollars, T_h :leisure in hours, P_h :consumer price index 1986=100, W_m :off farm wage rate in current dollars, n : off farm aftertax rate, K_t: value of human capital in real dollars, BC : Beale code.**

B **Hetcov is the correction for unspecified hetero-skedasticity in SHAZAM**

* **Denotes significance at probability = .15**

(Standard errors in brackets)

Table 4.3.1.3.c Model for estimating utility function parameters α and β for 1991 data: loagarithmic version.

$$\left(\frac{Y_h}{T_h}\right) = \hat{\Gamma}_1 + \hat{\Gamma}_{1,1}\left(\frac{nW_m}{P_h}\right) + \hat{\Gamma}_{1,2}K_t + \hat{\Gamma}_{1,3}BC$$

Model[A]	Constant	$\left(\frac{Y_h}{T_h}\right)$	K_t	BC	R^2	F-value
Logarithm (Hetcov)[B]	5.2994* (0.6669)	-2.3200* (0.4690)			.5970	20.738
Logarithm	5.2994* (0.5879)	-2.3200* (0.5095)			.5970	20.738
Logarithm (Hetcov)	4.8945* (1.923)	-2.3914* (.5876)	-0.00000 (0.000001)	.21465 (.9614)	.5989	5.973
Logarithm	4.8945* (2.679)	-2.3914* (.6319)	-0.00000 (0.000001)	.21465 (1.313)	.5989	5.973

A Y_h **: expenditure on household goods in real 1986 dollars,** T_h **:leisure in hours,** P_h **:consumer price index 1986=100,** W_m **:off farm wage rate in current dollars, n : off farm aftertax rate,** K_t**: value of human capital in real dollars, BC : Beale code.**

B Hetcov is the correction for unspecified hetero-skedasticity in SHAZAM

*** Denotes significance at probability = .15**

(Standard errors in brackets)

Table 4.3.1.4.a Model for estimating production function parameters θ and π for 1991 data: linear version.

$$\left(\frac{T_f}{X_f}\right) = \hat{\Delta}_1 + \hat{\Delta}_{1,1}\left(\frac{mW_f}{nW_m}\right) + \hat{\Delta}_{1,2}K_t + \hat{\Delta}_{1,3}BC$$

Model[A]	Constant	$\left(\frac{mW_f}{nW_m}\right)$	K_t	BC	R^2	F-value
Linear (Hetcov)[B]		456.14 (6185)	-00000070 (0.000220)	84.695 (98.06)	-0.180	0.936
Linear		456.14 (14560)	-00000070 (0.000102)	84.695 (178.0)	-0.180	0.936
Linear (Hetcov)		6651.7* (3552)			-0.0528	2.470
Linear		6651.7*(			-0.0528	1.
		4232)				2.470
Linear	4905.6*	-17290*	-0.000035	-339.52	0.1758	1.506
(Hetcov)	(3063)	(11060)	(0.000018)	(269.4)		
Linear	4905.6*	-17920	-.000035	-339.5	.1758	1.506
	(2920)	(17250)	(0.000098)	(302.6)		
Linear	2058.1*	-14712*			.0506	2.126
(Hetcov)	(1293)	(10580)				
Linear	2058.1	-14712			.0506	2.126
	(1592)	(17030)				

[A] X_f :factor inputs in index units, T_f : on farm effort in hours, W_f: factor price index 1981=100, W_m :off farm wage rate in current dollars, m : on farm aftertax rate, n : off farm aftertax rate, K_t: value of human capital in real dollars, BC : Beale code.

[B] Hetcov is the correction for unspecified hetero-skedasticity in SHAZAM

* Denotes significance at probability = .15

(Standard errors in brackets)

Table 4.3.1.4.b Model for estimating production function parameters θ and π for 1991 data: difference version.

$$\left(\frac{T_f}{X_f}\right) = \hat{\Delta}_1 + \hat{\Delta}_{1,1}\left(\frac{mW_f}{nW_m}\right) + \hat{\Delta}_{1,2}K_t + \hat{\Delta}_{1,3}BC$$

Model[A]	Constant	$\left(\frac{mW_f}{nW_m}\right)$	K_t	BC	R^2	F-value
Difference (Hetcov)[B]		-24303 (19440)	-.000256 (.000226)	215.48 (173.4)	.2911	2.424
Difference		-24303 (21250)	-.000256* (.000118)	215.48 (213.3)	.2911	2.424
Difference (Hetcov)		-6756.7 (5269)			.0024	1.622
Difference		-6756.7 (5305)			.0024	1.622
Difference (Hetcov)	- 2809.1* (1661)	-6449.6 (12011)	-0.000273 (.000213)	401.5 (279.7)	.3475	2.130
Difference	-2809.1 (2760)	-6449.6 (27530)	-.000273* (.000119)	401.51 (280.7)	.3475	2.130
Difference (Hetcov)	-74.735 (826.7)	-5805.1 (12510)			0.0025	0.035
Difference	-74.735 (2396)	-5805.1 (31000)			0.0025	0.035

A X_f :factor inputs in index units, T_f : on farm effort in hours, W_f: factor price index 1981=100, W_m :off farm wage rate in current dollars, m : on farm aftertax rate, n : off farm aftertax rate, K_t: value of human capital in real dollars, BC : Beale code.

B Hetcov is the correction for unspecified hetero-skedasticity in SHAZAM

***** Denotes significance at probability = .15

(Standard errors in brackets)

Table 4.3.1.4.c Model for estimating production function parameters θ and π for 1991 data: logarithmic version.

$$\left(\frac{T_f}{X_f}\right) = \hat{\Delta}_1 + \hat{\Delta}_{1,1}\left(\frac{mW_f}{nW_m}\right) + \hat{\Delta}_{1,2}K_t + \hat{\Delta}_{1,3}BC$$

Model[A]	Constant	$\left(\frac{mW_f}{nW_m}\right)$	K_t	BC	R^2	F-value
Logarithm (Hetcov)[B]	.74117* (.02724)	2.2328* (1.035)	-0.000005 (0.000007)	2.7205* (1.693)	.1926	.954
Logarithm	.74117* (.05903)	2.2328 (1.679)	-0.000005 (0.000009)	2.7205* (1.679)	.1926	.954
Logarithm (Hetcov)	4.3624* (1.990)	1.9996* (0.9254)			.0968	1.500
Logarithm	4.3624 (3.984)	1.9996 (1.633)			.0968	1.500

A X_f :factor inputs in index units, T_f : on farm effort in hours, W_f: factor price index 1981=100, W_m :off farm wage rate in current dollars, m : on farm aftertax rate, n : off farm aftertax rate, K_t: value of human capital in real dollars, BC : Beale code.

