# AN ECONOMIC ANALYSIS OF THE FREIGHT RATES DEFINED UNDER THE WESTERN GRAIN TRANSPORTATION ACT

by

Joanna P. Karman

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## ABSTRACT

The sophistication of the grain freight rate-setting cycle is defined by the Western Grain Transportation Act (WGTA). Uncertainty of future economic events gives rise to the unknown financial obligations of the federal government and grain shippers. The general objective of this study was to evaluate how the determination of freight rates legislated under the WGTA influences the type and level of financial obligations of shippers and government.

A Monte Carlo simulation model was developed. Several of the variables used in the rate-calculation were randomly generated from assumed probability distributions such that the range future payment responsibilities of shippers and government could then be forecast. In addition to the probability distributions generated for the financial commitments of the federal government and grain shippers, the study also determines the range of freight rates and the probabilities of invoking the safety net feature of the Act, and the distribution for the tally.

The model was then utilized to determine the effects of various economic events and structural change on these future financial obligations. Economic events examined were a bench case reflecting the economic status quo, an increase in railway costs, and a decrease in the Canada - United States currency exchange rate. The two rate structures examined were a bench case depicting the current method of payment of the Crow subsidy and an alternate case involving a change in the method

of payment to a "pay the producer" approach based on net sales of eligible grains. Four scenarios resulted. The bench scenario was examined in depth in terms of probability distributions and descriptive statistics relating to all aspects of the rate-setting process. The alternate scenarios were analyzed and compared to the bench case.

For each scenario, twenty crop years were simulated (1981-82 through 2000-01). Each twenty year sequence, considered to be one trial, was replicated two hundred times to achieve stable distributions of possible outcomes. For each of the scenarios, four crop years were reviewed: 1986-87, 1990-91, 1995-96 and 2000-01.

Basically, the results indicated that under today's economic conditions and current method of payment, the total freight rates for grain will rise to just over $49 per tonne by 2000-01. Throughout the simulation period, the financial obligations of both shippers and government increase. Freight rates paid by shippers also increase to an average of about $30.50 per tonne by 2000-01 (some 60% of the total freight bill). However, because forecast volumes of grain are increasing and because the government's absolute payment responsibilities are only increasing slightly, the rate per tonne paid by the government decrease over time. By 2000-01, the average government freight rate will be around $19 per tonne.

If railway cost inflation doubles (scenario 2), grain freight rates increase to almost $85 per tonne by 2000-01. Total financial commitments and freight rates increase throughout the simulation for both shippers and government. By 2000-01, shippers pay a mean rate of about

$46 per tonne (55% of the total rate) and the government freight rate averages $38 per tonne. Relative to the bench case, shippers rates have risen as they are now liable for the maximum 6% inflationary cost increases. Government rates have increased due to greater contributions through the inflation protection measure and more frequent and larger adjustments resulting from the safety net provision.

If Canadian grain prices drop (scenario 3), the total grain freight rate if unaffected, but the shares paid by shippers and government change. The reduction in grain prices causes shippers to receive greater financial assistance through the safety net feature, thus reducing their share of the rate. Although the payment obligations of producers and the freight rates they pay increase throughout the period under analysis, the average shipper rate will be only $29 per tonne by 2000-01 (or almost 60% of the total $49 per tonne grain freight charge). Due to increased requirements of shipper share limitation adjustments, the financial obligations of the federal government are higher relative to the bench case. Consequently, the mean freight rates paid by the government increase throughout the simulation time frame. By 2000-01, the mean government freight rate will be approximately $20.50 per tonne.

Should a change in the method of payment occur (scenario 4), shippers pay the full freight rates. Despite a refund payment to producers, the net cost to shippers will be greater than what they would pay under the present rate structure. The net costs to shippers increase throughout time and by 2000-01, their net cost is some $33 per tonne. Under the formula determining the government's payment responsibilities, revisions were made to the safety net percentages to try to give producers a measure of protection equivalent to that under the current method of payment. Government contributions to the GTR begin to drop toward the end of the analytical period. On a per tonne basis, the subsidy amounts to an average of some $18 per tonne. This reduction occurs because the shipper share limitation adjustments which have been triggered throughout the simulation become lower and less likely as time goes forward and grain prices rise.

Under the economic status quo and the current rate structure, shipper share limitation adjustments (safety net) will be triggered around 1991-92, although the probability of an adjustment is small. By the end of the simulation period (2000-01), the probability of an adjustment has risen to some 30% with an average level of almost $42 million. When railway costs increase and the shipper freight rate increases, the safety net feature occurs earlier and the financial assistance shippers receive is greater than that under the base case. By 2000-01, the shipper share limitation adjustment averages almost $365 million under scenario 2 with a likelihood just over 90%. When Canadian grain prices drop, shippers again receive additional financial aid through more frequent and larger adjustments from the safety net feature. By 2000-01, the probability of a adjustment under scenario 3 is almost 60%, with a mean level of over $110 million. Under the fourth scenario, the revised safety net percentages (20%) result in frequent shipper assistance in early years as producers are paying the full rate up front. In later years, the aid is reduced as grain prices rise and the full rate producers pay drops below 20% of the basket price of grain in Canada.

With respect to the tally system and volume forecast errors, the analysis indicated that there is a tendency toward negative annual tally adjustments (monies owed by producers to the government). This is because negative tally adjustments are the result of underforecasting grain shipments which is more probable than overforecasting.[1] Negative annual tally adjustments can be subject to a lower limit if the forecast error which caused it was constrained. For example, all of a bumper crop may not be able to be shipped to port if the grain handling and transportation system does not have the available capacity to handle that entire volume. Positive annual tally adjustments caused by overforecasting have no limit as there are no constraints on crop failures. However, the results indicated that the range in negative and positive annual tally adjustments is similar meaning the range of up-side and down-side forecast errors is also similar.

The result was that the long-run cumulative tally averaged about $17 million by 2000-01. However, during the simulation period, the cumulative tally often exceeded its legislated limits. This required an adjustment to be made to the government's share of costs in order to avoid having to large a sum owed to either shippers or the government. It should also be noted that the magnitudes of the annual tally adjustment (both positive and negative adjustments) were such that the cumulative tally could exceed its bounds in just one year.

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[1] The use of a least squares technique (which assumes a normally distributed error term) will produce mostly underestimates because grain shipments are characterized by Beta distributions skewed to the left.

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# Chapter I

# INTRODUCTION

The Western Grain Transportation Act (1983) replaced the previous statutory regulations with a set of new payment schedules for grain shipped from the prairie provinces. The Act set out a procedure for determining freight rates whereby railways are compensated for their aggregate costs of hauling grain from the region. The freight rate payments shared by shippers and government are subject to economic conditions in the agricultural sector, as well as the rest of the economy. The complexity in terms of sharing the freight rate when linked to the uncertainty associated with future economic events, results in unkown financial obligations on behalf of shippers and the federal government. This thesis is intended to analyze a range of possible outcomes of future rail freight rates and the cost shares borne by grain shippers and the federal government.

## 1.1 THE WESTERN GRAIN TRANSPORTATION ACT

Western Canadian grain, coal and potash exports grew substantially from the 1960's onwards. By the late 1970's, forecasts of continued growth led to serious concerns about the capacity of Canadian railways to serve the needs of the 1980's and 1990's. Rail renewal and expansion to improve the system would require immense capital investment; without it the railways argued that rail capacity rationing could be necessary, an alarming prospect for the region's economy.

'Crow' rates, fixed by federal statute in the Crow's Nest Pass Agreement of 1897, covered a decreasing portion of the costs of moving grain. The lack of revenue from hauling grain came to be seen as an obstacle to raising the necessary capital to improve the rail system. By 1982, it was estimated that the freight rates (Crow) paid by shippers covered only about twenty percent of the actual costs of transporting grain.[2] Pressure built for some new arrangement for sharing the costs of grain movement. In early 1982 the federal government began a process which would alter the historic Crow rates.

In November of 1983, Bill C-155, an Act to facilitate the transportaion, shipping and handling of western grain, became law. The objectives of the new bill, also cited as the Western Grain Transportation Act (WGTA), are:

> "to improve the capacity and efficiency of the grain transportation, shipping and handling system for the purpose of maximizing returns to producers" [12,17],
>
> "to ensure an adequate, reliable and efficient railway transportation system that will meet the future requirements for the movement of grain" [38(2)a,55(2)], and
>
> "to ensure that the overall revenues of the railway system are adequate to meet its long-term needs" and to ensure that grain contributes fairly to railway fixed costs "in relation to the contribution provided by other commodities". [38(5)]

Unlike the old statute which fixed the dollar levels of grain rates, the WGTA incorporates a method of determining rates that allows the railways to recover their aggregate costs of shipping grain from the Prairies. Every four years these costs will be established by an audit

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[2] Canadian Transport Institute, Public Hearing, "An Overview of the Report of the Committee of Inquiry on Crow Benefit Payment", June 1985, p. 3.

performed by the Canadian Transport Commission. Between these costing reviews, railway costs will be estimated by the Commission.

Three categories of railway costs have been defined under WGTA: volume-related variable costs which refer to the cost of railway crews, fuel, materials and the costs of investing in and maintaining capital equipment; line-related variable costs which refer to railway expenditures to maintain grain dependent branch lines and which are independent of volume; and the contribution to constant or fixed costs which is a phasing-in of railway overhead as a percentage of volume-related variable costs. The sum of these cost categories represents the total payment to the railways and is referred to as the estimated eligible costs. The payments are made in the form of a freight rate shared by the federal government and the shipper for qualifying grain moved by rail to points of export.

Under Bill C-155's rate structure, the federal government is committed to pay a fixed amount and to share in future annual railway cost increases above specific limits. The fixed amount, known as the Crow Benefit is unaffected by cost changes or shipments and represents the difference between the estimated system cost of shipping grain by rail and what the shippers paid under statutory rates in 1981-82. Based on the base year shipments of 31.5 million tonnes, the Crow Benefit has been set at $570.1 million in 1983-84, $599.6 million in 1984-85, $629.1 million in 1985-86 and at $658.6 million thereafter. If railway costs to move the base year volume increase, the cost increases will be shared by government and shippers, with limits on the increase borne by shippers.

In addition to the government commitment, the shipper share limitation clause or safety net feature of the Act requires the government to contribute additional funds if the shippers' share of the freight rate exceeds a fixed percentage of a weighted average price of the six major grains. Percentages are 4%, 5%, 8%, and 9% for calendar years 1984 through 1987 respectively and 10% thereafter.

Shippers are responsible for what they would have paid under Crow rates on the base volume of 31.5 million tonnes plus a share of railway cost increases on the base volume. Producers are required to pay the first three percentage points (accumulating) of annual rail cost increases on the base volume in the crop years through 1985-86 and the first six percentage points thereafter. In addition, shippers must pay the full cost, including all cost increases, of transporting any volumes of grain in excess of the base volume of 31.5 million tonnes.

All rate calculations are based on the Grain Transportation Agency's estimate of grain volumes to be moved by rail. Specific distance-related rates are listed in the WGTA's Base Rate Scale (similar to the old Crow rate) where shippers more distant from port pay higher rates. To determine specific rates for each crop year, these base rates are multiplied by a factor referred to as the Crow Multiplier. The Crow Multiplier is the railways' estimated eligible costs divided by the Crow revenue, where the Crow revenue is the revenue the railways would have earned if the Crow rate had not been changed (i.e., \$4.85 per tonne x estimated volume to be moved by rail in that particular crop year). The multiplier is reset annually so that the railways will just recover their estimated eligible costs. The government and shippers pay the railways the new rates in accordance with the shares established in the Act.

On August 1, 1985, Bill C-44, an amendment to the WGTA came into force. Under the bill, government financial responsibilities were increased. The 31.5 million tonne volume cap as it relates to federal government obligations to sharing in rail cost increases was removed.

Secondly, federal government financial obligations increased by the implementation of a tally system to replace Bill C-155's system of interim and final rate adjustments. Both the adjustment system and the tally system were devised to account for errors in grain shipment forecasts. As previously mentioned, all rate calculations are based on an estimate of grain volumes to be moved by rail. Under the previous system of interim and final adjustments, three estimates or determinations of grain shipments were necessary. The first was made in February prior to the beginning of the crop year and it was upon this estimate that the freight rate for the upcoming crop year was based. The second or interim volume estimate was made in April of the crop year in question. Any cost change associated with the difference between the inital and interim estimates was incorporated into the freight rate the following year in the form of an interim adjustment. The third or final volume determination was made in October after the end of the crop year. The cost effect of any difference between interim and final estimates was incorporated into the freight rate two years following in the form of a final adjustment.

If earlier estimates were too low, additional costs were incorporated into the rate in later years; if they were too high, credits were generated which reduced the rate in subsequent years. Thus, the errors in volume forecasts were picked up by this system in terms of the interim and final ajustments which were later incorporated into the rate. Under this procedure it took take three years before shippers' freight bills associated with shipping any one year's crop were settled. The problem inherent in this procedure was that the larger the forecast errors, the larger the adjustments. The fluctuations in freight rates resulting from these adjustments were leading to instability and uncertainty in the rate.

To stabilize freight rates and avoid large swings from year to year, Bill C-44 adopted a tally system rather than the system of interim and final adjustments. This proc dure removes the forecast errors from the internal rate setsting cycle and set up a tally within which cost differences associated with errors in forecasting grain shipments are kept. Under this system, only two volume estimates or determinations are necessary - the initial volume estimate, made in February prior to the beginning of the crop year and the final volume determination, made after the end of the crop year.

A tally is kept, year by year, of the total amount owed to or owed by government which results from errors in forecasting volumes. The annual tally adjustment is the government commitment plus the shipper share limitation adjustment less the government's actual expenditure. A positive value in the tally indicates an unspent government financial commitment or an amount owing to producers by the government; a negative value indicates an overspent government commitment or an amount owed by producers to the government. When the volume forecast is below actual shipments, the federal government commitment would be exceeded and the amount owed to the government will increase. When the volume forecast is above actual shipments, the government commitment is not spent and the amount owed by the government will increase.

This procedure increases the federal government's costs. Prior to the amendment, if the actual grain movement was below the volume cap, the government did not spend its commitment. Under the new system, the unspent government's commitment is put in the tally and used in future years.

If the forecast errors are random and normally distributed, the number of years where actual exceeds projection should equal the number of years where actual is below projection. As long as this statistical assumption holds then the cumulative amount owed to or owed by shippers will fluctuate around zero. The amounts registered in the tally would not be factored into the freight rate.

To avoid having an excessive sum either owed to or owed by the government, a limit of $150 million is set on the cumulative tally. Any amount over this limit is factored into the freight rate. For example, if the previous cumulative tally exceeds $150 million, the government's share of freight costs for the upcoming crop year increases by that amount; if the previous cumulative tally exceeds minus $150 million, the government's share of freight costs for the upcoming crop year decreases by that amount.

## 1.2 PROBLEM

In the Western Grain Transportation Act, freight rates for transporting grain are reviewed annually by the Canadian Transport Commission. The review takes into account changes in variable and overhead costs by the railways. These cost changes are affected by prices of operating inputs, productivity and technological advances in the grain transportation and handling sector, interest rates and forecasts of grain shipments. Whereas the railways are compensated for their costs, who pays the costs is defined in the Act. The cost shares borne by shippers and the federal government are dependent upon economic conditions in the agricultural sector as well as the economy as a whole. Because of the sophistication of the rate-setting cycle and the uncertainty as to future economic circumstances, future payment levels on the part of shippers and government are unknown.

This uncertainty is compounded by the method of payment. The inquiry into Crow Benefit payments commissioned by the Act, was presented in March of 1985 and it recommended a procedure to pay the producers instead of the method of subsidy payments to the railways. A Grain Transportation Refund, consisting of the Crow Benefit and government contributions through the inflation protection and safety net provisions would be paid directly to producers in the Canadian Wheat Board Designated Area on the basis of net sales of eligible grains in each crop year.

The recommendation from the method of payment inquiry had been referred to the comprehensive review of WGTA, which took place in the 1985-86 crop year. This comprehensive review provided an evaluation of the Act and its impact on the transportation, shipping and handling of grain in terms of the future apportionment of cost increases between the government and shippers, the recommedations from the method of payment review, the advisability of implementing awards and sanctions for system participants for meeting or failing to meet performance objectives, the appropriateness of the new rates, their derivation, apportionment between government and shippers, provision for lower rates, rate setting mechanisms and other rate-related provisions, the operation and effect of the shipper share limitation, and the need for future comprehensive reviews.

In this context, the comprehensive review could only evaluate the events occurring between the onset of the Act (January 1984) and the 1984-85 crop year. Because this period may not have been representative of possible outcomes, research on the range of outcomes (future rail freight rates and the cost shares borne by grain shippers and the federal government) will be valuable for any future reviews or analysis.

## 1.3 OBJECTIVES

The principal objective of the study is to quantitatively evaluate how the freight rates legislated in the Western Grain Transportation Act influence the type and level of payments from grain shippers and the federal government. To accomplish this, a simulation model must be developed to incorporate the new payment principles with the integral components of the rate setting cycle.

Secondly, the research intends to examine various structural and economic conditions which may impact the freight rate. Structural conditions analyzed will be the current freight rate structure and method of payment; and a change in the method of payment of the Crow subsidy to a pay the producer approach based on net sales of eligible grains. At the time this research was undertaken, the Review of the WGTA had not yet commenced (the Review recommended that the Grain Transportation Refund not be implemented). Economic conditions to be analyzed will be prevailing trends in economic variables; an increase in railway costs due to inflation or a change in the utlization of inputs, and a decrease in the Canada - United States currency exchange rate (and subsequent drop in grain prices). To meet this objective, several scenarios will be composed based on combinations of the above conditions. These scenarios will be reviewed separately and comparatively as they influence the financial obligations of grain shippers and the federal government.