B Hetcov is the correction for unspecified hetero-skedasticity in SHAZAM

* Denotes significance at probability = .15

(Standard errors in brackets)

result of depressed prices that would encourage the farmer to work off of the farm more intensively and market human capital in the off farm market more aggressively. This is a limitation of the model in that it does not permit the allocation of human capital between on farm and off farm activity. It is also possible that the model encompasses different groups of part time farmers who have a range of human capital that on average does not have a large effect, but individually is more important. This is also a limitation of the data and the definition of the part time farmer.

The coefficients were in logarithmic form and the anti-log was taken to convert the coefficients into estimates of the parameters[24]. On the basis of this set of data, the parameter estimates were:

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For example given

$$\left(\frac{Y_h}{T_h}\right) = \Gamma_1 + \Gamma_{1,1}\left(\frac{nW_m}{P_h}\right) + \Gamma_{1,2}K_t + \Gamma_{1,3}B_c + \varepsilon_1$$

when estimated in logarithmic form is transformed as an estimable equation:

$$\ln\left(\frac{Y_h}{T_h}\right) = \hat{\Gamma}_1 + \hat{\Gamma}_{1,1}\ln\left(\frac{nW_m}{P_h}\right) + \hat{\Gamma}_{1,2}\ln K_t + \hat{\Gamma}_{1,3}\ln B_c + \hat{\varepsilon}_1 \text{ where } \hat{\Gamma}_1 \text{ estimates}$$

$$\ln\left(\frac{\alpha}{\beta}\right) \Rightarrow \left(\frac{\alpha}{\beta}\right) = \exp^{\hat{\Gamma}_1}$$

1986	1991
$\hat{\alpha} = .3883102$	$\hat{\alpha} = .3227486$
$\hat{\beta} = .6116898$	$\hat{\beta} = .6772514$
$\hat{\theta} = .9939264$	$\hat{\theta} = .9925679$
$\hat{\pi} = .0060735$	$\hat{\pi} = .0074213$

There is an apparent shift in the utility function parameters over the 1986 to 1991 period while the production function remained fairly stable. It is possible that no change took place in fact and the apparent shift is merely a statistical anomaly.

The method of checking for the change in the parameters was based on the Chow test, in which the data are lumped together or pooled and the sum of squares due to error of the combined data are then compared with the un-lumped sum of squares due to error and the resulting contrast is distributed as an F statistic with K and $T_1 + T_2 - 2K$ degrees of freedom where K is the number of parameters and T_1 is the number of observations in the first dat group and T_2 is the number of observations in the second data group.

The degrees of freedom for the F-statistic were $T_1 = T_2 = 16$ and $K = 4$ as the background variables were included in these regressions. Thus for the utility function and the production function the critical values of the F-statistic at 5% confidence were taken at 4,24 as 2.78. The value of the F-test statistic is 4.497 for the utility function. The value of the F-test statistic is 2.54 for production. Thus there is evidence that the change in the utility function parameters is statistically significant but not the change in the production function parameters.

To that end the model must be tested with the reduced form equations in order to determine if the data support the application of the model to policy scenarios that would prove useful.

These results suggest that there was some change in preferences but very little change in the production function coefficients. The expectation is that in agriculture the part time farmer will have a very heavy reliance on factor inputs and hence the production function will be very sensitive to factor inputs[25]. As this also includes hired labor the implication is that the part time farmer will have made substitutions for his or her own labor and the effort that is expended is focused on management. In this data set the factor inputs also include payments made to family members and therefore there is an imbedded labor component in the factor inputs.

The shifts in the utility function reflect an increased sensitivity to leisure. Generally we expect that utility parameters will be stable, but this shift seems reasonable in light of the increase in off farm effort. While farm life is generally intense with very long hours, the farmer lives at his place of work and thus travel time is not an important consideration. However, for off farm work the length of the commute is important. Even though the total number of active hours decreased from 3180.6 in 1986 to 3163.0 in 1991, the increase in off farm work most likely also led to an increase in travel time and hence an over allocation of this time taken to commute to leisure. Thus it is reasonable that there

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Depending on the organization of the farm unit it is also possible that the agent will draw a salary from the farm corporation and therefore the return to the effort spent on the farm by the farmer may be interpreted as a return to ownership of the farm or as a rent. (Saint-Paul, p.9) would be a shift of this nature towards leisure and away from goods.

Table 4.4.1 presents the results for the reduced form regressions for 1986. As this is a cross -sectional study, the p-values are considered acceptable indicators of statistical significance if they are approximately 0.1500 or less.

For the consumption of household goods the off farm wage rate is significant as is the impact of an autonomous transfer of funds. The impact of the off farm wage rate is positive. The impact of the autonomous transfer is negative which is contrary to expectations. The rest of the equations in this set are uninfluential.

With respect to the impacts on leisure the off farm wage is positive and significant. This is as expected. The impact of the autonomous transfers is also positive and significant which was also as expected.

The impact of off farm wage rate on factor usage is positive and significant. The impact of autonomous transfers on factor usage is negative and significant and suggests that factor usage will drop if there is an increase in the level of funds transferred. The p-value for this statistic is 0.148 which may in fact be relatively close to non-significance and therefore this may well be a data problem that is caused by the presence of two different types of part time farmers in this data set, namely the "genuine" part time farmers and the hobby farmers defined and described above.

There is no significant impact of many of the exogenous variables on the on farm effort and for off farm effort there is a positive impact for the on farm aftertax factor. This suggests that the data again may be clustered as the p-value for this statistic is 0.144. Nevertheless, these results support the condition that the farm must be profitable.

Table 4.4.1 Reduced Form Analysis 1986

Variable	Coefficient	Standard Error	t-value	p-value
Dependent Variable $Y_{h(1986)}$	**R^2=.5612**			
$W_{m(1986)}$	22128.0000*	8634.0000	2.5630	0.0250
$V_{h(1986)}$	-6.0087*	2.0730	-2.8990	0.0130
$m_{(1986)}$	-380240.0000	403700.0000	-0.9410	0.3650
$n_{(1986)}$	82751.0000	420100.0000	0.1970	0.8470
Dependent Variable $T_{h(1986)}$	**R^2=.5452**			
$W_{m(1986)}$	863.9500*	155.3000	5.5630	0.0000
$V_{h(1986)}$	0.0100	0.0373	0.2672	0.7940
$m_{(1986)}$	-315.3500	7262.0000	-0.0434	0.9660
$n_{(1986)}$	-7390.3000	7558.0000	-0.9778	0.3470
Dependent Variable $X_{f(1986)}$	**R^2=.3902**			
$W_{m(1986)}$	5345.5000*	2892.0000	1.8480	0.0890
$V_{h(1986)}$	-1.0746*	0.6942	-1.5480	0.1480
$m_{(1986)}$	-129690.0000	135200.0000	-0.9592	0.3560
$n_{(1986)}$	36044.0000	140700.0000	0.2561	0.8020
Dependent Variable $T_{f(1986)}$	**R^2=.0571**			
$W_{m(1986)}$	-195.8100	213.8000	-0.9159	0.3780
$V_{h(1986)}$	-0.0052	0.0513	-1.1008	0.9210
$m_{(1986)}$	11.8710	9997.0000	0.0012	0.9990
$n_{(1986)}$	10763.0000	10400.0000	1.0340	0.3210
Dependent Variable $T_{m(1986)}$	**R^2=.1090**			
$W_{m(1986)}$	50.4760	79.7900	0.6327	0.5390
$V_{h(1986)}$	-0.0022	0.0192	-0.1169	0.9090
$m_{(1986)}$	5827.2000*	3730.0000	1.5620	0.1440
$n_{(1986)}$	-5598.2000	3882.0000	-1.4420	0.1750

For the consumption of household goods the off farm wage rate is significant but the other exogenous variables are not. The impact is positive. The rest of the equations in this set are uninfluential. The data set are analyzed in reduced form for 1991 and the results are presented in Table 4.4.2. With respect to the impacts on leisure the off farm wage is significant and is positive. This is as expected. The impact of the autonomous transfers is also positive and significant which was also as expected. The impact on factor usage is significant positive for the off farm wage rate. With respect to the impact of the off farm wage rate on the amount of effort spent off the farm the wage rate was the only significant variable.

The reduced form results indicate that there is a marked change in the results for the 1991 data set when compared to the 1986 results. This suggests that there was a shift in the parameters of the utility function. Further, this suggests that policy changes will also be different when the 1986 data set and the 1991 data set are analyzed. These results, however, point out that the changes that are detected in this data set would not normally be found if the issue were resolved only by estimating the reduced form of the model. Thus there can and will emerge contradictions in terms of signs even when the same individuals are sampled, unless there is a concerted effort made to determine the nature of the utility and production functions.

Table 4.4.2 Reduced Form Analysis 1991

Variable	Coefficient	Standard Error	t-value	p-value
Dependent Variable $Y_{h(1991)}$	**R^2=.3752**			
$W_{m(1991)}$	55237.0000*	17550.0000	3.1480	0.0080
$V_{h(1991)}$	-0.7528	4.8360	-0.1557	0.8790
$m_{(1991)}$	-961620.0000	1230000.0000	-0.7927	0.4430
$n_{(1991)}$	-266810.0000	1491000.0000	-0.1790	0.8610
Dependent Variable $T_{h(1991)}$	**R^2=.0928**			
$W_{m(1991)}$	319.1400*	81.2500	3.9280	0.0020
$V_{h(1991)}$	0.0419*	0.0224	1.8700	0.0860
$m_{(1991)}$	-2795.0000	5617.0000	-0.4976	0.6280
$n_{(1991)}$	6831.8000	6903.0000	0.9897	0.3420
Dependent Variable $X_{f(1991)}$	**R^2=.2417**			
$W_{m(1991)}$	3046.3000*	1342.0000	2.2700	0.0420
$V_{h(1991)}$	-0.1204	0.3698	-0.3255	0.7500
$m_{(1991)}$	-47240.0000	92760.0000	-0.5092	0.6200
$n_{(1991)}$	-22951.0000	114000.0000	-0.2013	0.8440
Dependent Variable$T_{f(1991)}$	**R^2=-.3070**			
$W_{m(1991)}$	66.0680	62.6800	1.0540	0.3130
$V_{h(1991)}$	0.4297*	0.0173	2.4840	0.0290
$m_{(1991)}$	7982.3000*	4333.0000	1.8420	0.0900
$n_{(1991)}$	-7506.7000	5325.0000	-1.4100	0.1840
Dependent Variable $T_{m(1991)}$	**R^2=.3752**			
$W_{m(1991)}$	128.0200*	78.9400	1.6220	0.1310
$V_{h(1991)}$	-0.0283	0.0218	-1.3000	0.2180
$m_{(1991)}$	1388.7000	5457.0000	0.2545	0.8030
$n_{(1991)}$	-817.8300	6706.0000	-0.1220	0.9050

In this data set there are very few observations and as such there is reason to believe that the results would be improved with a larger sample.[26] However, this analysis has pointed out that the parameters of the utility function and the production function are important and therefore an evaluation of the policy elasticities that trace the impact and the effects of policy intervention is warranted.

4.6 Policy Elasticity Results

Policy elasticities refer to the percentage impact that a change in an exogenous variable may have on the endogenous variable. The mathematical expression of this is as follows:

$$\eta_{a,b} = \frac{\bar{b}}{\bar{a}}\frac{\partial a}{\partial b}\ ;\ -\infty < \eta_{a,b} < \infty \tag{79}$$

From the theoretical discussion of the comparative statics, the ∂a/ ∂b are the values generated when the comparative static effects for variable b on variable a (equations 9 through 57) are evaluated at the means of the variables. This statistic is useful for policy appraisal as it specifies the impact that a change in the exogenous variable will have on

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Possible methods of expanding the data set include using part time farmers in either 1986 or 1991 but not necessarily both, using the data that can be derived from the tried cases where the defendant was "found" to be a part time farmer by the court, and using a "representative" agent based on averages within industry groups and importing standards derived from other studies. In this first approach those who were exiting and entering agriculture would also be included. In the second case the data would have been massaged to the fullest extent possible under all available tax provisions and might not be indicative of family farm economic activity. The last approach is generally too restrictive and would most certainly have side-stepped the possibility that preferences might have changed. Each approach would have added more data but also removed the focus from part time farming activity itself.

the endogenous variable according to the parameters of the data set in percentage terms. Because the comparative static effects are purely theoretical they set the sign that is expected and the elasticity is the impact of the comparative static on a particular group of part time farmers.