## 1.4 OUTLINE

The remaining chapters of this thesis attempt to meet the specific objectives as stated. Chapter 2 includes a description the type of method to be used in evaluating how rail tariffs defined in the Western Grain Transportation Act affect both the type and level of payments made by shippers and the federal government, an explanation of the conceptual model, and a detailed examination of each component of the model. Chapter 3 provides the experimental design and a description of each of the four scenarios to be analyzed. Chapter 4 examines the results of the bench scenario in depth and provides a comparative analysis of each alternate scenario in terms of the financial obligations of the government and grain shippers. Chapter 5 provides a brief summary of the results and examines the policy implications of the study. This last chapter also discusses some of the limitations of the research and mentions some suggestions for further research.

# Chapter II

# THE MODEL

Determining the probability of expected future freight rates and how the rate will be shared by shippers and government requires the specification of a systematic framework to account for the rate structure and the economic setting. To reflect the uncertainty of future freight rates, a Monte Carlo experiment will be utilized in the model.

## 2.1 MONTE CARLO METHODS

The definition of Monte Carlo methods appears to be a subject about which there is a good deal of disagreement. The original concept, developed by von Neumann and Ulam in the 1940's, seems to have been that Monte Carlo specifically designated the use of random sampling procedures for solving deterministic mathematical problems. Some define Monte Carlo as the use of random sampling to treat both deterministic and probabilistic problems. Others require that the sampling process be sophisticated (involving the use of a variance reduction technique) in order to qualify as Monte Carlo.[3] For the purposes of this thesis, Monte Carlo methods is defined as that branch of experimental mathematics (whereby conclusions are inferred from observations) which is concerned with using random numbers as a technique for the solution of a probabilistic problem.

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[3] Meyer, H.A., editor, Symposium on Monte Carlo Methods, (New York: John Wiley and Sons, Inc., 1956). p. 2.

One application of the Monte Carlo method is that of distribution sampling or model sampling.[4] The purpose is to determine the distribution or some parameters of the distribution of a stochastic variable. This particular stochastic or output variable is a known function of one or more stochastic input variables which have known or assumed distributions. Repeated sampling from the input variables' distributions and the calculation of each resulting value of the output variable yields an estimate of that output variable's distribution.

Another area of Monte Carlo is that of simulation.[5] In the case of a probabilistic problem, the simplest Monte Carlo approach is to observe random numbers, chosen in such a way that they directly simulate the physical processes of the original problem, and to infer the desired solution from the behavior of these random numbers. However, it should be noted that simulation does not necessarily imply the use of random numbers. Time-series regression techniques can be used as an example of deterministic simulation in that once the parameters are estimated, the disturbances are suppressed and the timepath of the endogenous variable is calculated from the exogenous variables and lagged endogenous variables, without using any random numbers. Therefore, it is only the area of experimentation involving the sampling of stochastic variables using random numbers that is denoted Monte Carlo simulation.

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[4] Kleijnen, J.P.C., Statistical Techniques in Simulation, Part 1, (New York: Marcel Dekker, Inc., 1974). p. 9.

[5] Ibid., p. 9.

The model utilized in this thesis will combine the ideas behind distribution sampling with those of simulation. The significance of this work is both scholastic and has direct application with respect to reviewing the WGTA. A Monte Carlo experimental design has not been used widely to analyze grain transportation issues. In addition, this type of procedure has many advantages over deterministic modelling, in that uncertainty regarding future economic events can be built in to the model by using stochastic input variables. As well, Monte Carlo experiments can be very effective in the area of comparative simulation. Because the same random numbers may be used to simulate the two situations and their corresponding results, the difference between the two unbiased estimates is an unbiased estimate of the difference. Further, the precision of the estimated difference will be greater if the dependence is such that, when a result in one simulation occurs due to the variance being overestimated, then the result in the other situation is affected in the same manner.

## 2.2 THE CONCEPTUAL MODEL

The modelling process involved in structuring the rate setting cycle can be broken down into five major components:

1. the estimation of eligible railway costs which are based on the forecast of grain volumes to be moved by rail, various input price indices on both volume-related and line-related variable costs, and adjustments for productivity and technological advancement,

2. the determination of the cost shares borne by the federal government and grain shippers,
3. the shipper share limitation adjustment, dependent upon the value of the computed freight rate to grain price ratio relative to those limits defined in the Act (where the computed freight rate to grain price ratio is based on the average freight cost to shippers and a weighted average or basket price of grain),
4. the determination of actual grain shipments by rail (shipments are influenced by randomly generated crop yields, the use of grain in the Prairie region, and the capacity of the grain handling and transportation system), whereby these values are also used in computing grain shipment forecasts, the shipper share limitation adjustment and in the tally system, and
5. the determination of various decision variables' probability distributions including government and shipper shares of total estimated eligible railway costs, government and shipper freight rates, the shipper share limitation adjustment, the cumulative tally and surpasses of its limits, as well as forecast and actual grain shipments, the basket price of grain and Canada - United States currency exchange rates.

To facilitate comprehension of the model, a schematic diagram is presented in Figure 2.1. The diagram is illustrated as a flow chart with the various arrows indicating the relationships. For example, Estimated Eligible Railway Costs are influenced by both the forecast of grain shipments and railway cost inflation.

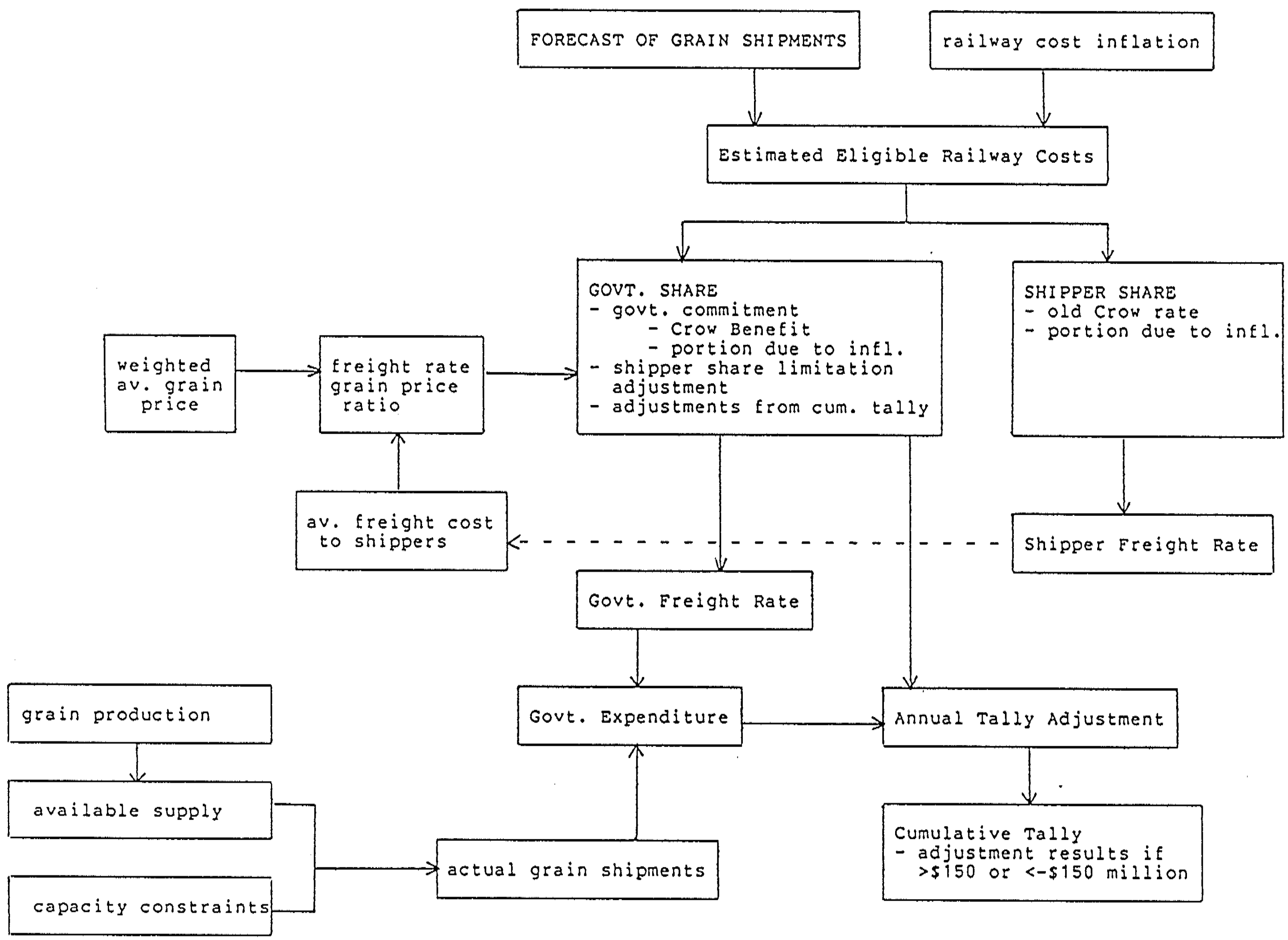


Figure 2.1: The Rate Setting Cycle under the WGTA

The program logic of the Monte Carlo experimental design will simulate twenty crop years, from 1981-82 to 2000-01 with actual events overriding the random nature of the simulation for crop years to 1985-86. Each twenty year sequence is considered one replication of outcomes or one trial. The desired number of trials will depend on the observations required to establish a stable statistical distribution of possible outcomes. This will be determined using a chi-square test on various sample sizes.[6]

This Monte Carlo process of sampling from several probability distributions allows the model to simulate a range of possible outcomes within a given structure. Specifying a model in this manner allows the researcher to undertake changes representing different structural or economic conditions in either the agricultural sector or the economy as a whole. If the results simulated after the structural or economic change produce different distributions of outcomes, policy makers and advisors will have some a priori information on the expected effects.

## 2.3 MODEL COMPONENTS

This section discusses the major components of the model. Underlying relationships and assumptions concerning each component are identified. It should be noted that the model presented refers to the bench-run simulation in that it exhibits current trends in economic variables and reflects the structure of the grain handling and transportation sector which existed when the WGTA was established.

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[6] The expected number of observations in each frequency class is assumed to be those which result when the twenty year sequence is replicated one thousand times.

### 2.3.1 Estimating Eligible Railway Costs

In estimating total eligible railway costs of transporting grain, there are three cost categories which must be examined: volume-related variable costs, line-related variable costs and fixed costs. With respect to the estimation of volume-related variable costs for the upcoming crop year, the first requirement is a forecast of grain volumes to be moved. For the purposes of the model, forecast grain volumes are the predicted values which result when the randomly generated actual grain shipments are regressed upon a trend variable (see equation 2.1). To generate these predicted values, perfect knowlege of the future is assumed with respect to actual grain shipments.

$$\text{PREDSHIP} = 31.519099 + (.515914 * \text{TREND}) \qquad (2.1)$$

t-statistics: 178.485 31.623

where PREDSHIP = forecast of grain volumes to be moved

TREND = time trend variable (trend = 1, 2, 3, ...18; where 1 is 1983-84, 2 is 1984-85, etc.)

This type of procedure is used because the tally system is based on the expectation that the cumulative amount owed to or owed by the federal government fluctuates around zero. For this expectation to be borne out, forecast errors associated with grain shipments must be zero. This will occur if the assumptions of the linear stochastic regression model are satisfied, specifically that the mean value of the random error term is zero. On average, the error associated with forecasting grain volumes shipped should be zero, and thus, the expected value of the tally should be zero because the tally is, in concept, the random error term.

The resulting values of forecast shipments are used to adjust the previous year's volume-related variable costs. Other factors affecting volume-related variable costs include an input price index reflecting increases in the price of inputs (labour, fuel and materials), the cost of capital, depreciation and tank car rentals, as well as a productivity adjustment which accounts for a greater use of government owned hopper cars in place of railway owned box cars. The volume-related input price index is assumed to be 1.04 per year and the productivity adjustment $20 million per year over the simulation period. The computation of volume-related variable costs is shown in equation 2.2.

$$VVC = (VVC_{-1} * VIPI * PREDSHIP/ACTSHIP) - PRODADJ \qquad (2.2)$$

where VVC = volume-related variable costs (1981-82 or base year volume-related variable costs are defined in the Act as $590 million)

variable costs are defined in the Act as $590 million)

VIPI = volume-related input price index (base year index is 1.0)

PREDSHIP = forecast grain shipments

ACTSHIP = actual grain shipments (base year shipments are 31.5 million tonnes)

PRODADJ = productivity adjustment

Line-related variable costs are independent of grain volumes shipped but are affected by a line-related input price index reflecting increases in input prices (labour and materials), the cost of capital and depreciation, as well as a productivity index accounting for changes in the number of grain dependent branch lines due to the changing mix of traffic and abandonments. Line-related variable costs are also affected by temporary spending adjustments regarding maintenance costs which are submitted by the railways. These are not included in the model. The line-related input price index is assumed to be 1.03 per year over the simulation period and the productivity index .89 in 1986-87, .88 in 1987-88, .87 in 1988-89, and .86 thereafter indicating a process of deletions in the mileage of grain dependent branch lines. The computation of line-related variable costs is shown in equation 2.3.

$$LVC = LVC_{-1} * LIPI * PRODINDX \tag{2.3}$$

where LVC = line-related variable costs (base year line-related variable costs are defined in the Act as $104.7 million)

LIPI = line-related input price index (base year index is 1.0)

PRODINDX = productivity index (base year index is 1.0)

Fixed costs, referred to in the Act as the contribution to constant costs, are grain handling's share of railway overhead. The contribution to constant costs is calculated as follows in equation 2.4.

$$FC = a * VVC \tag{2.4}$$

where FC = phased-in contribution to constant costs (fixed costs)

a = the Act defines constant costs to be phased in at a rate of 5% of volume-related variable costs in 1983-84, 10% in 1984-85, 15% in 1985-86, and 20% thereafter

VVC = volume-related variable costs

The sum of these three cost categories represents the total payment to the railways and is referred to as estimated eligible costs (equation 2.5).

$$EEC = VVC + LVC + FC \tag{2.5}$$

where EEC = estimated eligible costs

The payment takes the form of the government share, the shipper share and the CN adjustment. The CN adjustment is an amount paid by the Minister of Transport directly to CN relating to moving grain over the high cost lines to Churchill and Prince Rupert. The CN adjustment is assumed to be $10 million per year over the simulation period.

### 2.3.2 Determination of Shares borne by Government and Shippers

The government share is determined by the sum of the government commitment, the shipper share limitation adjustment and any tally adjustment (which results when the cumulative tally exceeds $150 million or is less than -$150 million). The government commitment is the Crow Benefit plus the cumulative government share of cost changes on all grain volumes forecast to be shipped. The process by which the cumulative government share of cost changes is calculated is complex and can best be explained by the following procedure. Firstly, cost changes on a per tonne basis are determined as in equation2.6.

$$CCT = EECT - CTBASE - SCCT \tag{2.6}$$

where CCT = cost change per tonne

EECT = estimated eligible railway costs expressed on a per tonne basis and based on the forecast grain shipments

CTBASE = average cost of moving one tonne of grain in the 1981-82 crop year. It is defined in the Act to be equal to the following amounts, taking into account the phased-in contribution to constant costs:

$22.05 in 1982-83,

$22.99 in 1983-84,

$23.93 in 1984-85,

$24.86 in 1985-86, and

$25.80 thereafter.

SCCT = sum of the previous cost changes on a per tonne basis

Secondly, the rate of cost change on a per tonne basis is calculated as follows in equation 2.7.

$$RCCT = CCT/(EECT - CCT) * 100 \qquad (2.7)$$

where RCCT = rate of cost change on a per tonne basis

The government share of cost changes on a per tonne basis is shown in equation 2.8.

$$GSCCT = (RCCT - MAXSS) * (EECT - CCT) \qquad (2.8)$$

where MAXSS = maximum shipper share of the rate of cost change defined in the Act as: 3% in 1983-84, 1984-85, 1985-86 and 6% thereafter

If the rate of cost change per tonne is negative, the government share of cost changes is simply the current crop year's cost change per tonne. If the rate of cost change per tonne is less than the maximum shipper share, the government share of cost changes is zero (shippers pay all inflationary costs). The government share of cost changes on a per tonne basis is cumulative and applies to all volumes forecast to be moved (see equation 2.9)

CGSCC = (CGSCCT + GSCCT) * PREDSHIP (2.9)

where CGSCCT = cumulative government share of cost change on a per tonne basis for the previous years

GSCCT = governmnent share of cost changes on a per tonne basis for the current crop year

PREDSHIP = forecast grain shipments

The determination of the government commitment is shown in equation 2.10.

GCOM = CROW BENEFIT + CGSCC (2.10)

where GCOM = government commitment

CROW BENEFIT = government subsidy defined in the Act to be:

$286 million for the period beginning January 1, 1984 and ending July 31, 1984,

$599.6 million for 1984-85,

$629.1 million for 1985-86, and

$658.6 million thereafter

CGSCC = cumulative government share of cost changes

The government's share of the estimated eligible railway costs in total dollar terms is computed as follows in equation 2.11.

GSHARE = GCOM + SSLADJ + TALEXC - CNADJ (2.11)

where GSHARE = government's share of estimated eligible costs

SSLADJ = shipper share limitation adjustment (detailed in subsection 2.3.3

TALEXC = the amount by which the cumulative tally exceeded its limits in the crop year two years preceeding (detailed in subsection 2.3.4)

CNADJ = CN adjustment

The freight rate paid by the government is the government share divided by the forecast of grain volumes to be shipped.

The shipper's share of estimated eligible railway costs in total dollar terms is a residual amount (see equation 2.12).

$$SSHARE = EEC - CNADJ - GSHARE \tag{2.12}$$

where SSHARE = shippers' share of estimated eligible costs

The average freight rate paid by grain shippers is the shipper share divided by the forecast of grain volumes to be shipped.

### 2.3.3 The Shipper Share Limitation Adjustment

This component of the model determines whether the safety net feature of the WGTA will be triggered. Under this feature, shippers are protected against relatively high freight rates when grain prices are low. The government is required to contribute additional funds in the form of a shipper share limitation adjustment if the average freight cost to shippers exceeds a fixed percentage of a weighted average price or basket price of the six major grains (wheat, barley, oats, rye, rapeseed and flaxseed). The computation of this adjustment is defined in equation 2.36. The average price is based on the price of each grain at its predominant point of export and weighted according to the volume of each grain moved by rail (see equation 2.34).