Given that there are a small number of observations, that there are conceptual errors in the measurement of nonhuman capital which confounds the measurement of human capital, and that there are outliers in the data set, these results should be used with caution. It is difficult to predict the direction in which these elasticities might change with an improved data set. However, more data will improve the precision . In this data set it is possible that there may be some biases in the estimated elasticities due to the quality of the data.

Table 4.5 provides the elasticity measurements with respect to all of the exogenous policy variables. In 1986, part time farmers were farming profitable farms, but in 1991 there was actually an average loss of $1,847.03 per farm. Moreover, while there is an incentive to work off the farm in 1991, it is not present in the data set for 1986. The results suggest that for 1986 lowering taxes on off farm income will increase on farm effort by 2.6% and decrease farm inputs usage by 2.6%. Lowering off farm taxes encourages on farm effort. In the 1991 case when the incentive to work off the farm is not present, the effects indicate that the farmer will increase farm inputs and decrease farm effort. In 1991 the elasticities suggest that the percentage increase will be 8.8% in factor inputs and 8.8% decrease in farm effort. Between 1986 and 1991 the opportunity cost of leisure had dropped from 147.32% of household expenditures to 86.70%, which supports the contention that farmers were indeed working harder by taking less leisure in order to

Table 4.5 Policy Elasticities for 1986 and 1991*

	Exogenous						
Endo-genous	P_h	W_f	P_f	W_m	V_h	m	n
$\lambda_{(1986)}$	0.0012	0.0084	-5.4209	0.0007	-0.0042	-.7066	0.0007
$\lambda_{(1991)}$	**0.0006**	**-0.0106**	**1.3202**	**0.0012**	**0.0125**	**0.2461**	**0.0004**
$\gamma_{(1986)}$	0.0000	0.0002	-0.0542	-0.0037	0.0000	-.0000	0.01000
$\gamma_{(1991)}$	**0.0000**	**-0.0000**	**0.0132**	**0.0092**	**0.0000**	**-0.0000**	**0.0100**
$Y_{h(1986)}$	-0.0001	-0.0025	0.7320	-0.7899	-0.0001	-0.0007	-0.0347
$Y_{h(1991)}$	**-0.0001**	**0.0038**	**-0.5024**	**-0.4607**	**-0.0002**	**-0.0001**	**0.0000**
$T_{h(1986)}$	0.0006	6.9874	-2.1674	-8.0062	0.0004	-0.0026	-2.61844
$T_{h(1991)}$	**-0.0032**	**-20.1564**	**2.6708**	**13.0305**	**-0.0026**	**0.0021**	**8.7838**
$X_{f(1986)}$	-0.0010	-21.4618	-3.3303	-2.5142	2.5223	0.0033	0.1656
$X_{f(1991)}$	**0.0041**	**22.6555**	**0.0023**	**1.4481**	**5.2147**	**-0.0029**	**0.1194**
$T_{f(1986)}$	-0.0100	-0.2020	0.5921	0.0506	0.0075	0.0537	0.0068
$T_{f(1991)}$	**-0.0100**	**0.3454**	**-1.4615**	**0.0017**	**0.0163**	**0.0131**	**0.0164**
$T_{m(1986)}$	-0.0006	3.6200	0.0075	-0.0016	0.0012	-0.0026	2.6137
$T_{m(1991)}$	**0.0032**	**-26.5309**	**3.3352**	**0.0040**	**0.0006**	**0.0021**	**-8.7791**

* The number in any cell is the elasticity of the endogenous variable in that row with the exogenous variable in that column. The entries in bold are for 1991.

compensate for the decline in profitability of their farms. In this case the farmers were subsidizing farming effort with off farm effort. In terms of policy, the singular lesson that emerges is that the off farm aftertax factor has the ability to draw farm effort out of farming or push it up.

The off farm aftertax rate is merely the existing tax rate without the tax adjustments for losses in on farm operations. In terms of the balances that the part time farmer must utilize, the lesser is the "tax risk", the more effective will be the policy impact of the off farm aftertax rate in terms of its impact related to profitability. Between 1986 and 199, the "tax risk" dropped and the impact was greater. This implies that the narrower the "tax risk", even to the point at which it is eliminated entirely, the more effective would the single tax rate be in directing effort and factor input usage in agriculture.

The prices of farm output have impacts to the extent that a one percent increase in farm prices in the 1986 case, where there is some profit and no apparent incentive to work off the farm that part time farmers will react by decreasing farm effort by 2.16% and off farm effort by 3.33%. This would be appropriate if farmers acted as if they were on a "bandwagon" and believed that these price changes were permanent. This impression is supported by the impact on the marginal utility of income, which is decreased by 5.43%. Conversely, when there is less profit and an apparent incentive for off farm work there, is a 2.6 % increase in farm effort and a 3.35% increase in factor inputs. Moreover, there is also an attendant increase in the marginal utility of money of 1.32%. At the same time, there is little reaction to a subsidy that is paid in the form of an autonomous transfer. In the 1986 data, an increase in transfers of one percent would result in an increase in off farm work by 2.52%, but the same change in 1991 would increase off farm work by 5.2%.

The difference in reaction appears to be due to the substantially reduced profitability in 1991. In terms of practical policy the price of output appears to be an important and effective policy instrument.

The elasticity results suggest that the price of household goods does not have a major impact on the choices that part time farmers make in terms of allocation of effort. The price of factor inputs do appear to have significant impact.