This feature of the rate setting cycle differs in that it is based on the calendar year rather than the crop year The average freight cost to shippers and the basket price of grain for calendar year i must be determined by March 31 of the following year and if a shipper share limitation adjustment is required, it is incorporated into the next crop year's freight rate.

### 2.3.3.1 The Average Freight Cost to Shippers

The average freight cost to shippers in calendar year i (say 1985) is calculated by weighting the average shipper freight rates for the previous crop year (1984-85) and for the current crop year (1985-86) by an estimate of grain shipments which occurred during the second half of the previous crop year (January 1, 1985 to July 31, 1985) and during the first half of the current crop year (August 1, 1985 to December 31, 1985). For the purposes of the model, it is assumed that 56% of grain shipments occur January 1 through July 31 and 44% of grain shipments occur August 1 through December 31.[7]

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[7] Kraft, D.F. and Fields, V.J., "Aggregate Agricultural Crops Model" in conjunction with "The Drought Sensitivity Analysis", (University of Manitoba, Department of Agricultural Economics: June 1985).

For example, the average freight cost to shippers in calendar year 1985 is determined as follows:

$$AC_{85} = \frac{(SSHT_{8485} * .44 * PREDSHIP_{8485}) + (SST_{8586} * .56 * PREDSHIP_{8586})}{(.44 * PREDSHIP_{8485}) + (.56 * PREDSHIP_{8586})} \qquad (2.13)$$

where AC = average freight cost to shippers on a per tonne basis

SSHT = shipper freight rate (per tonne basis)

PREDSHIP = forecast grain shipments

### 2.3.3.2 The Basket Price of Grain

The determination of the basket price of grain in Canada is based on randomly generated United States export wheat prices, randomly generated Canada - United States exchange rates and a weighting procedure involving randomly generated grain shipments. Grain prices in Canada are linked closely to those established in the United States market. Thus, this manner of generating the basket price can enable the researcher to examine different pricing policies in the United States, as well as variations in exchange rates.

Wheat prices are randomly generated because of the uncertainty which exists in this area. A rectangular probability distribution from which sampling occurs was chosen due to the significant annual variation which is present in grain prices.[8] The rectangular distribution has variable

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[8] Snitynsky, Raymond E., Risk Analysis of Farmland Investment, thesis, (Uiversity of Manitoba, Department of Agricultural Economics: October 1983). pp. 33-38.

bounds which are linked to the previous year's price, as well as overall bounds. The purpose of this is to create a bounded price distribution. The variable with-in year bounds determine the price distribution and the overall bounds confine these variable bounds.

The 1985 United States Farm Bill sets the framework for agricultural policy for five years (1986 through 1990). Under the new legislation, minimum loan prices for wheat are no longer indexed with inflation. Instead loan rates for wheat in 1986 are set at levels below those in 1985 and can decrease during the period from 1987 through 1990 if wheat prices average less than 110 percent of the loan rate. This means that the lower overall bound can decrease throughout this period. The procedure for establishing lower overall bounds on the price distribution is outlined in equations 2.14 through 2.17.

1985-86: $LB' = \$120/\text{tonne (U.S. \$)}$ (2.14)

1986-87: $LB' = \$88/\text{tonne (U.S. \$)}$ (2.15)

1987-88 through 1990-91: if $USFP_{-1} < (1.10 * LB'_{-1})$

then $LB' = .95 * LB'_{-1}$ (2.16)

1991-92 through 2000-01: $LB' = LB'_{-1}$ (2.17)

where LB' = lower overall bound for U.S. wheat price distribution

USFP = randomly generated U.S. farm price of wheat (U.S. dollars)

For 1985-86 and 1986-87 the lower overall bound is the minimum loan price for wheat (\$120/tonne in 1985-86 and \$88/tonne in 1986-87 expressed in U.S. dollars). For the next four years, if the previous year's farm price averages less than 110 percent of the loan rate, the new loan rate (lower overall bound) drops by five percent. For the remainder of the simulation period, the lower overall bound takes on the 1990-91 value.

The overall upper bound is assumed to be \$160 per tonne. This bound can increase with inflation. Grain price inflation is assumed to be four percent per year. The variable bounds for the price distribution are based on a price change of plus or minus twenty-five percent of the previous year's price. This range is expected to account for the majority of variation. The following equations illustrate the procedure which determines the price distribution:

$$LB = .75 * USFP_{-1} \tag{2.18}$$

$$UB = 1.25 * USFP_{-1} \tag{2.19}$$

If $LB < LB'$

then $LB = LB'$

$$\text{and } UB = UB' * (1 + INFL)^{**}i\ /1.25 * .75 \tag{2.20}$$

If $UB > UB' * (1 + INFL)^{**}i$

then $UB = UB' * (1 + INFL)^{**}i$

$$\text{and } LB = LB'\ /.75 * 1.25 \tag{2.21}$$

where LB = lower variable bound for U.S. wheat price distribution

UB = upper variable bound for U.S. wheat price distribution

LB' = lower overall bound for U.S. wheat price distribution

UB' = upper overall bound for U.S. wheat price distribution

INFL = grain price inflation

i = time (0, 1, 2, ...15; where 0 = 1985)

Note that the distribution is reset if the resulting variable bounds are greater than or less than the overall bounds such that the distribution range is plus or minus twenty-five percent of the previous year or the loan rate price. The farm price of wheat is randomly generated by taking the product of the range of the distribution bounds and the random value and adding it to the lower distribution bound (see equation 2.22).

$$USFP = LB + [(UB - LB) * RND] \tag{2.22}$$

where USFP = randomly generated U.S. farm price of wheat

LB = lower bound of the price distribution

UB = upper bound of the price distribution

RND = random value between 0 and 1

The export price of wheat in the United States is the farm price plus marketing costs (equation 2.23). Marketing costs are assumed to be $27 per tonne in 1985 and increase at a rate of four percent per year.

$$USEP = USFP + [MC * (1 + INFL)**i] \tag{2.23}$$

where USEP = U.S. export price of wheat (2.23)

USFP = randomly generated U.S. farm price of wheat

MC = U.S. marketing cost of wheat

INFL = inflation

i = time

Export wheat prices in the United States are randomly generated from 1985 throughout the simulation period.

Exchange rates between Canada and the United States are generated from a triangular probability distribution reflecting a nature of central tendency. For the benchrun simulation, the initial maximum value or upper bound for the distribution is assumed to be .85; the initial minimum value or lower bound .69. The initial modal value is .73. Specifying the distribution in this manner means that the probability of the Canadian dollar appreciating relative to the U.S. dollar is much greater than the probability of it depreciating. However, there is no time-related upward trend with respect to the value of the Canadian dollar. The following equations (2.24 through 2.27) illustrate the derivation of the triangular distribution:[9]

probability density functions:

$$f(X) = 2 * (X - MIN)/(MAX - MIN) * (MODE - MIN); \quad MIN < X < MODE \tag{2.24}$$

$$f(X) = 2 * (MAX - X)/(MAX - MIN) * (MAX - MODE); \quad MODE < X < MAX \tag{2.25}$$

where X = the United States - Canada exchange rate

MAX = maximum value of the United States - Canada exchange rate

MIN = minimum value of the United States - Canada exchange rate

MODE = modal value of the United States - Canada exchange rate

The two probability density functions above are integrated resulting in the following cumulative probability density functions:

$$F(X) = (X - MIN)**2/(MAX - MIN) * (MODE - MIN); \quad MIN < X < MODE \tag{2.26}$$

$$F(X) = 1 - [(X - MAX)**2/(MAX - MIN) * (MAX - MODE)]; \quad MODE < X < MAX \tag{2.27}$$

[9] Snitynsky, Raymond E., Op.Cit., p. 39.

where F(X) = a random value between 0 and 1 used to derive the stochastic variable X (U.S. - Canada exchange rate)

The United States - Canada exchange rate is determined by the following equations (2.28 through 2.32):

MIN = .72 * (1 + APP)**i (2.28)

MAX = .85 * (1 + APP)**i (2.29)

MODE = .75 * (1 + APP)**i (2.30)

if 0 < RND < (MODE - MIN)/(MAX - MIN)

then X = MIN + [RND * (MAX - MIN) * (MODE - MIN)]**.5 (2.31)

if (MODE - MIN)/(MAX - MIN) < RND < 1

then X = MAX - [(1 - RND) * (MAX - MIN) * (MAX - MODE)]**.5 (2.32)

where APP = rate at which the exchange rate probability distribtion shifts; for the bench case APP = 0 indicating no apparent trend of appreciation or depreciation of the Canadian dollar relative to the U.S. dollar

RND = randomly generated value between 0 and 1

X = United States - Canada exchange rate

The variation of the randomly generated exchange rate is dependent upon its range of maximum and minimum values. The range represents the degree of uncertainty associated with exchange rates. The values of the Canada - United States exchange rate (reciprocal of the randomly generated United States - Canada exchange rate) are multiplied by the randomly generated United States wheat price to yield a Canadian price for wheat.

In determining the basket price of grain in the model, prices of the five major grains (wheat, barley, oats, rapeseed and flaxseed) are utilized. Since only Canadian wheat prices are generated through randomly selecting U.S. wheat prices and an exchange rate, prices for the remaining grains are determined by examining the historic relationships of these remaining grains relative to wheat.[10] These prices are then weighted according to the actual volume of each grain shipped. For example, the calculation of the weighted average price for the 1985 calendar year is illustrated in equation 2.33.

$$\begin{aligned} WTP_{85} = {} & (USPRICE_{85} * CANUS_{85}) * \{(.44*SHIPW_{8485} + .56*SHIPW_{8586}) \\ & + [PB/PW\ (.44*SHIPB_{8485} + .56*SHIPB_{8586})] \\ & + [PO/PW\ (.44*SHIPO_{8485} + .56*SHIPB_{8586})] \\ & + [PR/PW\ (.44*SHIPR_{8485} + .56*SHIPR_{8586})] \\ & + [PFL/PW\ (.44*SHIPFL_{8485} + .56*SHIPFL_{8586})]\}/ \\ & (.44*SHIP_{8485} + .56*SHIP_{8586}) \end{aligned} \tag{2.33}$$

where WTP = proxy for the weighted average or basket price for the six major grains in Canada

CANUS = Canada - United States exchange rate

SHIPW = randomly generated actual wheat shipments

SHIPB = randomly generated actual barley shipments

SHIPO = randomly generated actual oats shipments

SHIPR = randomly generated actual rapeseed shipments

SHIPFL = randomly generated actual flaxseed shipments

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[10] data source : Canadian Wheat Board Annual Reports (total CWB payment for #1 CWRS, #1 feed barley and #1 feed oats), and Statistics Canada 22-007, "Grains and Oilseeds Review" (Winnipeg Commodity Exchange average cash prices for #1 Canada rapeseed basis Vancouver and #1 Canada flaxseed basis Thunderbay), 1962-84.

SHIP = randomly generated actual shipments of all grain

note: all individual grain shipments are adjusted for capacity constraints (eg. the relationship between randomly generated potential wheat shipments and randomly generated potential total grain shipments is applied to randomly generated actual grain shipments - see subsection 2.3.4 with respect to capacity constraints)

PB/PW = historic relationship between barley and wheat prices = .55

PO/PW = historic relationship between oats and wheat prices = .37

PR/PW = historic relationship between rapeseed and wheat prices = 1.46

PFL/PW = historic relationship between flaxseed and wheat prices = 1.79

The freight rate to grain price ratio for 1985 is then:

$$FP_{85} = AC_{85}/WTP_{85} * 100 \qquad (2.34)$$

where FP = freight rate to grain price ratio

AC = average cost to grain shippers on a per tonne basis

If the freight rate to grain price ratio exceeds the safety net percentages as legislated in the WGTA, a shipper share limitation adjustment is triggered and incorporated into the government freight rate the following crop year (1986-87 in this example). The computation of this adjustment is shown in equation 2.35.

$$SSLADJ_{8687} = (FP_{85} - SAFENET_{85})*WTP_{85}*(.44* SHIP_{8485} + .56*SHIP_{8586})/100 \qquad (2.35)$$

where SSLADJ = shipper share limitation adjustment

SAFENET = percentage by which shippers are protected against high freight rate when grain prices are low. The safety net is defined in the Act as:

4% in 1984,

5% in 1985,

8% in 1986,

9% in 1987, and

10% thereafter.

### 2.3.4 Actual Grain Shipments

Actual volumes of grain shipped are determined through a process of randomly generating prairie yields, computing grain production and potential tonnage movements, and adjusting these potential shipments utilizing a capacity function accounting for limitations in the grain transportation and handling sector. Actual grain shipments are randomly generated from 1983-84 throughout the simulation period.

Crop yields exhibit a random nature in that they are largely affected by weather. Random yields are generated for each of the five major crops (wheat, oats, barley, rapeseed and flaxseed) on stubble seedbeds and on fallow seedbeds. The yields are jointly determined in that all are tied to the random yield of wheat on stubble.

Wheat yields were found to be best depicted by a Beta distribution.[11] A distribution such as this (skewed to the left) indicates a greater probability of below average crop yields than bumper crops. The yield

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[11] Kraft, D.F. and Fields, V.J., "Comparison of Beta and Triangular Distributions to Approximate Crop Yield Probability Distributions" (University of Manitoba, Department of Agricultural Economics: February 1985).

for wheat on stubble in Western Canada is generated from a Beta distribution of the first kind, where a continous variate, x, is distributed with a probability density function:[12]

$$f(x) = x^{(l-1)} * (1-x)^{(m-1)}/B(l,m) \quad (2.36)$$

through the range of values zero to one

$$\text{with mean value of } x = l/(l+m) \quad (2.37)$$

$$\text{and variance} = (l * m)/(l+m)^{2} * (l+m+1) \quad (2.38)$$

The parameters l and m are derived from the normalized mean and variance for each yield such that:

$$m = [NMEAN * (1 - NMEAN)^{2} + (NMEAN * NVAR) - NVAR]/NVAR \quad (2.39)$$

$$l = (NMEAN * m)/(1 - NMEAN) \quad (2.40)$$

where NMEAN = normalized mean

NVAR = normalized variance

and

$$NMEAN = 1 - [(WSMAX - WSMEAN)/WSMAX - WSMIN)] \quad (2.41)$$

$$NVAR = \{[WSMEAN - (WSMEAN - WSSD)]/(WSMAX - WSMIN)\}^{2} \quad (2.42)$$

where WSMEAN = mean value of yield of wheat on stubble

$$= 21.0777 * (1 + GROWTH)^{i} \quad (2.43)$$

WSMAX = maximum value of yield of wheat on stubble (upper bound of the distribution)

$$= 29.4221 * (1 + GROWTH)^{i} \quad (2.44)$$

WSMIN = minimum value of yield of wheat on stubble (lower bound of the distribution)

[12] Weatherburn, C.E., A First Course in Mathematical Statistics, (Cambridge: University Press, 1962). p. 153.

$$= 14.7606 * (1 + GROWTH)^{i} \qquad (2.45)$$

WSSD = standard deviation of yield of wheat on stubble

$$= 3.908 \qquad (2.46)$$

Initial parameters of the distribution were determined by a statistical analysis of prairie wheat yields on stubble seedbeds for the period 1962 through 1984. The growth factor on yield (GROWTH) is assumed to be 1.5% per year, and i represents a time factor.

The Statistical Analysis System package (SAS), used in programming of the model, has an internal function which computes the inverse of the cumulative beta distribution and returns the P-th quantile[13] as illustrated in equation 2.47.

$$P = BETAINV(RND,l,m) \qquad (2.47)$$

where P = P-th quantile

BETAINV = SAS function

RND = random value between 0 and 1

l and m = parameters of the distribution

The yield of wheat on stubble is computed as the P-th quantile multiplied by the distribution range and added to the lower bound (equation 2.48):

$$YWS = WSMIN + P * (WSMAX - WSMIN) \qquad (2.48)$$

[13] SAS User's Guide: Basics 1982. p. 162.

A stubble-fallow relationship utilizing the randomly generated value for yield of wheat on stubble determines a preliminary value for the yield of wheat on fallow in Western Canada (equation 2.49). The equation indicates that the relationship between fallow and stubble yields is not one of fixed proportion (eg. under drought conditions fallow yields will not be suppressed as far relative to stubble yields).

$$YWF1 = 20 + (.5 * YWS) \qquad (2.49)$$

A new random value between zero and one is generated to account for variability between stubble and fallow yields, and the yield of wheat on fallow is dependent upon the value of this new random variate (see equation 2.50 and 2.51).

$$\text{If } RND <= .7 \text{ then} \quad YWF = YWF1 - 14 + (20 * RND) \qquad (2.50)$$

$$\text{If } RND > .7 \text{ then} \quad YWF = YWF1 + 2.33 - (3.33 * RND) \qquad (2.51)$$

where YWF = randomly generated yield wheat on fallow

YWF1 = preliminary value for yield wheat on fallow resulting from the stubble-fallow relationship

RND = new random value between 0 and 1

The determination of the remaining crop yields seeded on stubble (fallow) on the prairies are based in the historic relationships with the yield of wheat on stubble (fallow) as estimated by ordinary least squares. The resulting linear regression models[14] are depicted in equations 2.52 through 2.53.

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[14] data source: Statistics Canada 22-002, "Field Crop Reporting Series: Summerfallow and Stubble, Area and Yields of Specific Crops", 1962-84.

Stubble Seedbeds:

$$YBS = 4.2955 + (1.5196 * YWS) \qquad \text{R-SQUARE} = .87 \qquad (2.52)$$

t-statistics: 1.587 12.028

$$YOS = 20.4242 + (1.2274 * YWS) \qquad \text{R-SQUARE} = .82 \qquad (2.53)$$

t-statistics: 7.488 9.639

$$YRS = 1.0536 + (.6740 * YWS) \qquad \text{R-SQUARE} = .66 \qquad (2.54)$$

t-statistics: .469 6.427

$$YFLS = -.2943 + (.5800 * YWS) \qquad \text{R-SQUARE} = .68 \qquad (2.55)$$

t-statistics: -.157 6.609

Fallow Seedbeds:

$$YBF = 9.9253 + (1.350 * YWF) \qquad \text{R-SQUARE} = .89 \qquad (2.56)$$

t-statistics: 3.522 12.978

$$YOF = 22.1153 + (1.335 * YWF) \qquad \text{R-SQUARE} = .79 \qquad (2.57)$$

t-statistics: 5.368 8.78

$$YRF = 7.4202 + (.4287 * YWF) \qquad \text{R-SQUARE} = .50 \qquad (2.58)$$

t-statistics: 2.581 4.4548

$$YFLF = -1.6746 + (.6417 * YWF) \qquad \text{R-SQUARE} = .71 \qquad (2.59)$$

t-statistics: -.697 7.238

where YWS, YWF = yield wheat on stubble, fallow

YBS, YBF = yield barley on stubble, fallow

YOS, YOF = yield oats on stubble, fallow

YRS, YWF = yield rapeseed on stubble, fallow

YFLS, YFLF = yield flaxseed on stubble, fallow

In order to generate the remaining crop yields a point prediction approach is applied, where values of the explanatory variable in any period are the randomly generated yield of wheat on stubble and on fallow. It is assumed that the structural relationships will continue, that is, the parameters do not change throughout the forecast period. The resulting predicted values (crop yields) possess normal distributions associated with certain variances due to sampling errors of the parameter estimates and to the variance of the random error terms.

The remaining crop yields are then randomly generated from within their resulting distributions. Triangular distributions are used to approximate the normal distributions. The modal value for each triangular distribution is assumed to be the value of the point prediction from the econometric function (equation 2.60). The upper and lower bounds of each distribution (see equations 2.61 and 2.63) are the modal value plus or minus two standard errors associated with that point prediction. Using the yield of barley on stubble as an example, parameters of the distribution are:

MODE = YBSP = 4.2955 + (1.5196 * YWS) (2.60)

SE = (RSS/(n - 2)) * [1 + (1/n) + (YWS - WSMEAN)**2/WSCSS]**.5 (2.61)

MIN = MODE - (2 * SE) (2.62)

MAX = MODE + (2 * SE) (2.63)

where MODE = modal value of yield barley on stubble

YBSP = resulting point prediction given the randomly generated yield wheat on stubble (YWS)

SE = standard error of the point prediction

(RSS/(n - 2)) = estimate of the variance of the random error term, where RSS is the residual sum of squares from the regression of yield barley on stubble on yield wheat on stubble

n = number of observations

WSMEAN = mean value of yield wheat on stubble (see equation 2.43)

WSCSS = corrected sum of squares for wheat on stubble

MIN = minimum value of yield barley on stubble (lower bound of distribution)

MAX = maximum value of yield barley on stubble (upper bound of distribution)

The yield of barley on stubble is then randomly generated from this triangular distribution. All other crop yields are determined using this same procedure.

Grain production in Western Canada is computed by multiplying the random yields for the five major crops by seedbed by the share of each crop seeded and by the total available landbase. The shares of each crop seeded on fallow and on stubble are the five-year averages (1980 through 1984). No trend is incorporated to account for a reduction in land summerfallowed. The total available landbase used is fixed at the 1984 level. It is assumed that no new land enters into production. As an example, wheat production is computed as follows in equation 2.64.

$$PRODNW = [(YWS * SWS) + (YWF * SWF)] * TOT \qquad (2.64)$$

where PRODNW = production of wheat in Western Canada

YWS, YWF = randomly generated yield wheat on stubble, fallow

SWS, SWF = five-year average share of wheat seeded on stubble (fallow) relative to the total seeded area

TOT = total available landbase for seeding in 1984

Production is determined for all crops in the same manner and then summed together to give total prairie production. Although other crops are not included in this portion of the analysis, it is assumed that actual tonnages will be reflected since the total available landbase is used.

Domestic use on the prairies is subtracted from production to give potential grain shipments if no capacity constraints existed. Domestic use involves prairie seed and feed requirements, as well as grain processed in Western Canada. All of these factors are assumed constant throughout the simulation period. Seed requirements are a fixed percentage of grain production in 1984, with wheat being .015% of wheat production, barley .0275% of barley production, oats .0275%, rapeseed .0011%, and flaxseed .0075%. Total seed requirements are calculated to be 1.84 million tonnes. Feed use is determined using a theoretical approach involving the share of milkcow equivalents for each prairie province (based on livestock populations and their ration requirements) and Western Canadian feed, waste and dockage data.[15] Total feed use for the prairies is estimated to be 8.22 million tonnes. Total grain processed on the prairies is assumed to be 3.783 million tonnes.[16]

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[15] Reynolds, T.L., "Prairie Grain Producer Response to Export Constraints, 1970-80", M.Sc. Thesis, University of Manitoba, May 1987.

[16] Kraft, D.F., "Dilution and the Method of Payment", research report, University of Manitoba, Department of Agricultural Economics, September 1985.

Production minus domestic use results in potential grain shipments. These annual differences are generated throughout the simulation period. A shipping and handling capacity function is then applied to potential shipments to account for constraints in the grain transportation and handling sector. The capacity function used is based on a simple form of the acceleration principle which posits a certain fixed relationship between capital and output.[17] Because the grain transportation and handling sector cannot know the level of output (grain shipments) in any given year, they will also base this year's capital requirements (reflected by the system's capacity) on some weighted average of previous output which extends over many years. Using a Koyk transformation, the system capacity can be stated as a function of grain shipments and the previous year's capacity (equation 2.65). Equation 2.66 prevents a reduction in capital (system capacity) which might result from previous capacity exceeding grain shipments for several consecutive years.

$$CAP = SHIP^{**}.0535 * CAP_{-1}^{**}.95 \qquad (2.65)$$

$$\text{If } CAP < CAP_{-1} \text{ then } CAP = CAP_{-1} \qquad (2.66)$$

where CAP = tonnage movement capacity in the grain transportation and handling system

SHIP = randomly generated actual grain shipments

The system's capacity for tonnage movement acts as a constraint on potential grain shipments. Grain not shipped due to capacity limitations is carried into the next crop year. Thus, actual grain shipment are ei-

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[17] Evans, Michael K., Macroeconomic Activity: Theory, Forecasting and Control - An Econometric Approach, (New York: Harper & Row, Publishers, 1969). pp. 80-83.

ther less than or equal to capacity. Capacity is initialized at 36 million tonnes in 1983-84 and an additional 2.5 million tonnes are added in 1985-86 as a result of the Prince Rupert terminal becoming fully operational.[18]

Randomly generated actual grain shipments are used throughout the model - in the estimation of grain shipments forecasts (subsection 2.3.1), the determination of the shipper share limitation adjustment (subsection 2.3.3), and in the tally system.

The cumulative tally accounts for the total amount owed to or owed by the Government of Canada. It results from errors in forecasting volumes. The annual tally adjustment (equation 2.67) is the government commitment (based on forecast grain volumes) plus the shipper share limitation adjustment minus the actual expenditure by the government (computed by multiplying the government freight rate by actual grain shipments).

$$TALADJ = (RGCOM + SSLADJ) - GOVTEXP \qquad (2.67)$$

where TALADJ = annual adjustment to the tally

RGCOM = government commitment revised to account for actual tonnages moved and limited by the difference between eligible costs and base revenues

SSLADJ = shipper share limitation adjustment

GOVTEXP = total government payments to the railways (based on the average government freight rate plus the CN adjustment)

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[18] Kraft, D.F. and Karman, J., "Analysis of Procedures Used to Forecast Grain and Oilseed Shipments", November 1986. p. 86

The cumulative tally is the sum of all past tally adjustments plus the current adjustment to the tally. If the previous cumulative tally exceeds a surplus or deficit of \$150 million, the government's share of railway costs for the next crop year increases or decreases by that amount (referred to as TALEXC in equations 2.68 and 2.69).

$$\text{If CTALLY} > 150 \text{ then TALEXC} = \text{CTALLY} - 150 \qquad (2.68)$$

$$\text{If CTALLY} < -150 \text{ then TALEXC} = \text{CTALLY} - (-150) \qquad (2.69)$$

where CTALLY = cumulative tally

TALEXC = amount by which the cumulative tally exceeds its limit

### 2.3.5 Probability Distributions

In order to evaluate the type and level of payments from grain shippers and the federal government, the model estimates probability distributions for each crop year of the simulation period for:

1. the government's share of estimated eligible railway costs (in total dollar terms) with individual distributions for the cumulative government share of cost changes, the shipper share limitation adjustment and any adjustments due to the cumulative tally exceeding its limits,
2. the grain shippers' share of estimated eligible railway costs (in total dollar terms),
3. the government freight rate,
4. the average shipper freight rate,
5. the annual tally adjustment, and

6. the cumulative tally.

As well, the model produces probability distributions for each stochastic element of the rate determining process. These include:

1. the weighted average or basket price of grain including the randomly generated United States wheat price and the Canada - United States exchange rate,
2. the forecast of grain volumes to be shipped, and
3. the actual grain shipments.

Each probability distribution is broken into ranges and a certain frequency is associated with each range.

To obtain stable probability distributions, a specific number of replications are required to ascertain whether the resulting distributions are not statistically different from what is expected. To accomplish this, a chi-square test for uniformity is employed.[19] Each probability distribution is divided into frequency class ranges and a certain number of observations are associated with each particular class. The total number of observations in each class is then compared with the uniform expected number of observations. It is assumed that the expected number of observations are those which result when the twenty-year simulation is replicated one thousand times.

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[19] Mendenhall, William, Introduction to Probability and Statistics, fifth edition, (Massachussetts: Duxbury Press, 1979). pp. 372-375.

# Chapter III

# EXPERIMENTAL DESIGN

This chapter sets out the experimental design to be utilized in analyzing and comparing various scenarios of the model. In order to conceptualize these, a description of each particular scenario is included.

## 3.1 EXPERIMENTAL DESIGN

The design of the experiment takes on a framework whereby the structural and economic conditions proposed in Chapter 1 are combined to produce different scenarios. A benchmark or base scenario is generated, as well as three alternate scenarios. Each of these alternate scenarios exhibits one particular economic or structural change from the bench case.

EXPERIMENTS

| SCENARIO 1 (bench) | SCENARIO 2 | SCENARIO 3 | SCENARIO 4 |
|---|---|---|---|
| -current rate structure and method of payment | -current rate structure and method of payment | -current rate structure and method of payment | -change method of payment to 'pay the producer' |
| -economic status quo | -increasing rail costs | -appreciation of Canadian $ | -economic status quo |

Figure 3.1: Experimental Design

Figure 3.1 presents the experimental design in a concise manner.

Probability distributions and relevant descriptive statistics used in evaluating the type and level of payments from shippers and government will be generated for each of the scenarios. Rather than the comparative analysis encompassing each crop year of the simulation period, only four specific crop years will be reviewed - 1986-87, 1990-91, 1995-96, and 2000-01. Th bench scenario will be examined in depth in terms of probability distributions and descriptive statistics relating to all aspects of the model (see Chapter 2, section 2.3.5). The alternate scenarios will be analyzed and compared specifically with the bench case.

## 3.2 DESCRIPTION OF SCENARIOS

### 3.2.1 Scenario 1 (Benchmark experiment)

Scenario 1, the bench case, is intended to reflect the current status of the grain handling and transportation sector which existed when the WGTA was implemented. Freight rates are structured under the current method of payment of the Crow subsidy. It is also intended to reflect current trends in economic variables. Volume-related railway costs increase at a rate of four percent per year; line-related costs increase by three percent per year. The value of the Canadian dollar relative to the U.S. dollar exhibits no trend of appreciation or depreciation over the simulation period. The model described in Chapter 2 illustrates the benchmark experiment.

### 3.2.2 Scenario 2

Scenario 2 also reflects the status of the grain handling and transportation sector which existed upon implementation of the WGTA. However, the experiment involves an increase in railway costs. Volume-related railway costs increase at a rate of eight percent per year (volume-related input index equal to 1.08 per year). Line-related railway costs increase by six percent per year (line-related input price index equal to 1.06 per year). These input price indices are composite indices. Individual cost components are weighted according to their share of volume-related or line-related variable costs and factored up by a specific index reflecting any cost change. Thus, these composite input price indices can increase for two reasons:

1. increased inflation; an increase in input prices (where inputs include labour, fuel, materials, depreciation and the cost of capital), or
2. a change in the weighting of individual cost components, whereby higher cost inputs account for a greater share of volume-related or line-related variable costs.

A change in the weighting of inputs could arise from a change in grain shipping patterns. An increase of grain sales through western Canadian ports would require a greater share of grain volumes to be shipped to Vancouver and Prince Rupert. This would alter input weights such that rail costs would increase substantially although input prices remained constant. Under the WGTA, rail cost increases are shared by the federal government and grain shippers. Producers are required to pay the first three percentage points (accumulating) of annual rail cost increases on all grain volumes shipped in the crop years 1985-86, and the first six percentage points thereafter. Although this feature of the Act is referred to as the inflation protection provision, rail cost increases need not result from inflation for this cost sharing to occur.

### 3.2.3 Scenario 3

The current status of the WGTA is also the stuctural basis for scenario 3. However, the economic status quo is altered with the introduction of an appreciation of the Canada - United States currency exchange rate. The triangular distribution from which exchanges rates are randomly generated shifts at a rate of 1.5 percent per year, resulting in an upward trend of the Canadian dollar relative to its American counterpart. In the determination of exchange rates (equations 2.28 through 2.32), the variable APP takes on a value of .015.

### 3.2.4 Scenario 4

Scenario 4 assumes a change in the structure of the WGTA under current economic trends. The alternate structural condition revolves around a change in the method of payment of the Crow Benefit to a "pay the producer" approach. Producers pay the full cost of shipping prairie grain by rail to ports of export. A Grain Transportation Refund (GTR) would be established consisting of the Crow Benefit and government contributions through the inflation protection and safety net features of the WGTA. The GTR is then allocated to individual producers in the CWB designated area on the basis of net sales of eligible grains in each crop year.

The freight rate producers pay is based on a volume forecast and estimated railway costs for the upcominng crop year. The gross cost to producers for hauling grain is dependent upon actual volumes of grain moved by rail. Its computation is shown in equation 3.1.

$$GRSCOST = SSHT * SHIP \qquad (3.1)$$

where GRSCOST = gross cost to grain producers

SSHT = shipper freight rate (full freight rate)

SHIP = actual grain volumes shipped (randomly generated)

The net cost to producers is computed as their gross costs less payments recieved from the GTR. Because payments from the GTR are based on net sales of eligible grains, a greater tonnage is covered by the subsidy resulting in a dilution of that subsidy. The exact magnitude of that dilution would depend on how much of the grain currently fed on the prairies would be eligible for the GTR. For the purposes of this thesis, a dilution factor of 15 percent is assumed. Thus, payments to producers from the GTR are assumed to be 85 percent of the government freight rate under the current method of payment multiplied by actual volumes of grain shipped (equation 3.2).

$$NSCOST = GRSCOST - (.85 * GSHT * SHIP) \qquad (3.2)$$

where NSCOST = net cost to grain producers

GRSCOST = gross cost to grain producers

GSHT = government freight rate under the current method of payment

On a per tonne basis, the net freight rate shippers have paid is their net shipping costs divided by actual grain shipments (equation 3.3).

$$NSCOSTT = NSCOST / SHIP \quad (3.3)$$

where NSCOSTT = net shipping cost to producers on a per tonne basis (net shipper freight rate)

The financial obligations of the federal government (paid into the GTR) follow those of the bench case although the shipper share limitation provision requires a revision. The safety net ratios between the freight rate and the weighted price of grain in export position must be adjusted upwards to reflect the higher transportation costs being paid by producers before receiving compensation from the GTR. The Report of the Committee of Inquiry on Crow Benefit Payment estimated that a freight rate--price ratio equivalent to twenty percent would be required to give producers the same amount of protection.[20] The process of revising the safety net percentages requires an analysis and comparison of two relationships:

1. the freight rate--grain price ratio computed under the bench structure (Crow Benefit paid directly to the railways), and
2. the freight rate--grain price ratio computed under the alternate structure (Crow Benefit paid to the producer), where grain shippers pay the full rail freight rate.

Table 3.1 compares the mean values of the freight rate--grain price ratios generated under both methods of payment. The basket price of grain utilized in determining these relationships is randomly generated yet produces a stable distribution. Under the current method of pay-

[20] Hall, Justice G.C., et al., The Report of the Committee of Inquiry on Crow Benefit Payment, (Winnipeg: Canadian Government Publishing Centre, March 1985), p. 28.

TABLE 3.1

Freight Rate--Grain Price Ratios Under Two Methods of Payment

| | Current Method of Payment | | "Pay the Producer" Option |
|---|---|---|---|
| Year | Legislated Safety Net Percentage | Mean Freight Rate Grain Price Ratio | Mean Freight Rate Grain Price Ratio |
| 1985 | 5% | 3.9% | 15.3% |
| 1986 | 8% | 5.1% | 19.2% |
| 1987 | 9% | 6.3% | 19.9% |
| 1988 | 10% | 6.9% | 20.1% |
| 1989 | 10% | 7.4% | 20.3% |
| 1990 | 10% | 8.0% | 20.5% |
| 1991 | 10% | 8.5% | 20.0% |
| 1992 | 10% | 8.9% | 19.9% |
| 1993 | 10% | 9.2% | 19.5% |
| 1994 | 10% | 9.2% | 19.0% |
| 1995 | 10% | 9.2% | 18.3% |
| 1996 | 10% | 9.2% | 17.6% |
| 1997 | 10% | 9.3% | 17.1% |
| 1998 | 10% | 9.5% | 16.9% |
| 1999 | 10% | 9.1% | 15.5% |

note: rail cost inflation is 4% (volume-related) and 3% (line-related)

ment, the average freight rate--grain price ratios grow quickly in early years and then tend to stabilize at approximately 9 percent. The corresponding safety net percentages were defined by law to follow this pattern. Under a structure whereby the subsidy is paid to grain shippers, the mean freight rate--grain price ratios fluctuate between 15 and 20 percent and generally average just over 18 percent. No pattern of increase and subsequent stabilization exists. Thus, a fixed safety net percentage equal to 20 percent throughout the entire period of simulation should give producers an equivalent measure of protection under a "pay the producer" method of payment.