In the 1986 case, an increase in factor prices by one percent would see a 3.6% increase in usage and a 21.4% drop in off farm effort. On farm effort would actually increase by 6.9%. When profitability decreases and there is an incentive to work off the farm, however the impact of a one percent change in factor input prices would be quite profound resulting in a 20.1% decrease in farm effort, a reduction in factor input usage by 26.5% and an increase in off farm work by 22.7%. This suggests that there is a threshold level that motivates a sudden change in the decision process. In the 1986 case, it appears that an increase in factor input prices would have motivated increased framing activity, while in 1991, a price increase might well have encouraged farmers to leave agriculture entirely.

The elasticity results for the off farm wage rate effects suggest that the agent is likely to decrease the effort on the farm by 8.00% and also decrease off farm effort by 2.54% in the 1986 case. In the case of the 1991 data, the converse holds, such that when the off farm wage is raised, the time spent on the farm will be increased by , while off farm effort will also be increased by 1.44%.

The data suggest that the off farm wage will have a differential impact depending on the profitability of the enterprise and whether there is an incentive to work off the farm or not. From the policy point of view, the most effective instruments are the tax rates.

4.7 Impacts on Policy

This analysis shows that the policy groupings reveal fairly consistent behavior with respect to the isomorphism classification developed by Bruce Gardner and the theoretical perspective suggested by the comparative static results. Moreover, the results also support the impression that the avowed target of the differential tax policy for encouraging full time farming is prone to influences from other policies. More specifically from off farm wage policy. This has been shown to be effective in changing the allocation of effort by the rational agent, depending on the nature of the utility function. The policies as administered will have impacts, but the advisability of how those impacts are achieved is also an arena in which fair comment may be expected.

At the same time that the focus has been placed on the encouragement of full time farming, there has been an accelerated decline in rural populations as farms have become more mechanized and expansive. The result has been a general exodus of population from rural areas to urban areas. Inasmuch as population levels have an effect that reduces the profitability and advisability of the provision of various services, many rural communities have suffered severe economic declines. In response to this, in Manitoba, various policy themes have been established, including the development in the 1970's of the "Stay Option", which laid the groundwork for encouraging growth in rural areas outside of agriculture. The preferred objective was to seek diversification rather than specialization. This theme has been supported by successive governments in Manitoba including the establishment of a separate Ministry of Rural Development. There is an apparent tension between the off farm wage rate policy at the provincial level and the full time farming policy at the federal level.

At the same time there are several indirect policy impacts that have rather circuitous routes in their influence on the pluriactive behavior of farmers. The desire of the federal government to pursue a "cheap food" policy requires that general price levels, which derive a large portion of their weighting from retail food purchases, be kept under control. Thus controls on inflation will have little impact on the amount of effort allocated off the farm. Holding down inflation, however, also means holding down prices in output markets. If this occurs, but there is general inflationary pressure, then it is expected that factor prices will increase and the margins that farmers earn will be restricted. Thus, there is an apparent tension between general economic price policy and market adjustments. In this set of results, the impact on off farm effort is larger for changes in factor input prices than for changes in output prices, but the direction of that change is dependent on the nature of the utility function.

Thus, the impact of various policies and market forces on off farm income is dependent on a multitude of factors, such that the adjustment in any one area may have significant impacts in any number of pathways. These possible pathways may be proportional such that one effect is tempered by the presence of another and it is the ratio of the effects that has the major effect. The effects may be additive such that one policy impact reinforces another. Another pathway is that one effect will multiply or amplify the effect of another policy impact. Clearly the degree of control over the overall effect will be greater the less the possible interaction is with other policy practices, processes, and procedures.

In this light, if a policy is blunt it will have impacts that are dependent on other background effects. Thus pricing policy, in both output and factor input markets, is effective. The effect, however, is contingent on many other factors, such as international market conditions, the state of processing and further finishing that often governs agricultural markets, and the degree of efficiency in distribution systems. Similarly, general price policy is affected by many other economic forces that include monetary, trade and financial circumstances. Autonomous transfers are seen as a last resort and, as such, represent a high profile compensation for policy changes that are otherwise uncontrollable.

In terms of this model, it is only the off farm wage and the aftertax factors that are administratively controllable and are readily understood by the agents involved. They are readily understood because it is in the interests of the policy administrators to have that information regarding the wages being offered and the level of the "tax risk" widely known in order to ensure that "hobby farmers" are not attracted and to avoid litigation based on legal technicalities in the case of a prosecution under the *Income Tax Act*.

If there are differences in skill levels amongst the farm population such that at least one set of agents has a higher degree of skill than another set of agents, then the firm offering the wage will be inefficient because if it offers one wage it will overcompensate the lower skilled workers and under compensate the higher skilled workers. Thus a pooling wage offer must always mean that there is no equilibrium in the labor market as any other firm could be established that offered differential wages based on skill and attract away the highest skilled workers. (Varian, p.466-468) However, if the firm that is investing in the rural economy and providing the off farm employment faces a condition that it must meet employment levels, it must seek to offer a comprehensive package that will attract workers of all skill levels and therefore face higher cost curves than otherwise would be expected. Given that many of these firms will not have been drawn into rural areas by market forces, a higher cost operation is less likely to survive in a competitive market.[27]

One counter argument that has often been raised in this context is based on the fact that skill levels are fairly uniform in agriculture. The average farm regardless of the sector that it operates in has a fairly standard complement of equipment. Many operations that are diversified grow food for their animals if they are in the livestock sector. The basic skill set of the farmer includes many generally sought after task competencies, such as the ability to maintain large equipment, carpentry and other construction skills, as well as the ability to weld and machine metal parts. The uniformity of the capital assets on the average farm is seen as an indicator of a uniformity of practical skills amongst farmers.

In the case of the part time farmer, however, it may well be the case that these skills are not uniformly distributed and the fact that the agent may be involved in off farm work could well indicate that there is a lack of skill in the basic set of farming skills as well. Without a set of significant human capital measurements that can be theoretically

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If the investment arises because of a grant, the provisions often include the requirement that certain job levels be met within an appropriate period of time. Failure to reach that objective may result in the requirement to pay back the amount of the grant or the "forgivable" loan. In these cases the firm will need to evaluate the inefficiency caused by the adverse selection of lower skilled workers against the potential requirement to pay back the financial assistance. In essence these programs work on the basis of an implicit government risk which is not dissimilar from the "tax risk" that the part time farmer faces.

and practically linked back to various skill sets, it is unlikely that this can be resolved. The data in this study did not support the resolution of this question. For the sake of this argument, however, it is clear that regional development policies that attract workers from farming to work off the farm will generally be expected to thrive if they draw upon agricultural skills rather than non-agricultural skills.

When viewed in this light, the off farm wage policy is seen as a blunt instrument and it is the taxation differential which has the most refined focus. It is also the most readily controlled as its application is placed clearly in the hands of the bureaucracy to administer and the provisions of the Canadian tax system leave the burden of proof on the individual taxpayer in response to a tax ruling. Thus, this policy operates on translating the perceived "tax risk" that the agent faces in taking on the off farm activity and enforcing it in practical terms, the impact of which will again be dependent on the utility function parameters of the agent.

The avowed objective of the tax scheme is not to discourage part time farmers, but rather to encourage full time farmers by discouraging hobby farmers (also referred to as gentlemen farmers). This follows from the debates in the House of Commons on May 27, 1952 between Mr. Abbott, the Minister of Finance and Mr. Knowles, a Manitoba Member of Parliament:

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> Mr Abbott:.....If you are running a grocery business and a drug business, you can offset the loss in the grocery business against the profit in the drug business. The only case in which we do not allow that is in the case of the gentleman farmer, who is limited to the amount of the loss.....

Mr. Knowles: Are there no gentleman grocers or gentleman druggists?[28]

However, as this data set reveals, there may well be certain gentlemen farmers who are not thwarted by this provision and for whom the tax risk is not a deterrent. As most of the cases before the Tax Court of Canada have proceeded, they have done so on the basis of the level of income that has been declared by the agent. Given that other policies, programs, practices, and procedures allow for deductibility of certain expenses it is entirely possible that even this focused program is unable to have the intended effects because of conflicts and tensions internal to the tax system itself.

If the policy is ineffective, then it is appropriate to either modify the policy or seek an alternative pathway to achieve the same result. In the analysis conducted above, it was shown that part time farming could be discouraged by means of autonomous income transfers that would in effect maintain full time status without altering market conditions or dealing with the apparent risks being transferred from the government to individuals or firms. Clearly, the other policy variables in the model have complex effects that are removed when this option is taken. This would in effect provide a guaranteed minimum income to farmers regardless of performance and would at the same time encourage production control by bureaucrats as the pursuit of profit would no longer be required in order to motivate farm management decisions. Agricultural practice has multi-faceted impacts on many other government policies, including environmental stewardship, natural resource management, and social policies of many different forms. Given this, it is clear that absentee management by government is not likely to be efficient in terms of farming decisions or overall government policy, nor is it likely to be socially preferred

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House of Commons Debates, 6th Session, 21st Parliament, Volume III, p.2626ff, May 27,1952.

over absentee management by the gentleman or hobby farmer.

In essence, the policy dilemma that is inherent in this discussion is why a policy such as this exists at all and whether there is any justification for its continuance. In practical terms it appears to be an expensive and expansive instrument, which while focused on a particular type of behavior is, relatively ineffective. Moreover, the theoretical and empirical impacts of this device call into question the need for the policy tool itself.

4.8 Summary

The model was estimated and the results were assembled with the following general conclusion:

- the definition of a part time farmer reduces the data set quite substantially, even though the data relate to exactly the same individuals in both 1986 and 1991;
- the estimates of the parameters indicate a shift in utility while there is a relative stability in the production function;
- the policy elasticities suggest that there are serious concerns that any particular policy instrument will be effective and only those with minimal administrative control in the hands of the government will have the desired effects and the model suggests that there may be a backward sloping supply curve for off farm labor; and
- the analysis of the effectiveness and efficiency of the policies themselves call into question the most appropriate methods to deal with part time farming and whether or not there is a need for a policy in this area at all.

Chapter 5

Conclusions and Suggestions for Further Research

5.1 Conclusions

From the results presented in this thesis, several policies were found to encourage part time farming by encouraging off farm effort. In 1986 the policy instruments included factor input prices and the off farm aftertax rate. In 1991 these supportive policies included the farm output price only. In 1991, however, the level of farm input prices actually was a major discouragement to off farm work as was the level of off farm aftertax factors. The taxation regime is also effective.

The major conclusion of this work is that the taxation policy regime, by itself, can be effective in controlling part time farming behavior and is an efficient policy instrument to the extent that it is fully within the control of the government. In contrast, other policy impacts may confound or even negate these impacts, especially those of policies that change the level of farm input prices. These other policy pathways are less effective and may present larger impacts that cannot be anticipated. Moreover, pursuing policies that involve secondary market impacts and adjustments in order to achieve a policy goal runs the risk of generating inefficiencies and dis-economies in other sectors. The major finding of this study is that the policy target itself may need to be redefined and it may well be advisable to ask the basic question as to whether or not policing the boundaries of part time farming is a worthwhile policy exercise at all.

The model of part time farming behavior that was developed in this study has revealed that shifts in the utility function parameters amongst part time farmers can alter the impacts of various policy devices. This is contrary to our normal expectations of policy impacts. Generally, it is assumed that the utility function parameters remain stable as policy is applied. In this case, however, the models were tested and it was found that significant changes in the parameter estimates could be traced back to differences between the two periods in the estimates of the utility function, but not in the estimates of the production function. This conclusion must at best be tentative given that the Chow test that was used is based on normality of the parameter estimators. However, given the nonlinearity of the estimated relationships, the parameters estimators are only asymptotically normal. Moreover, the small sample size reduces the precision of the estimates. On the other hand, the data supported many of the theoretically anticipated signs in the reduced form of the equations and in the impacts of the comparative statics. Inasmuch as most of the studies that have looked at part time farming have done so with a single reduced form equation, the simultaneity of this approach is at least as insightful as other studies. This was certainly the case when the autonomous transfer was included as a policy variable as well as in several other critical policy areas. Moreover, the data in this study dealt with the same farmers and the same farms and therefore the changes that are analyzed are changes in responses subject to the pure effects of these various policies. Therefore, it is concluded that this approach has incorporated more information than is normally considered and therefore offers additional insights into part time farming behavior.