The railways bear all risk in that revenues from grain shipping tariffs may or may not cover their costs of hauling grain. Thus, no tally system is required.

It should also be noted that a change in the method of payment will generate responses in the shipments of grain out of the prairies. First of all, the distortions of farm gate prices will be removed. Western feed grain prices will be reduced relative to export prices resulting in an expansion of the livestock industry in western Canada. Agriculture Canada has estimated total livestock output on the prairies to increase by approximately 18 percent by 1995-96.[21] This increase will require greater feed use which will result in a diversion of feed grains, particularly barley, from the export market to local prairie use. Assuming current feed use is about 8 million tonnes (see Chapter 2, section 2.3.6), an additional 1.4 million tonnes (.18 x 8) will be required by 1995-96 to sustain the expanding western livestock industry. This will serve to reduce export volumes and potential grain shipments. However, incorporating such a reduction in potential shipments into the model will not significantly affect actual grain shipments. This is because potential shipments are subject to capacity contraints. Volumes over the capacity limit are carried forth into the next crop year. Because the average carryover for the entire simulation is just over 7 million tonnes, grain inventories will be reduced but actual grain shipments will not change.

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[21] Agriculture Canada, 'Production and Marketing Response to Alternative Methods of Payment', (working paper 7/85), November 1984, p. 41, Table 12.

A reduction in grain inventories will reduce storage costs to producers. These savings will serve to offset a portion of the rail costs producers will pay under a change in the method of payment.

# Chapter IV

# EMPIRICAL RESULTS

This chapter analyzes the empirical results of each scenario under which th financial obligations of government and producers are evaluated. In order to conceptualize the results of any particular scenario, an individual simulation trial of the bench case will be examined in depth. It is the summation of these trials which forms the basis for the derived probability distributions. Probability distributions and statistics relating to all aspects of the bench scenario will be analyzed. The comparative analysis utilizing the alternate scenarios will follow the experimental design outlined in the previous chapter.

## 4.1 AN INDIVIDUAL SIMULATION TRIAL OF THE BENCH SCENARIO

Table 4.1 presents the detailed output of a twenty-year simulation trial representing one observation in determining the various probability distributions. The first column (CROPYR) indicates the crop year in question. Early years are included in the analysis because the rate-setting cycle of the WGTA is based on the 1981-82 crop year. Crop years 1983-84 through 1985-86 utilize the system of interim and final adjustments for determining the freight rate. These interim and final adjustments are not included in the table. The tally system is implemented in the 1985-86 crop year and continues throughout the simulation period.

TABLE 4.1

Detailed Output of an Individual Simulation Trial (Bench)

| 1 CROPYR | 2 PREDSHIP | 3 SHIP | 4 VVC | 5 LVC | 6 PHFC | 7 EEC | 8 CGSCC | 9 GCOM | 10 USPRICE | 11 CANUS | 12 WTP | 13 SAFENET | 14 FPRATIO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8182 | 31.5000 | 31.5000 | 0.00 | 0.000 | 0.000 | 0.00 | 0.0000 | 0.000 | 0.000 | 0.00000 | . | 0 | 0.0000 |
| 8283 | 32.9000 | 32.9000 | 651.10 | 108.084 | 0.000 | 759.18 | 32.4450 | 573.045 | 0.000 | 0.00000 | . | 0 | 0.0000 |
| 8384 | 31.7000 | 34.5500 | 650.90 | 109.000 | 32.545 | 792.45 | 40.6161 | 610.716 | 0.000 | 1.31873 | . | 4 | 0.0000 |
| 8485 | 31.8000 | 25.7000 | 660.40 | 97.102 | 66.040 | 823.54 | 39.3561 | 638.956 | 0.000 | 1.28504 | 0.000 | 5 | 0.0000 |
| 8586 | 31.8000 | 32.6901 | 698.60 | 100.506 | 104.789 | 903.89 | 64.0867 | 693.187 | 137.000 | 1.22185 | 0.000 | 8 | 0.0000 |
| 8687 | 33.5828 | 39.2829 | 784.43 | 92.134 | 156.885 | 1033.45 | 68.3241 | 726.924 | 122.326 | 1.26089 | 162.376 | 9 | 4.1523 |
| 8788 | 34.0987 | 39.9567 | 829.46 | 83.510 | 165.891 | 1078.86 | 69.3737 | 727.974 | 125.867 | 1.33843 | 143.897 | 10 | 5.4129 |
| 8889 | 34.6146 | 40.4018 | 876.80 | 74.834 | 175.360 | 1126.99 | 70.4234 | 729.023 | 127.581 | 1.36014 | 156.373 | 10 | 6.2561 |
| 8990 | 35.1305 | 41.0951 | 926.57 | 66.288 | 185.315 | 1178.18 | 71.4730 | 730.073 | 123.381 | 1.38895 | 163.858 | 10 | 6.6952 |
| 9091 | 35.6464 | 27.3458 | 978.89 | 58.718 | 195.779 | 1233.39 | 72.5226 | 731.123 | 132.443 | 1.39418 | 165.610 | 10 | 7.4617 |
| 9192 | 36.1623 | 28.0658 | 1033.88 | 52.012 | 206.777 | 1292.67 | 73.5723 | 732.172 | 119.645 | 1.32369 | 184.792 | 10 | 8.3074 |
| 9293 | 36.6782 | 30.4341 | 1091.68 | 46.072 | 218.335 | 1356.08 | 74.6219 | 733.222 | 120.999 | 1.33602 | 158.026 | 10 | 11.2495 |
| 9394 | 37.1942 | 31.1109 | 1152.41 | 40.811 | 230.481 | 1423.70 | 75.6715 | 734.272 | 154.179 | 1.34477 | 154.003 | 10 | 10.8425 |
| 9495 | 37.7101 | 36.7769 | 1216.22 | 36.150 | 243.243 | 1495.61 | 76.7211 | 735.321 | 165.130 | 1.20305 | 194.294 | 10 | 7.3186 |
| 9596 | 38.2260 | 42.2667 | 1283.25 | 32.022 | 256.651 | 1571.93 | 77.7708 | 736.371 | 152.175 | 1.31162 | 187.614 | 10 | 8.1777 |
| 9697 | 38.7419 | 43.0128 | 1353.68 | 28.365 | 270.735 | 1652.78 | 78.8204 | 737.420 | 164.511 | 1.27140 | 186.046 | 10 | 10.6026 |
| 9798 | 39.2578 | 43.5665 | 1427.65 | 25.126 | 285.530 | 1738.30 | 79.8700 | 738.470 | 178.897 | 1.26303 | 193.249 | 10 | 11.4904 |
| 9899 | 39.7737 | 43.6926 | 1505.34 | 22.256 | 301.068 | 1828.66 | 80.9197 | 739.520 | 235.496 | 1.18706 | 212.538 | 10 | 10.5377 |
| 20000 | 40.2896 | 44.5436 | 1586.93 | 19.715 | 317.386 | 1924.03 | 81.9693 | 740.569 | 315.355 | 1.37635 | 263.703 | 10 | 9.2825 |
| 20001 | 40.8056 | 44.9315 | 1672.61 | 17.463 | 334.521 | 2024.59 | 83.0189 | 741.619 | 219.173 | 1.28464 | 403.917 | 10 | 7.1006 |

| CROPYR | 15 SSLADJ | 16 GSH | 17 SSH | 18 GSHT | 19 SSHT | 20 RATE | 21 GOVTEXP | 22 RGCOM | 23 TALADJ | 24 CTALLY | 25 TALEXC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 8182 | 0.000 | 0.000 | 0.00 | 0.0000 | 0.0000 | 0.0000 | 0.000 | 0.000 | 0.00 | 0.00 | 0.00 |
| 8283 | 0.000 | 0.000 | 0.00 | 0.0000 | 0.0000 | 0.0000 | 0.000 | 0.000 | 0.00 | 0.00 | 0.00 |
| 8384 | 0.000 | 596.720 | 181.73 | 18.8200 | 5.7300 | 24.5500 | 664.231 | 613.865 | 0.00 | 0.00 | 0.00 |
| 8485 | 0.000 | 560.860 | 244.81 | 17.6300 | 7.7000 | 25.3300 | 471.091 | 559.548 | 0.00 | 0.00 | 0.00 |
| 8586 | 0.000 | 701.700 | 190.50 | 22.0700 | 5.9900 | 28.0600 | 733.171 | 694.781 | 0.00 | 0.00 | 0.00 |
| 8687 | 0.000 | 716.524 | 306.52 | 21.3361 | 9.1273 | 30.4634 | 848.542 | 737.487 | 64.00 | 64.00 | 0.00 |
| 8788 | 0.000 | 717.974 | 350.88 | 21.0558 | 10.2902 | 31.3460 | 851.320 | 738.969 | -111.05 | -47.05 | 0.00 |
| 8889 | 0.000 | 719.023 | 397.97 | 20.7723 | 11.4972 | 32.2695 | 849.237 | 740.016 | -112.35 | -150.00 | -9.41 |
| 8990 | 0.000 | 710.668 | 457.51 | 20.2294 | 13.0231 | 33.2525 | 841.329 | 741.525 | -109.22 | -150.00 | -109.22 |
| 9091 | 0.000 | 611.901 | 611.49 | 17.1659 | 17.1543 | 34.3201 | 479.415 | 715.039 | -99.80 | -150.00 | -99.80 |
| 9192 | 0.000 | 622.369 | 660.30 | 17.2104 | 18.2595 | 35.4699 | 493.024 | 716.363 | 235.62 | 85.62 | 0.00 |
| 9293 | 54.791 | 778.013 | 568.07 | 21.2118 | 15.4880 | 36.6998 | 655.562 | 720.950 | 223.34 | 150.00 | 158.96 |
| 9394 | 38.136 | 921.370 | 492.33 | 24.7719 | 13.2367 | 38.0086 | 780.676 | 722.250 | 120.18 | 150.00 | 120.18 |
| 9495 | 0.000 | 845.500 | 640.11 | 22.4211 | 16.9745 | 39.3955 | 834.577 | 733.469 | -20.29 | 129.71 | 0.00 |
| 9596 | 0.000 | 726.371 | 835.55 | 19.0020 | 21.8583 | 40.8603 | 813.153 | 744.424 | -101.11 | 28.60 | 0.00 |
| 9697 | 44.679 | 772.100 | 870.68 | 19.9293 | 22.4738 | 42.4031 | 867.216 | 745.960 | -68.73 | -40.13 | 0.00 |
| 9798 | 122.937 | 851.407 | 876.90 | 21.6876 | 22.3368 | 44.0244 | 954.852 | 747.109 | -76.58 | -116.70 | 0.00 |
| 9899 | 49.510 | 779.030 | 1039.63 | 19.5865 | 26.1387 | 45.7252 | 865.788 | 747.396 | -84.81 | -150.00 | -51.51 |
| 20000 | 0.000 | 679.059 | 1234.97 | 16.8544 | 30.6523 | 47.5067 | 760.757 | 749.135 | -68.88 | -150.00 | -68.88 |
| 20001 | 0.000 | 662.737 | 1351.85 | 16.2413 | 33.1292 | 49.3705 | 739.747 | 749.941 | -11.62 | -150.00 | -11.62 |
|  |  |  |  |  |  |  |  |  | 10.19 | -139.81 | 0.00 |

Column 2 (PREDSHIP) represents the forecast of grain shipments (million tonnes) made prior to the beginning of the crop year in question. It is upon these forecasts that the freight rates are based. These forecasts are the predicted values resulting from regressing the randomly generated actual grain shipments on a trend variable. Knowledge of future grain shipments is assumed and implicit in this is the theoretical success of the tally system.

Column 3 (SHIP) represents the randomly generated actual grain shipments (million tonnes) determined after the end of the crop year in question. Shipments increase through time as grain production increases (crop yields increase at a rate of 1.5 percent per year), yet are subject to system capacity constraints.

Columns 4 through 7 represent estimated railway costs where column 4 (VVC) is volume-related variable costs based on an input price index of 1.04 percent per year and a fixed productivity adjustment (accounting for a greater use of government hopper cars in place of railway owned box cars) of $20 million per year. Column 5 (LVC) is line-related variable costs which are based on an input price index of 1.03 percent per year and a decreasing productivity index (accounting for the changing mix of rail traffic and rail line abandonments). Line-related variable costs decrease through time due to the decreasing productivity index. Column 6 (PHFC) is the phased-in fixed cost component. Column 7 (EEC) is the sum of these individual costs and represents total estimated rail costs in millions of dollars.

Column 8 (CGSCC) is the cumulative government share of cost changes in millions of dollars. Prior to the 1986-87 crop year, the government is only responsible for cost changes up to the 31.5 million tonne volume cap. After 1985-86, the government is responsible for cost changes on all volumes of grain forecast to be shipped. The cumulative government share of cost changes tends to stabilize as the maximum shipper share of cost changes increases above the actual rate of cost changes. This results in producers picking up all inflationary costs.

Column 9 (GCOM) is the government commitment in millions of dollars, and is the sum of the Crow Benefit and the cumulative government share of cost changes.

Columns 10 through 15 are related to the shipper share limitation adjustment and are based on the calendar year. Column 10 (USPRICE) represents the randomly generated United States wheat price. The value in crop year 1985-86 refers to the average U.S. wheat price in the 1985 calendar year. Column 11 (CANUS) is the randomly generated Canada-United States exchange rate. The value in crop year 1985-86 refers to the average exchange rate in the 1985 calendar year. Column 12 (WTP) represents the weighted average or basket price of grain in Canada. The value in crop year 1986-87 refers to the basket price in the 1985 calendar year. Column 13 (SAFENET) represents the legislated safety net percentages by which the freight rate cannot exceed the weighted average price of grain. The value in the 1983-84 crop year refers to the 1984 calendar year, the value in 1984-85 refers to the safety net percentage for 1985, etc. Column 14 (FPRATIO) is the computed freight rate to grain price ratio. The value in crop year 1986-87 refers to the freight rate to grain price ratio for the 1985 calendar year. Column 15 (SSLADJ) is the shipper share limitation adjustment in millions of dollars. The value in crop year 1986-87 is incorporated into the 1986-87 freight rate and refers to that adjustment triggered from the 1985 calendar year. It is assumed that no shipper share limitation adjustment resulted with respect to the 1984 calendar year. The difficulty in determining shipper share limitation adjustments arises from these calendar year--based computations and it is because of this that the observations are staggered throughout several crop years.

Column 16 (GSH) is the government's share of estimated eligible rail costs in millions of dollars. Column 17 (SSH) is the grain shippers' share of estimated eligible rail costs in millions of dollars.

Column 18 (GSHT) is the average government freight rate and Column 19 (SSHT) is the average freight rate for shippers. Column 20 (RATE) is the average overall freight rate which railways collect.[22] Specific distance-related rates paid by individual shippers and the corresponding government freight rates are paid in proportion to the average freight rates and thus, sum to the overall freight rate.

Column 21 (GOVTEXP) is the government's actual expenditure in millions of dollars, determined after the end of the crop year in question and based on actual grain shipments which occurred. Column 22 (RGCOM) is the revised government commitment (revised to account for actual volumes of grain shipped as opposed to the forecast).

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[22] Lower rates may be allowed as of the 1986-87 crop year where agreed upon by a shipper and a railway [Bill C-155 sec. 45] but these are excluded from the analysis.

Column 23 (TALADJ) is the annual tally adjustment in millions of dollars. Bill C-44 specifies that the annual tally adjustment for the 1985-86 crop year shall be adjusted by adding to it the amount of $20 million. This amount accounts for lost interim and final adjustments in the transition of the rate adjustment system to the tally system. Column 24 (CTALLY) is the cumulative tally. When the previous cumulative tally exceeds its limits of plus or minus $150 million, the government share for the upcoming crop year is increased or decreased by that amount exceeding the limit. Column 24 (TALEXC) represents this amount.

## 4.2 RESULTS OF THE BENCH SCENARIO

The probability distributions to be analyzed are those in 1986-87, 1990-91, 1995-96 and 2000-01. For the bench scenario, all generated probability distributions (as outlined in section 2.3.5) will be examined for these four years. Graphical representations of the distributions will be presented for crop years 1990-91 and 2000-01. The process of examining the distributions is intended to lead up to the determination of the freight rate and the type and level of payments from grain shippers and the federal government.

### 4.2.1 Shipments of Grain

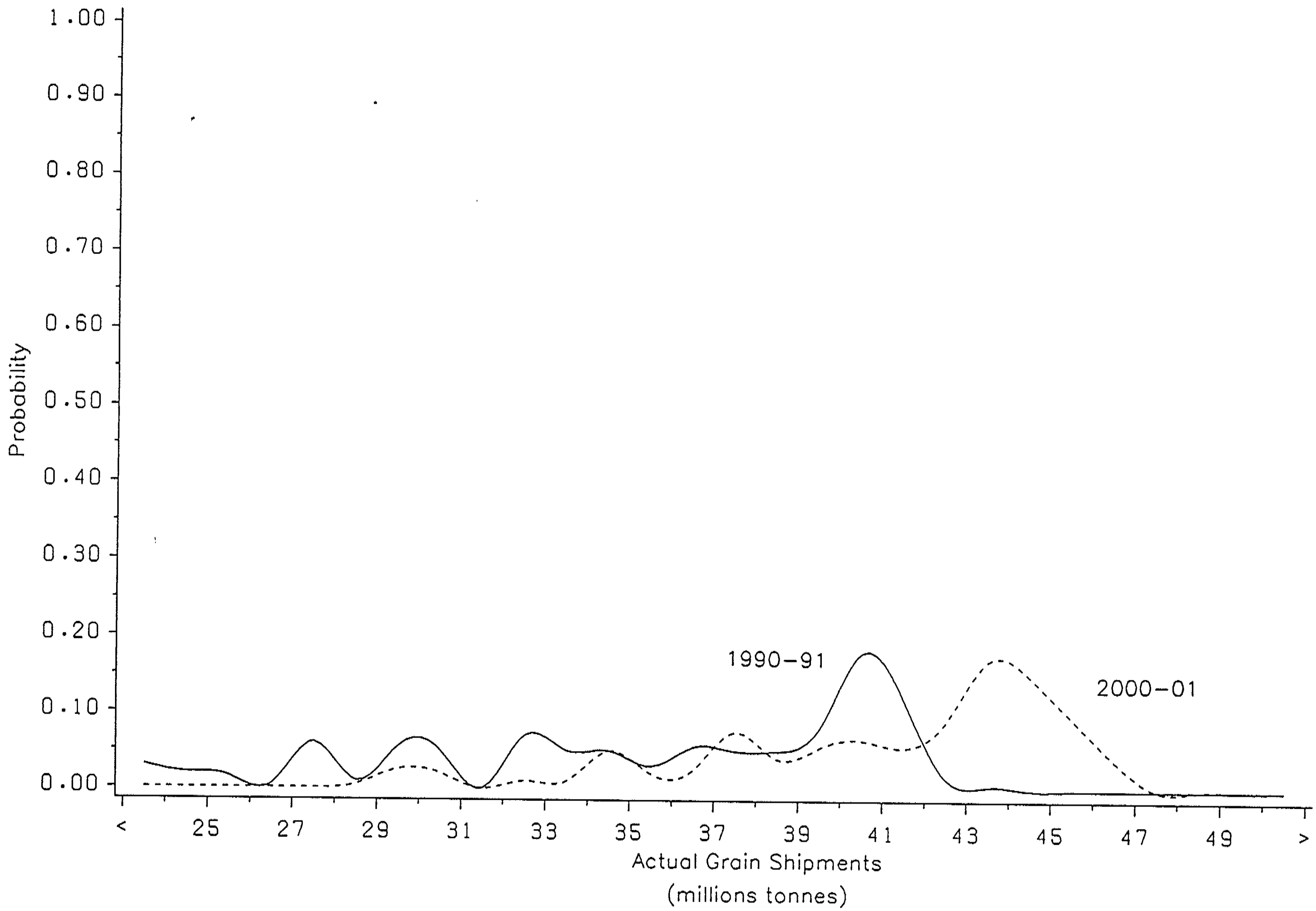
Because grain shipments forecasts are the predicted values resulting from the regression of all randomly generated grain shipments upon a trend variable, their values for any particular crop year are identical in each simulation trial. Thus, no probability distributions are necessary. In crop year 1986-87, the forecast of grain shipments is 33.6 million tonnes. In 1990-91, the forecast is 35.6 million tonnes. In

1995-96, shipments are forecast to be 38.7 million tonnes and in 2000-01, the forecast is 40.8 million tonnes (see Table 4.1).

To illustrate the characteristics of randomly generated actual grain shipments, Figure 4.1 presents the probability distributions for 1990-91 and 2000-01. In general, it is expected that the distributions depicting potential grain shipments would approximate a Beta distribution skewed to the left. All crop yields are related to the yield of wheat on stubble which is randomly selected from a Beta distribution of this kind. However, when potential shipments exceed system capacity, the capacity function truncates the upper end of these distributions. This occurs in early crop years when the potential for grain shipments is greater than capacity. As time increases and the grain handling and transportation system's capacity grows to allow potential tonnages, a lesser portion of the Beta distribution is truncated. Thus, the probability distributions in later crop years resemble negatively skewed Beta distributions.

In crop year 1986-87, actual grain shipments range from 18.1 to 40.4 million tonnes, with a mean of 33.9 million tonnes and variance 32.79. There is a probability of .295 that grain shipments will occur between 39 and 41 million tonnes, where the likelihood associated with the range of 39 to 40 million tonnes is .17, and for the range of 40 to 41 million tonnes is .125. In crop year 1990-91, grain volumes range from 21.4 to 43.2 million tonnes, with mean 35.7 million tonnes and variance 28.38. The highest probabilities occur in the range of 40 to 41 million tonnes (probability equal to .18) and in the range of 41 to 42 million tonnes (probability equal to 12). In 1995-96, grain shipments range from 24.3

FIGURE 4.1: Probability Distributions of Actual Grain Shipments



to 44.4 million tonnes, with mean 37.9 million tonnes and variance 24.20. The greatest probability (.195) occurs in the range between 42 and 43 million tonnes and the second highest probability (.12) occurs within the 41 to 42 million tonne range. In the final period of analysis, 2000-01, actual grain shipments cover a range of 28.6 to 46.8 million tonnes, with mean 41.0 million tonnes and variance 17.73. There is a 17% probability that shipments will be between 43 and 44 million tonnes and a 15% probability that volumes will be between 44 and 45 million tonnes.

Table 4.2 presents the probabilities that actual grain shipments exceed forecast shipments for each year of the simulation period. When shipments exceed the forecast, the government's actual expenditure exceeds its financial obligations and a negative annual tally adjustment results. When overforecasting occurs, the government's actual expenditure falls short of its financial obligations and a positive annual tally adjustment results. In all years of analysis, the probability that the forecast will underestimate shipments (SHIP > PREDSHIP) exceeds the probability that it will overestimate (SHIP < PREDSHIP). Table 4.2 also illustrates that the likelihood of a perfect forecast (SHIP = PREDSHIP) is nil.

Therefore, negative annual tally adjustments will be more likely to occur. However, this does not necessarily mean that the cumulative tally will tend to be in a deficit position. It is the magnitude of the forecast errors which determines the magnitude of the negative or positive annual tally adjustments. These, in turn, determine whether the long-run cumulative tally will result in monies owed to or by the federal government.

TABLE 4.2

Probabilities of Actual Grain Shipments Exceeding Forecast Shipments

| | Probability | | |
|---|---|---|---|
| Crop Year | SHIP < PREDSHIP | SHIP = PREDSHIP | SHIP > PREDSHIP |
| 1986-87 | 0.440 | 0 | 0.560 |
| 1987-88 | 0.415 | 0 | 0.585 |
| 1988-89 | 0.450 | 0 | 0.550 |
| 1989-90 | 0.475 | 0 | 0.525 |
| 1990-91 | 0.435 | 0 | 0.565 |
| 1991-92 | 0.440 | 0 | 0.560 |
| 1992-93 | 0.450 | 0 | 0.550 |
| 1993-94 | 0.445 | 0 | 0.555 |
| 1994-95 | 0.425 | 0 | 0.575 |
| 1995-96 | 0.425 | 0 | 0.575 |
| 1996-97 | 0.385 | 0 | 0.615 |
| 1997-98 | 0.395 | 0 | 0.605 |
| 1998-99 | 0.455 | 0 | 0.545 |
| 1999-00 | 0.360 | 0 | 0.640 |
| 2000-01 | 0.380 | 0 | 0.620 |

where SHIP = randomly generated actual grain shipments
PREDSHIP = forecast grain shipments

### 4.2.2 Grain Prices and the Shipper Share Limitation Adjustment

The four crop years examined are 1986-87, 1990-91, 1995-96 and 2000-01. The shipper share limitation adjustments which may result in these years are due to freight rate--grain price relationships which exist in calendar years 1985, 1989, 1994 and 1999. Therefore, the probability distributions depicting the U.S. export price of wheat, the Canada - United States exchange rate and the basket price of grain in Canada will be analyzed on the basis of these four calendar years.

Export wheat prices in the United States are randomly generated from a rectangular distribution. Two of the resulting probability distributions (1989 and 1999) are graphically depicted in Figure 4.2. In 1985, U.S. export wheat prices are assumed to be fixed at $137 per tonne (U.S. dollars). In 1989, prices range from $107 to $165 per tonne, with mean $129 per tonne and variance 97.78. The minimum value is below that in 1985 because the structure of the U.S. Farm Bill allows the minimum loan price for wheat (lower bound) to decrease when farm prices average less than 110 percent of the loan rate. For this year, the highest probabilities occur over the ranges of $120 to $130 per tonne (probability equal to .33) and $130 to $140 per tonne (probability equal to .305). In 1994, U.S. wheat prices range from $115 to $264 per tonne, with an average price of $171 per tonne and variance 1158.24. The highest probability (.20) is linked to a price range of $160 to $170 per tonne, while the second highest probability (.16) is associated with a price range of $130 to $140 per tonne. In calendar year 1999, prices range between $133 and $323 per tonne, with mean $252 per tonne and variance 2022.08. The highest probability (.395) is related to the range of over $270 per tonne. The increasing variance of these probability distributions is due mainly to the upper bound of the distribution which increases with inflation at a rate of four percent per year.

Figure 4.3 presents the probability distributions (for 1989 and 1999) associated with the Canada - United States exchange rate which is randomly sampled from a fixed triangular distribution. In all crop years, the range of the distribution is 1.18 to 1.44, with mean 1.32 and variance .003. These values correspond to the bounds and modal value of the

FIGURE 4.2: Probability Distributions of the U.S. Export Wheat Price

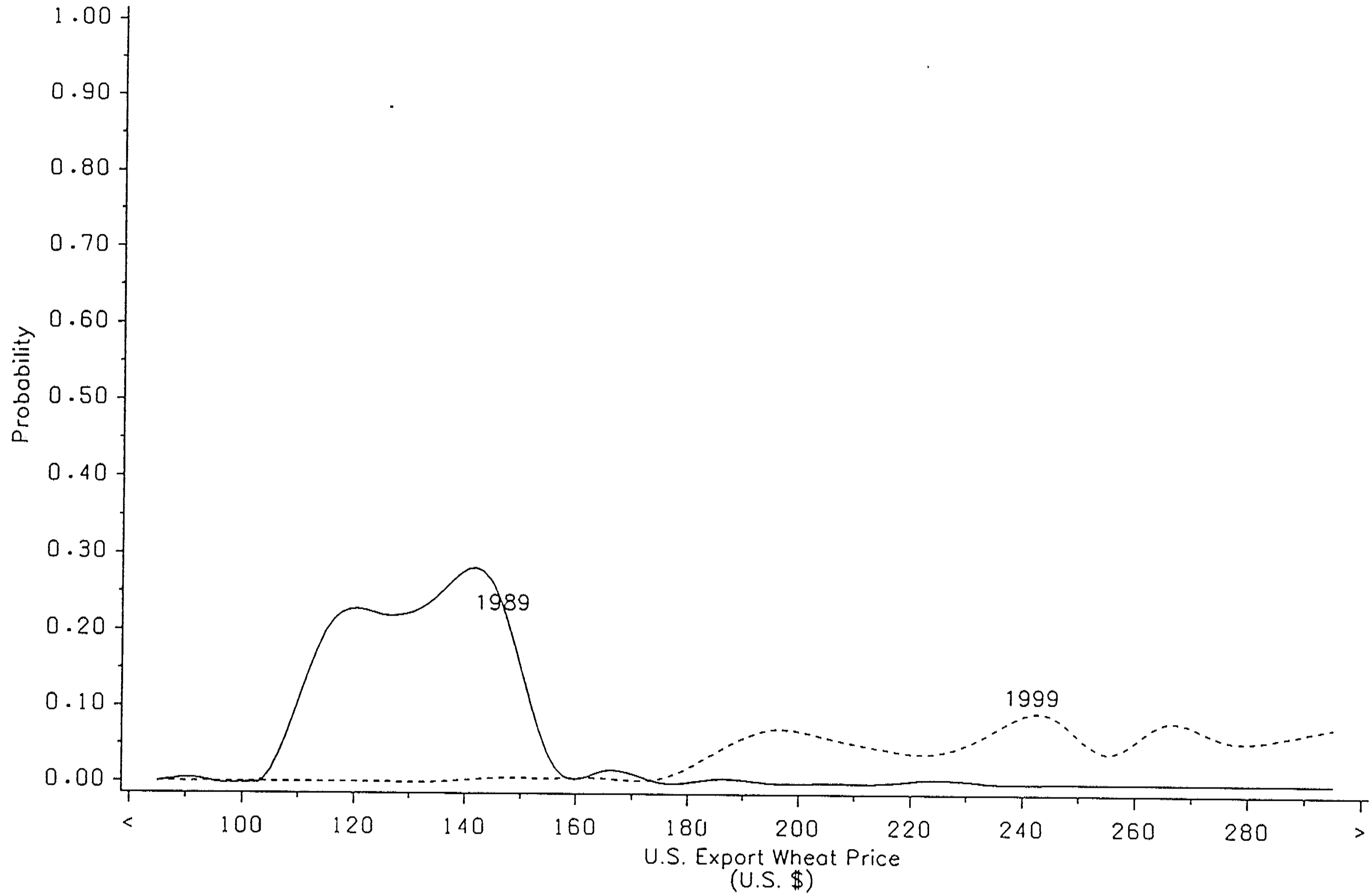
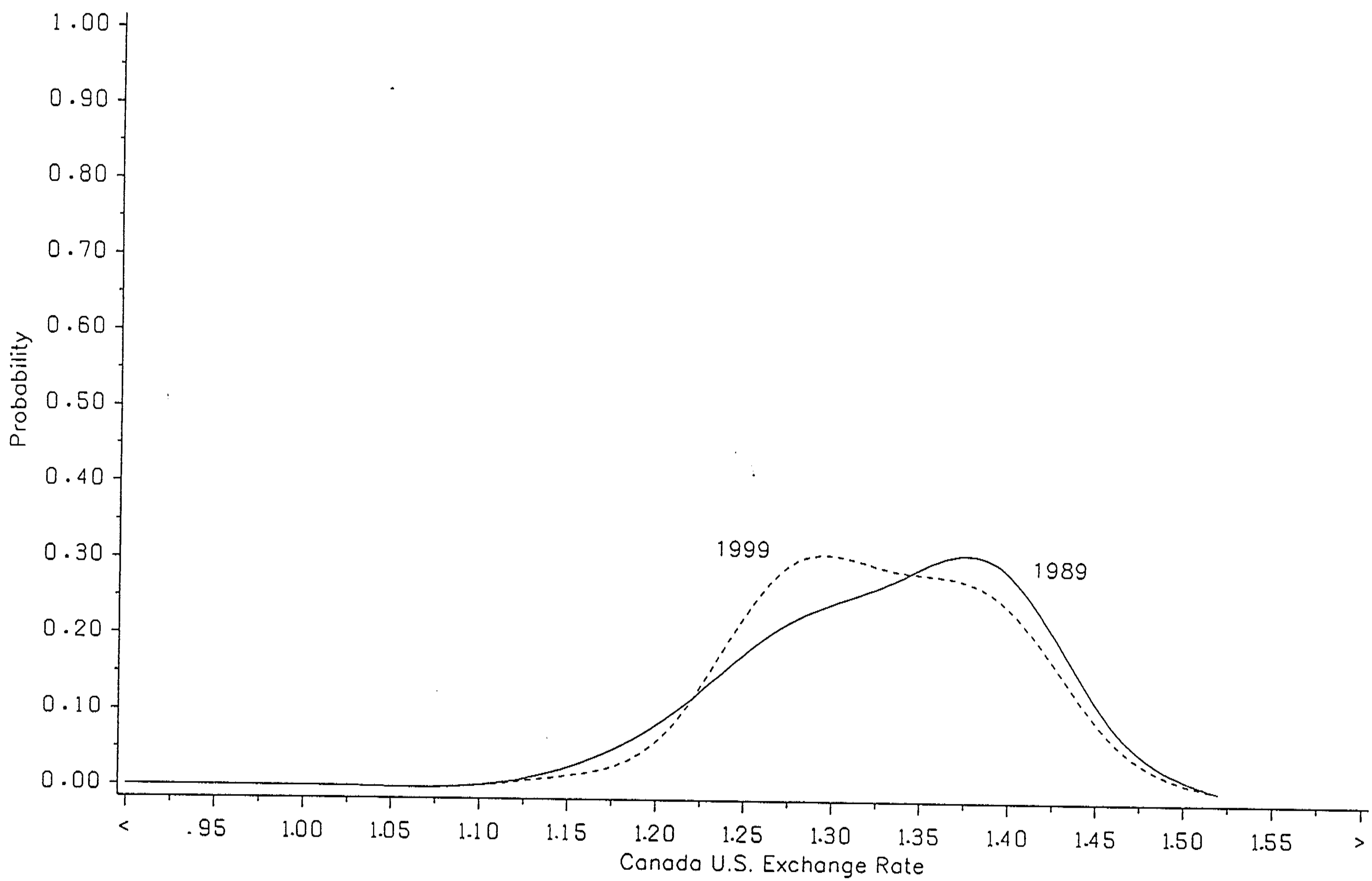


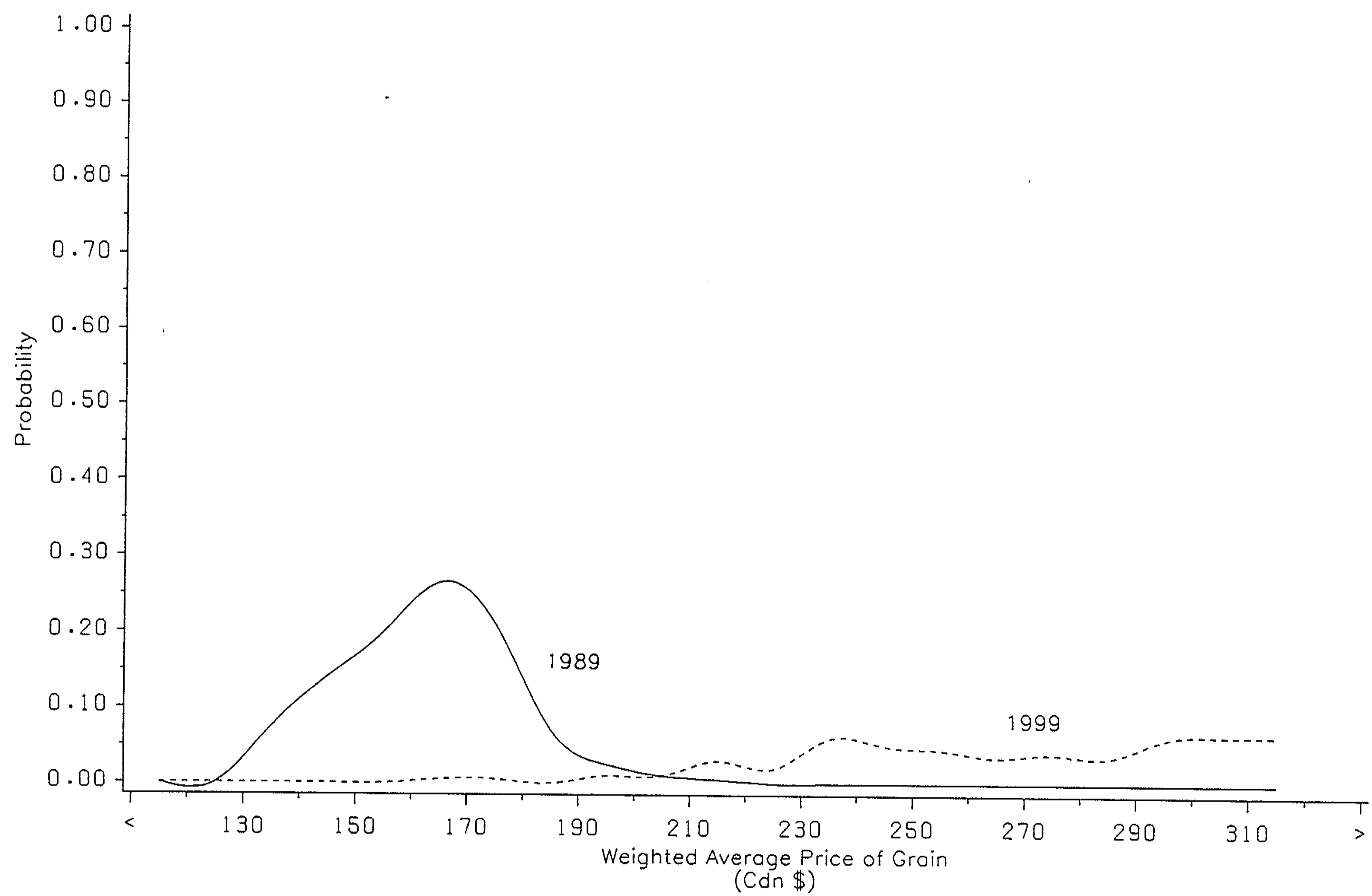
FIGURE 4.3: Probability Distributions of the Canada – U.S. Exchange Rate



United States - Canada exchange rate distribution as detailed in section 2.3.3.2. In calendar year 1985, the highest probability (.275) is linked to the range 1.35 to 1.40. In 1989, a .315 likelihood is associated with the 1.35 to 1.40 range and a .265 probability with the range about the mean. In 1994, there is a probability of .28 that the exchange rate will be between 1.30 and 1.35 and a .255 probability that it will fall within 1.25 and 1.30. In 1999, the highest probability (.29) is related to the range 1.35 to 1.40.