The first insight is that part time farmers may well have utility parameters that are different from those that characterize the utility functions of other farmers or of the general public at large. This is consistent with the findings of the Bessant (2000) study, which indicated that farms, in combination with farmers, were the determining parameters in at least six recognizable factor clusters of part time farming situations. The results of this study suggest that within these clusters it may well be the farmers, and their orientation to both household consumption goods and leisure that are the driving factors within these clusters.

Further this study deals with the same part time farmers over a five year interval. This is a unique aspect of this study in that most other studies have only dealt with a single set of observations at one point in time.

This model, while offering several unexpected conclusions appears to fit with results gathered from various other studies of the part time farming issue. The model, however, does test the uniquely Canadian policy of a differential tax risk that is not found in other jurisdictions. This unique policy arises form the differential tax rates that every part time farmer faces when choosing to take an off farm job. This "tax risk" can alter behavior when utility is highly sensitive to household goods consumption.

The tax system in force in both Canada and Manitoba[29] over this period was remarkably stable. The percentage of federal tax that was collected by Manitoba was unchanged and the notional tax rates, those that are generally understood to be in effect

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The tax system is a registration system in which an operator files a financial record of income and expenses. Other systems, such as excise systems in which payments are made periodically and credits claimed as they accrue, would have a lower tax risk because the tax risk is ongoing. The impact of notional tax rates can also be affected by the length and timing of fiscal years and the corporate structure of the farm itself. However, in this analysis these effects are assumed to be negligible.

remained unchanged including sales taxes and excise taxes. Thus the "tax risk" that the operators faced was unchanged, differing only in the implicit tax responses of the individuals themselves. The tax responses depend on the special deductions that are unique to each family and that revolve around such issues as the expenses paid for childcare and post secondary education. These are not considered to be changeable by the agent in the short run. The implicit tax rates may differ from the notional rates that are used in this analysis. On the other hand the notional rates are the rates that are most likely used in the planning for capital cost allowances and project budgeting, and are most certainly the rates that are directly affected by the differential taxation policies. These rates are most likely to be used in the calculation of a "tax risk" for a part time farmer.

An examination of how the policy is implemented and what it involves may also shed some light on how it may be evaluated or whether or not it should be evaluated at all. As discussed earlier, the critical issue is whether or not a farmer will be able to deduct losses for the current year on a cash basis in order to reduce the tax liability that he or she would face. A cash basis generally allows for much larger adjustments and removes the risk of having a large tax liability to the government in case the crop fails or revenues drop suddenly. In this type of system, those not involved in agriculture will view the cash basis as an advantage. In order to protect against this type of manipulation the Tax Court of Canada annually reviews the taxes of almost 400 Canadians who have claimed or are claiming special status as farmers, which process is initiated with a tax review and audit system.

In the case of the Manitoba part time farmer there were only 16 individuals out of a sample size of 917 who were earning off farm income and reporting their hours worked. If this sample is representative, we would expect that approximately 2% of all farmers are involved in persistent part time behavior. Then with approximately 200,000 Census farms in Canada, this suggests that there are approximately 4000 part time farmers in Canada who have a ten percent chance of being challenged under this provision of the *Income Tax Act.*

Given that there is no other occupational group that is identified in this way under the tax system, which provides complete discretionary authority to the Deputy Minister of National Revenue Taxation to determine who is and who is not a part time farmer, it is highly questionable as to whether or not this type of policy should continue. Moreover, there are factors in the administration of this type of policy which gradually reduce the effectiveness of the "tax risk" itself. When amounts that can be deducted, which are exempt from tax, increase, then the apparent "tax risk" is reduced if the levels of taxation and the rates remain the same.

Any changes in this system should consider not only the efficiency of the system, in terms of the number and cost of prosecutions, but also should consider the effectiveness of the policy in practice. In this analysis, it is apparent that hobby farmers may exist in the data set, and as such, the policy may well have been ineffective. The emphasis on protection may itself have been misplaced. The true target of this policy has not been to discourage part time farmers but rather to encourage full time farmers. Thus, it must be evaluated not only on how well it has "policed" the periphery of protection, but on how well it has encouraged people to remain full time in farming.

This is a formidable task and one which most developed countries have been unsuccessful in pursuing. Mechanization and modernization have led to rural population declines and a gradual erosion of economic and political impact in rural areas. No policy administered by any government has been able to stem this tide.

At the same time, support for active programs in the agricultural field that encourage growth and especially encourage the development and acceptance of new technologies has largely been curtailed or postponed in the name of fiscal restraint, trade obligations, or lack of suitably refined technologies. Thus the policy thrust has been restricted to a policing rather than a promotional stance.

Traditional agricultural policy has been based on bureaucratic leadership involving casual meetings with farmers as the government attempted to distribute technologies that it developed on its own through various extension services. Little attention has been paid to farmers' views and attitudes as an input in the direction of this research and or the application of policies. In a newer model where consultation is sought out and incorporated into the general thrusts of agricultural policy, it is unlikely that the resources and time devoted to policing farming practices of a few would be considered a high priority amongst all farmers, both full and part time.

It is strongly recommended that serious consideration be given to the removal of this distinction and the gradual elimination of all of the restrictions placed on part time farming as this model suggests, that even when there is a radical shift in attitudes and preferences, the essential nature of the agricultural production function is remarkably stable and the agents that do work both on and off the farm, do so in a rational manner as utility maximizing agents.

5.2 Suggestions for Further Research

This work has proceeded by taking a simple model and applying it in order to uncover and expose insights into part time farming behavior. It has been successful in demonstrating that the part time farmer can be seen as a rational agent and that there are serious implications if the parameters of the utility function change through time, such that even the same individuals may behave differently. The model is, however, a blunt instrument and there are several areas in which improvements can and should be made in order to verify the conclusions reached by this research. These suggestions will be dealt with in terms of the model, the data, and the policy framework.

5.2.1 The Model

In this model the background variables were insignificant, although there is a strong theoretical basis for suggesting that they be included. Human capital was seen as a very important part of the work as it also straddles the boundary between the farm and the off farm effort. Presumably, an agent will also have human capital that will assist in the enjoyment of leisure as well. In order to model this, a third function will need to be included in which the wage rate will increase as a result of more human capital being deployed and presumably this will enter as an argument in the utility function as well.