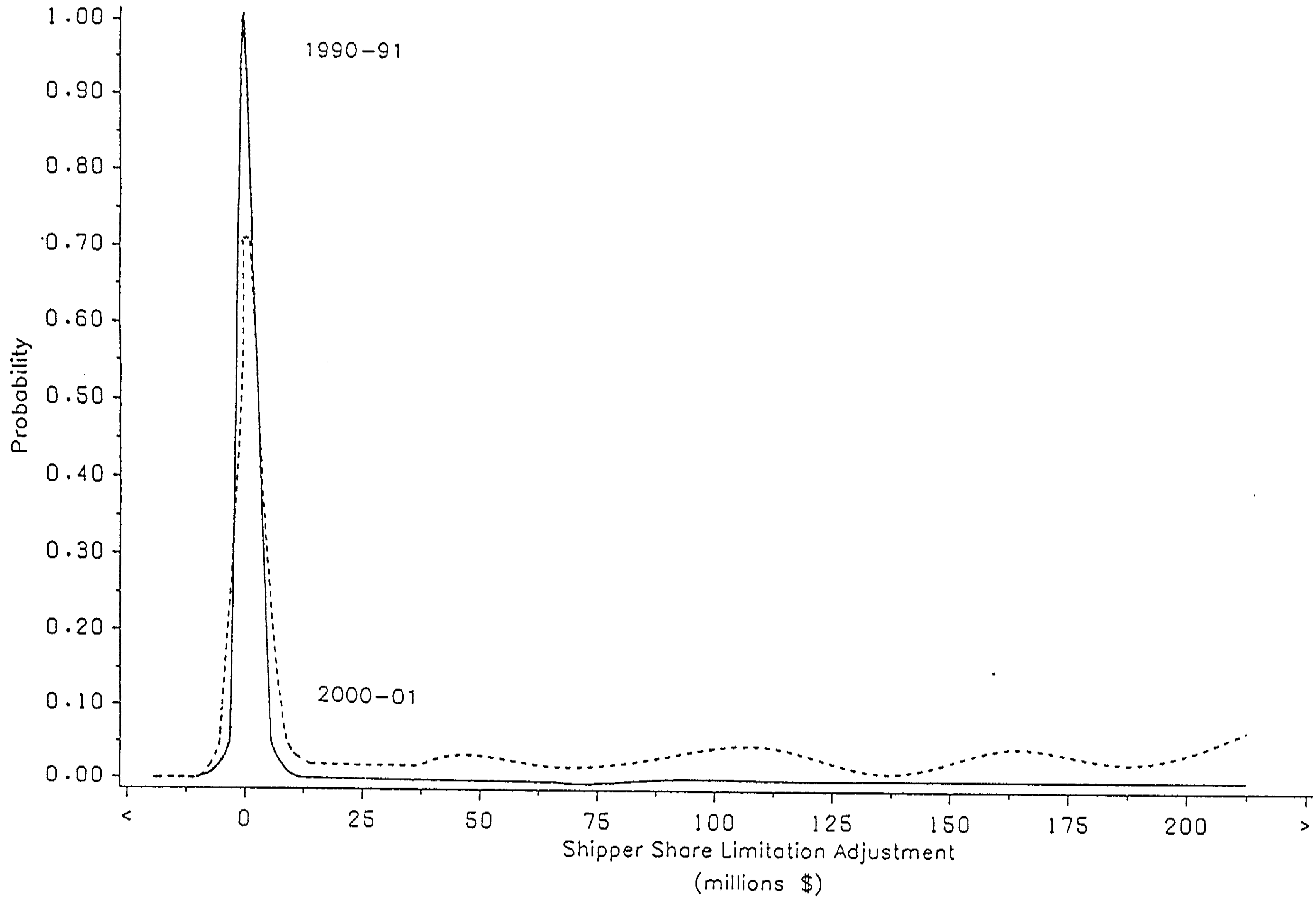
The probability distributions of the weighted average or basket price of grain, based on U.S. export wheat prices and the Canada - United States exchange rate for calendar years 1989 and 1999), are illustrated in Figure 4.4. In 1985, the weighted price ranges from $153 to $195 per tonne (Canadian dollars) with mean $173 per tonne and variance 80.79. The highest probability (.355) is associated with the range encompassing the mean, $170 to $180 per tonne. In calendar year 1989, the basket price ranges from $133 to $211 per tonne, with mean $163 per tonne and variance 232.95. Note that the minimum and mean values are below the 1985 levels reflecting a decrease in loan rates for wheat in the United States. A likelihood of .265 is associated the basket price falling between $160 and $170 per tonne. In 1994, the weighted average grain price ranges from $136 to $339 per tonne, with mean $212 per tonne and variance 1763.51. The highest probability (.14) exists over the price range of $190 to $200 per tonne. In calendar year 1999, the weighted average price of grain ranges from $166 to $427 per tonne, with mean $312 per tonne and variance 3495.00. The vast increase in variance of these probability distributions can be attributed to the growth in variance of the U.S. export wheat price distributions.

FIGURE 4.4: Probability Distributions of the Weighted Average Price of Grain



The shipper share limitation adjustment results when the basket price of grain falls below a fixed percentage of the average freight cost to shippers. Figure 4.5 illustrates the probability distributions related to the frequency and dollar values of the shipper share limitation adjustments for crop years 1995-96 and 2000-01. In crop years 1986-87 through 1990-91, no shipper share limitation adjustments occur. In crop year 1995-96, the likelihood of the requirement of a shipper share limitation adjustment is .31 with the maximum adjustment in dollar terms of $204 million. The average adjustment is $21.7 million (including the years where no adjustment was triggered). The highest probability (.69) is associated with no required adjustment and the second highest probability (.105) is related to an adjustment range of $50 to $75 million. These adjustments result from an activation of the safety net feature of the WGTA in the 1994 calendar year (i.e. in 1994, the average freight cost to shippers exceeded 10% of the basket price of grain). In crop year 2000-01, the probability of a shipper share limitation adjustment is .29, with the adjustment reaching a maximum of $323 million. The mean adjustment is $41.6 million. The greatest probability (.71) is related to no adjustment with 29% of the adjustments spread consistently over the remainder of the range.

FIGURE 4.5: Probability Distributions of Shipper Share Limitation Adjustment



### 4.2.3 Financial Obligations of the Federal Government and Grain Shippers

The federal government's share of estimated railway costs, expressed in total dollar terms, is relatively predictable in early crop years. This is because the majority of government funds are contributed in the form of the Crow Benefit and the cumulative government share of cost changes. There is no within-year variation associated with the government's cumulative share of cost changes given that costs are based on fixed input price indices and the volume forecast is identical in each year (see Table 4.1 for values of the cumulative government share of cost changes). In later years, variablity in the government's share increases as the cumulative tally builds up and the likelihood that this tally may exceed its limits increases. Thus, the government may be required to contribute additional funds due to unspent commitments accumulating to over $150 million, or the government may receive refunds due to overspent commitments accumulating to more than $150 million. Further variation in the government's share arises after the 1990-91 crop year, when the computed freight rate--grain price ratios begin to exceed the safety net percentages and shipper share limitation adjustments are necessary (see section 4.2.2). Figure 4.6 presents the probability distributions of the government's share of rail costs for crop years 1990-91 and 2000-01. The probabilities related to the cumulative tally exceeding its bounds are outlined in Table 4.3. Figure 4.7 presents the probabilities of the levels of adjustments to the government's share caused by the cumulative tally surpassing its legislated limits. The distributions of the adjustments are illustrated for 1988-89 and 1998-99 which will impact the government's share in 1990-91 and 2000-01, respectively.

FIGURE 4.6: Probability Distributions of the Government's Share of Costs

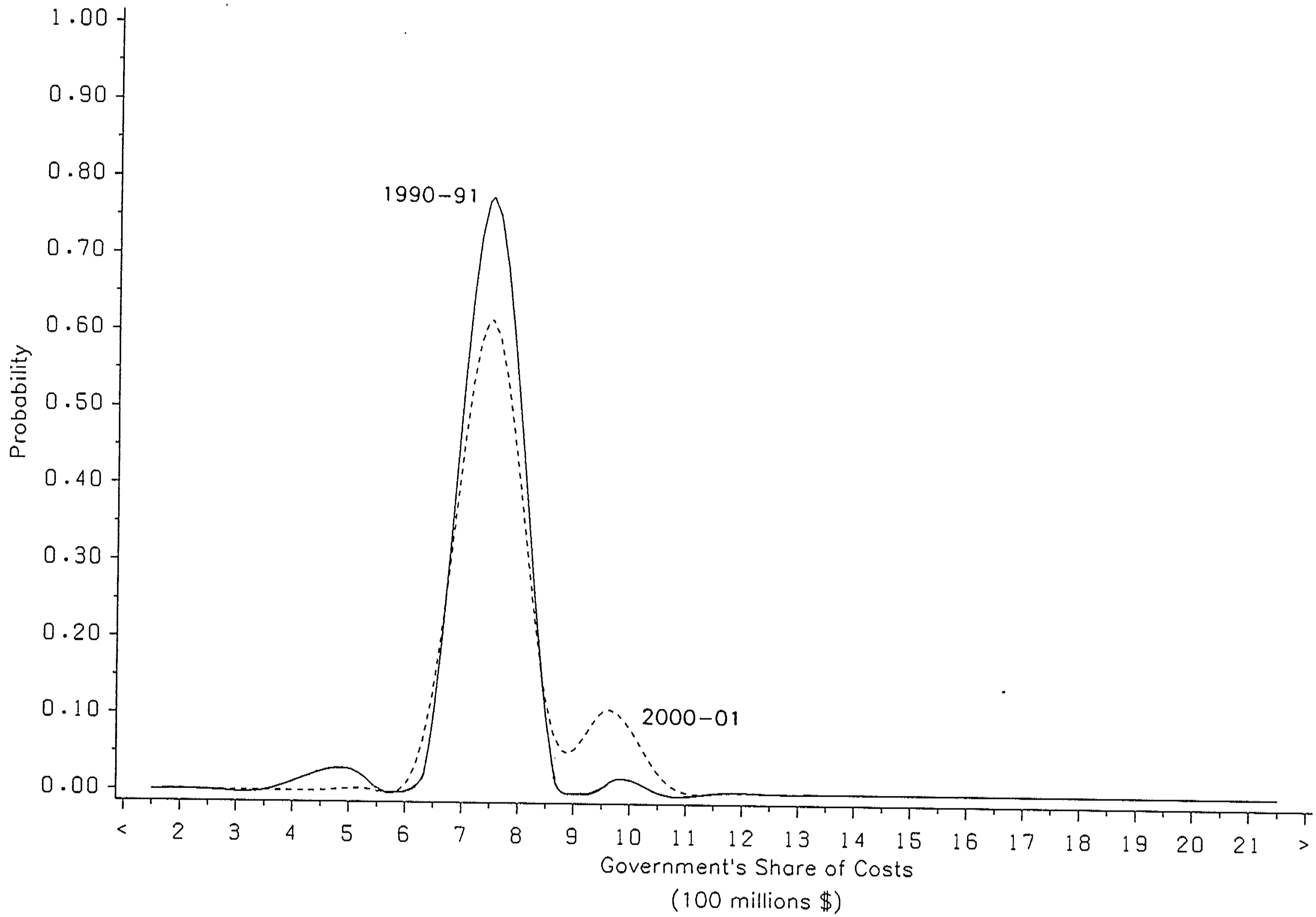


TABLE 4.3

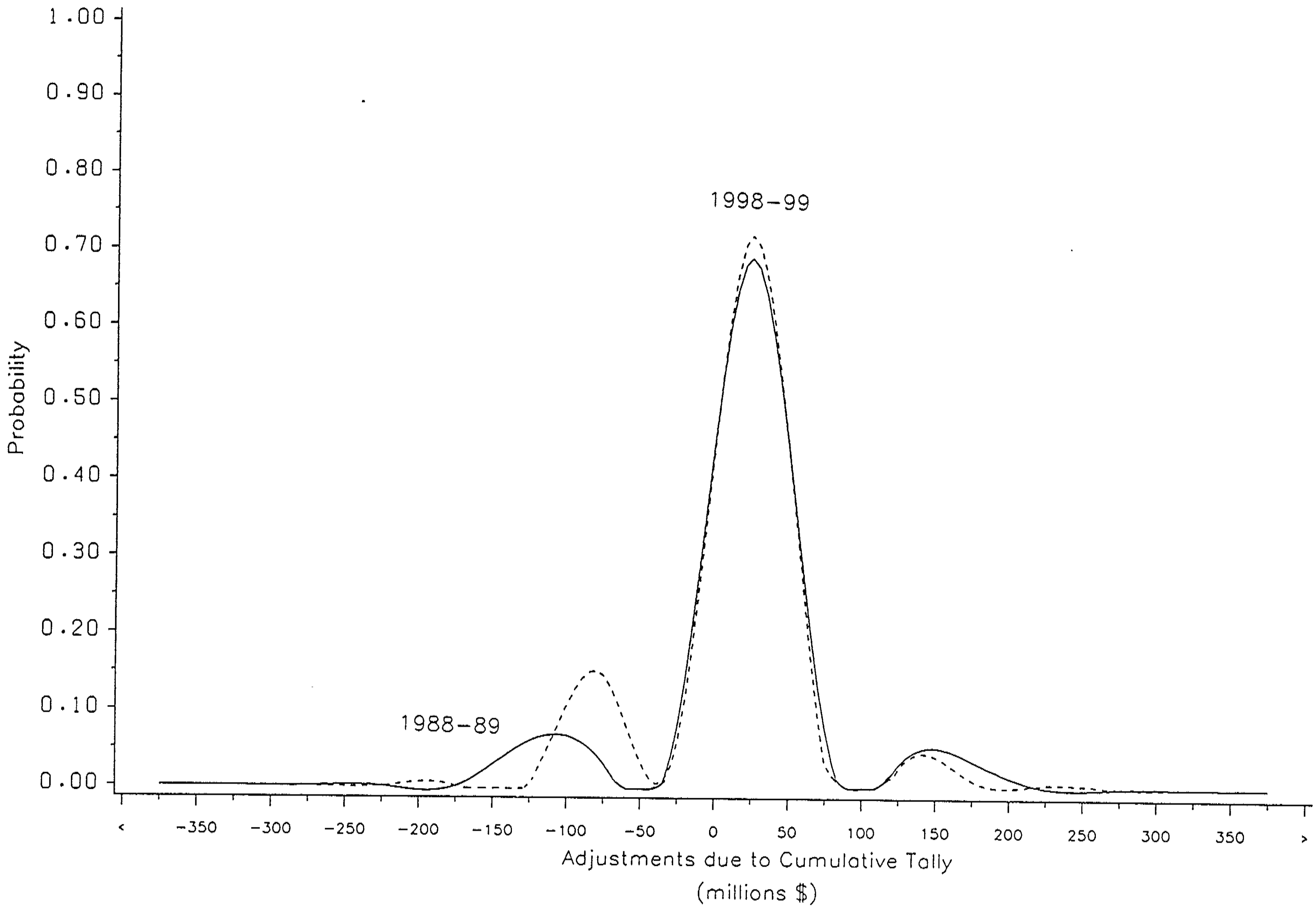
Probabilities of the Cumulative Tally Exceeding its Limits

| | Probabilites | | |
|---|---|---|---|
| Crop Year | Cumulative Tally Exceeds -$150 million | Cumulative Tally Lies Within Limits | Cumulative Tally Exceeds +$150 million |
| 1984-85 | 0.000 | 1.000 | 0.000 |
| 1988-89 | 0.170 | 0.645 | 0.185 |
| 1993-94 | 0.170 | 0.665 | 0.165 |
| 1998-99 | 0.210 | 0.650 | 0.140 |

Note: Crop Year is the year in which the cumulative tally exceeded legislated limits. The resulting adjustments are incorporated into the government's share in two years time (eg. the 1998-99 adjustment is factored into the government's share in 2000-01).