Other factors that may be included in a revised model would be the amount of nonhuman capital that may be involved in the operation of the farm. This suggests several hypotheses including whether or not a part time farmer is involved in part time farming merely in order to repay debt that may have been incurred in starting up a farm or undertaking a major restructuring. In addition, financial considerations may shed more insight into the types of behavior that are exhibited especially as an assist in identifying the hobby farmer within the data stream. Finally, the model may be readdressed to focus more on the sociological factors that are involved in the pluriactive farming decision especially, but not limited to the interactions that take place within the farm family unit which is suspected by many as being the real decision forum for most family farms in Canada.

It is also worthwhile to approach the part time farming decision from another perspective than utility maximization. If a corporate model were to be used then the model would seek to maximize profits and while changes in preferences would not be detectable, changes in allocation of effort would be more readily modeled and the financial and nonhuman capital issues would be critical to the analysis. In this case the part time farmer would decide whether or not he or she would be a valuable employee and if not would hire skills elsewhere in effect becoming a hobby farmer on their own farm. Another possibility is to look at volume maximization as an objective function. This would involve a bureaucratic or state enterprise approach in which output would be maximized and the part time farmer would essentially have to decide on labor units and how they would need to be coordinated. In this type of arrangement, the part time farmer is a portioned farmer and it would be expected that off farm employment would also involve similar skills as every farmer would be a part time farmer.

The model used in this research was a comparative static model that drew its inspiration from an attempt to solve the allocation decision simultaneously. Inclusion of a savings element would be important in establishing the theoretical groundwork for estimation of an equation of motion that would permit the testing of dynamic hypotheses.

5.2.2 The Data

The data used in this research were appealing because the data represented responses from the same individual at two points in time five years apart. The data were recorded as part of a country-wide Census and therefore farmers are more likely to comply with a data recording request since the entire country was involved. The Census may therefore be expected to be more accurate than an occasional survey. The data were also attractive because it provided the opportunity to evaluate individual responses directly. On the other hand the data set was sparse. Refining the data by removing outliers would violate the definition of part time farming that was used in this study. Merely having a large off farm income is not sufficient reason to exclude anyone from being a part time farmer. Expanding the data set for more precise estimates would include information on individuals who were either entering or exiting agriculture and not really part time framers at all. Other methods that might have been used to expand the data set could have included using the data from court cases or creating representative part time farms for analysis. If either of these approaches had been taken the data would have been even more influenced by taxation rulings than it already is or the data would be fabricated in which the only results that could be expected would be through simulation and not through investigation. Clearly data of this type is most conducive to the evaluation of part time farming behavior, but more of its would be needed in order to draw out more firm and exemplary results.

The data are based on a very long period between observations and this data set implies that there were major shifts in preferences over the sample period for this research. A more focused and more detailed data set would be required in order to establish the transmission process that would be involved in these types of changes, and to identify those factors that might influence these types of changes. In this model, the off farm effort is an allocation problem from a pair of questioning sequences that need to be massaged in order to gain an estimate of actual off farm hours worked. A more simple recording of a representative week would provide more readily useable information. A more detailed data base would allow for the assessments of costs associated with off farm work, which in this case are assumed to be included in the net wage. This type of information would be critical in modeling the off farm work choice as an optimization problem on its own, and might well provide some insights into the rationing of time that part time farmers would be expected to undertake in order to generate a net positive return from off farm effort.

Additional information that would be useful, would include specific information about the nature of the off farm work that is undertaken. It is entirely possible that an agent who became involved in the sale of agricultural implements would be working off the farm but would be doing so in an enterprise that would be dependent on agriculture for its survival. Similarly, the nature of the job that the agent was involved with might well provide specific training that would be beneficial for farming as well. These interactions would only be made available thorough a more detailed data set.

There are numerous other information streams that would be useful in providing more insights into the behavioral aspects of pluriactivity, but these data sets are not generally available and many of the series and special studies run by Statistics Canada have been abandoned for efficiency considerations. Even land grant universities in the United States do not maintain these types of records.

5.2.3 The Policy Framework

Agriculture is a joint responsibility of the federal and provincial governments and as such operates with numerous joint programs that are designed to maintain the incomes of farmers who operate within the limits set by agricultural policy. At the same time agriculture in Canada has suffered a severe and protracted decline for many decades as rural populations have been reduced and farms have grown bigger.

Most recently the federal and provincial governments have attempted to refocus the thrust of agricultural policy by encouraging more direct participation of farmers in setting national and provincial research agendas and in evaluating the efficacy of policy. This suggests that the issue of part time farming and whether it is indeed a good or a bad thing, and particularly whether or not it is worthwhile policing to the current extent, may become part of the debate. There is no doubt that the issue of giving protective tax status to farmers will be popular amongst farmers, but that may be addressable in a number of ways other than using the current taxation regime.

The possibility that encouragement of part time farming may be a method of enhancing the economic prospects for many in rural Canada may be attractive. This option will need to be considered if initiatives focus on activities that are specifically designed to use the skill sets that many farmers possess. An even greater return may come from focusing development assistance into those industries that are specifically geared to supply and service the farm. In times when budgets are being restricted and general programming funds are being carefully scrutinized, it is incumbent on policy managers to develop new initiatives. Regional development is a federal responsibility and a provincial domain and adjustments in these policy networks that favor part time farming hold great promise for the overall abatement of rural decline.

5.3 End Note

This research set out to demonstrate that part time farmers could be viewed as rational economic actors maximizing utility and that this type of behavior could be modeled using a simultaneous model which more closely suited the nature of farming decision making and therefore was considered to be more realistic in terms of the pluriactive decision.

In the process, it was found that , although the production function might be fairly stable, preferences could change dramatically and in this model these changes were detected readily. These changes would not be included in a sequential solution to the model as they would in essence be assumed away. Yet this research has shown that changes in preferences suggest that many of the policy instruments that are available to those who seek to manage the part time farmer can be confounded by this type of change and may even be counter productive.

This study has shown that part time farmers have been and will continue to be a factor in the development of Agriculture in Canada and Manitoba. Policies that are designed to control part time activity might well consider switching to encouraging part time farming in order to enhance and promote the economic, political and social development of agriculture generally and the incomes of a farmers specifically.

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