In crop year 1986-87, the government's share is fixed at $716.5 million. The Crow Benefit subsidy is $658.6 million and contributions through the inflation protection feature are $68.3 million based on a forecast of 33.6 million tonnes. Because no shipper share limitation adjustments or adjustments related to the tally system are required for this crop year, there is no variation in the government's share of rail costs. In crop year 1990-91, the government's share ranges from $597.0 million to $903.8 million, with a mean of $725.6 million and variance 2905.9. The highest probability (.775) is associated with a range of $700 to $800 million. The Crow Benefit is $658.6 million and the cumulative government share of cost changes is $72.5 million. Because no shipper share limitation adjustments are necessary for this crop year,

FIGURE 4.7: Probability Distributions of the Adjustments due to the Cumulative Tally



the variation in the government's share is attributable to the 1988-89 cumulative tally and the possibility that it may have exceeded its bounds. The likelihood that the value in the cumulative tally from the 1988-89 crop year will lie within its defined limits is .645. A probability of .17 exists with respect to this tally declining below -$150 million and a probability of .185 exists regarding the tally surpassing $150 million.

In crop year 1995-96, the government's share ranges from $618.6 to $980.4 million, with an average of $751.6 million and variance 2931.4. The highest probability (.615) is related to a range of $600 to $700 million. The Crow Benefit is $658.6 and government contributions through the inflation protection measure are $77.8 million. Thus, the variance in this year's distribution arises from a combination of financial adjustments due to the cumulative tally and to the shipper share limitation. The likelihood that the 1993-94 cumulative tally will lie within its limits is .665, while the probability that it will fall below -$150 is .17 and the probability that it will rise above $150 is .165.

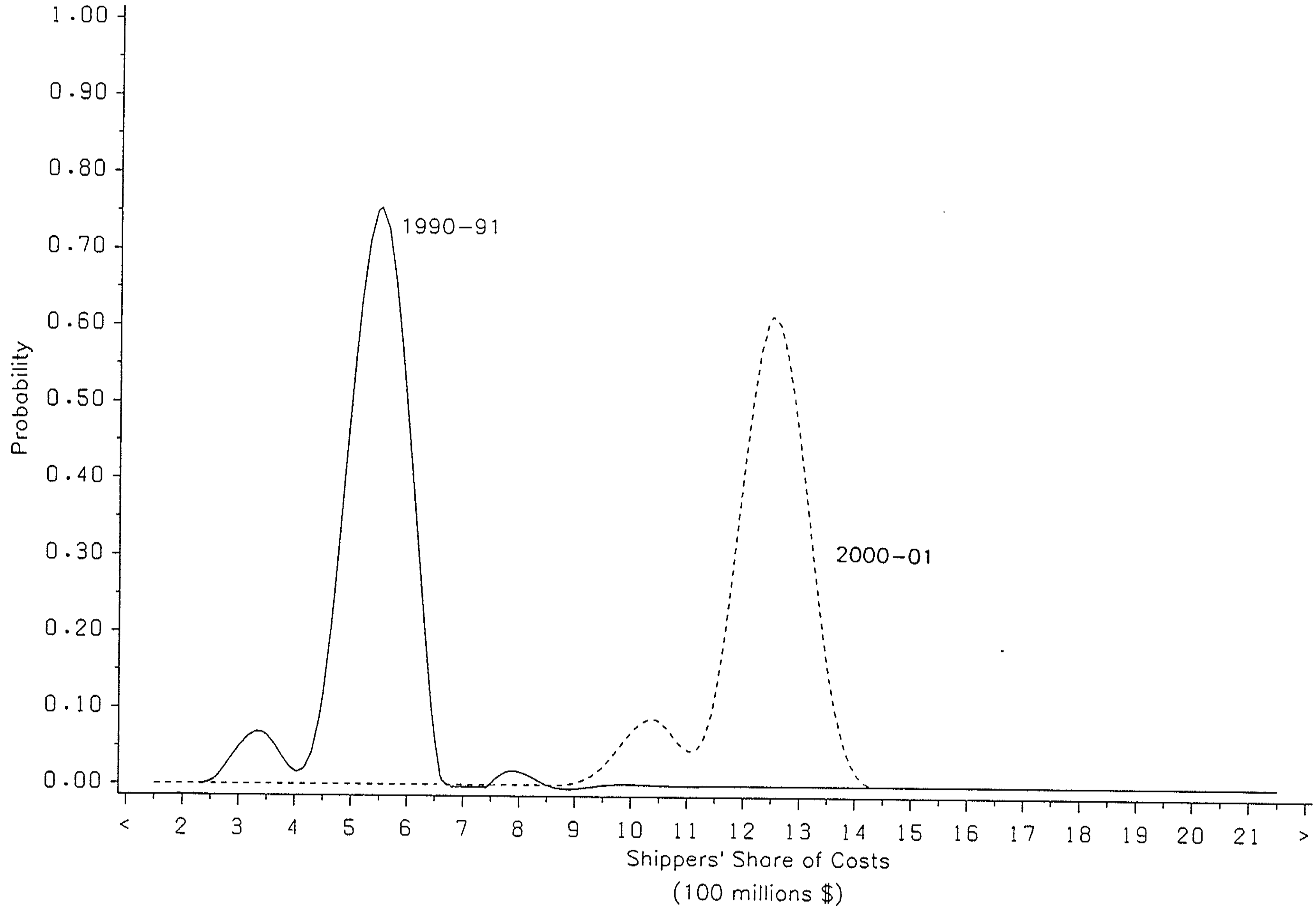
In crop year 2000-01, the government's share ranges from $627.4 to $1077.1 million, with mean $769.6 million and variance 8047.2. The highest probability (.615) is linked to a range of $700 to $800 million. Given that the Crow Benefit is still $658.6 million and the cumulative government share of cost changes is $83.0 million, the remaining variation again results from a combination of the possibility of adjustments due to the tally system and the safety net features of the Act. The likelihood that the 1998-99 cumulative tally will fall wihin plus or minus $150 million is .65. A .21 probability exists that it will fall

-$150 million (resulting in a refund to the government), and a .14 probability exists that it will accumulate to greater than $150 million (resulting in an additional contribution by the government).

The grain shippers' share of estimated rail costs in total dollar terms is calculated as a residual. Therefore, the variance associated with the probability distributions depicting the shippers' share for any particular crop year is identical to the variance associated with the government's share in that same year. Figure 4.8 illustrates the probability distributions of the shippers' share of estimated railway costs for crop years 1990-91 and 2000-01.

In 1986-87, the shippers' share is constant at $306.5 million. In 1990-91, the shippers' share ranges from $319.6 million to $640.8 million, with an average of $497.8 million. The highest probability (.755) is linked to the range around the mean ($400 to $500 million). In 1995-96, the shippers' share ranges from $581.5 million to $943.3 million, with mean $810.3 million. The highest probability (.635) is associated with a range of $800 to $900 million, and the second highest probability (.29) is associated with the next lowest range ($700 to $800 million). This is the first year of the analysis where the average grain shippers' share of rail costs exceeds the average government's share. In the final year of the simulation, 2000-01, the shippers' share ranges from $937.5 million to $1387.1 million, with a mean of $1245.0 million. The highest probability (.615) is related to a range of $1200 to $1300 million.

FIGURE 4.8: Probability Distributions of the Shippers' Share of Costs



In summary, the probability distributions of the government's share are heavily skewed to the left, while the distributions of the shippers' share are heavily skewed to the right. As well, the distributions reflecting both the government's share and shipper's share are characterized by increasing variance as time progresses. This increased variation is due to additional rate-determining components coming into play in later years.

4.2.4 Freight Rates

The actual freight rates which the federal government or grain shipper pays on each tonne of grain hauled is their respective share of rail costs divided by the forecast of grain volumes to be shipped. Because there is no within-year variation regarding predicted shipments, no additional variation is incorporated into either of these per tonne charges relative to their shares of railway costs. The distributions reflecting the government freight rate and the shipper freight rate also possess the same variances (as did the distributions for the government's share and the shippers' share). In addition, the patterns of skewness of these rate distributions follow the skewness tendencies of their respective share distributions.

Figure 4.9 presents the probability distributions depicting the government freight rate and Figure 4.10 illustrates the distributions related to the shipper freight for 1990-91 and 2000-01. In 1986-87, the government freight rate and shipper freight rate are fixed at $21.34 and $9.13 per tonne respectively based on forecast shipments of 33.6 million tonnes.

FIGURE 4.9: Probability Distributions of Government Freight Rate

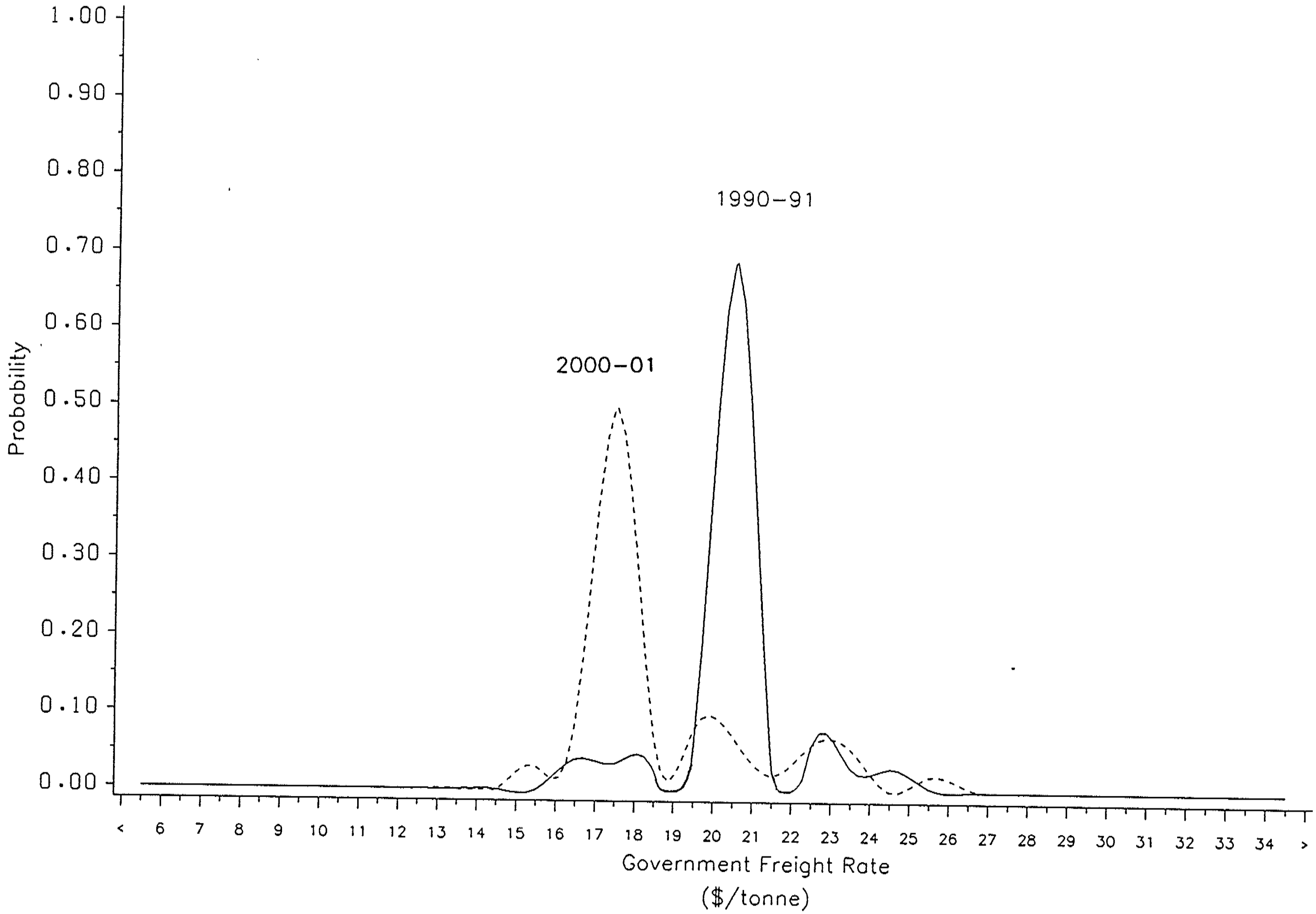
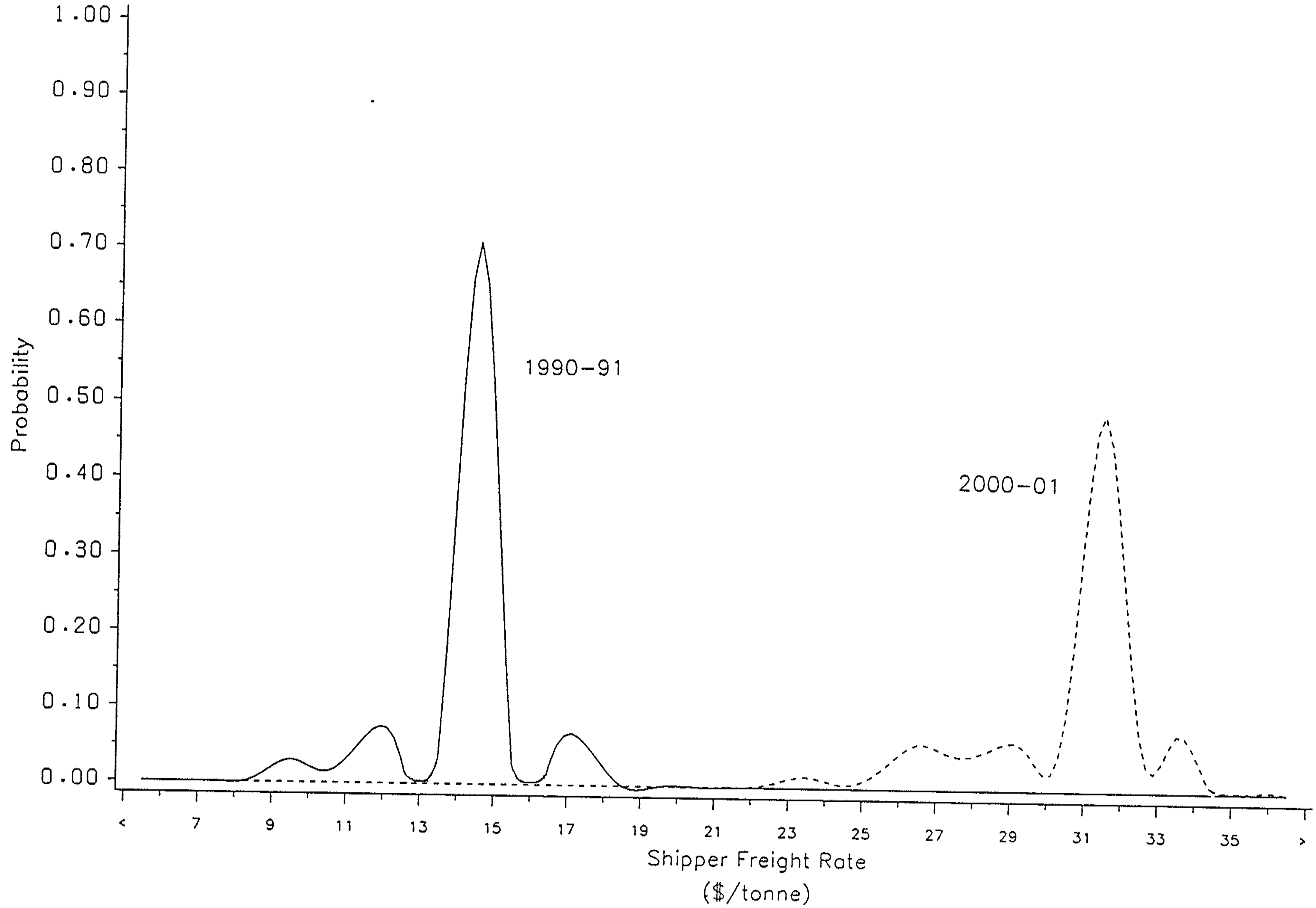


FIGURE 4.10: Probability Distributions of Shipper Freight Rate



In 1990-91, the minimum government freight rate is $16.34 per tonne and the maximum rate is $25.35 per tonne. The mean of the distribution is $20.36 per tonne with variance 2.69. The highest probability (.74) is linked to a range of $19 to $20 per tonne. The range of the freight rate charged to grain shippers is $7.83 per tonne to $15.63 per tonne, with mean $13.89 per tonne. The highest probability (.81) is associated with a range extending from $14 to $15 per tonne.

In 1995-96, the rate paid by government ranges from $16.18 per tonne to $25.65 per tonne, with an average rate of $193.66 per tonne and variance 2.01. The highest probability (.57) is related to a range of $19 to $20 per tonne. The shipper freight rate ranges from $15.21 per tonne to $24.68 per tonne with mean $21.20. The highest probability (.59) is associated with a rate ranging between $21 and $22 per tonne. This is the first year of the simulation in which the mean value for the rate paid by shippers exceeds the mean value for the government freight rate.

In the last year of the analysis, the government freight rate ranges from $15.38 per tonne to $29.40 per tonne, with an average rate of $18.86 per tonne and variance 4.83. The highest probability (.50) is related to a range of $17 to $18 per tonne. The shipper rate ranges from $22.97 per tonne to $33.99 per tonne with mean $30.51 per tonne. The highest probability (.495) is linked to the range of $31 to $32 per tonne.

The overall freight rate which railways collect on every tonne of grain shipped is calculated as estimated eligible rail costs divided by the forecast of grain volumes to be shipped. Because no within-year variation exists in either estimated rail costs (based on fixed input price indices) or predicted shipments, there is no within-year variation regarding the overall freight rate. Table 4.1 lists the overall freight rates for each year of the analysis. For each simulation trial, the particular government freight rate and shipper freight rate sum to this overall freight rate. As well, for any specific crop year, the mean of the government freight rate distribution and the mean of the shipper freight rate distribution sum to approximately the overall freight rate.

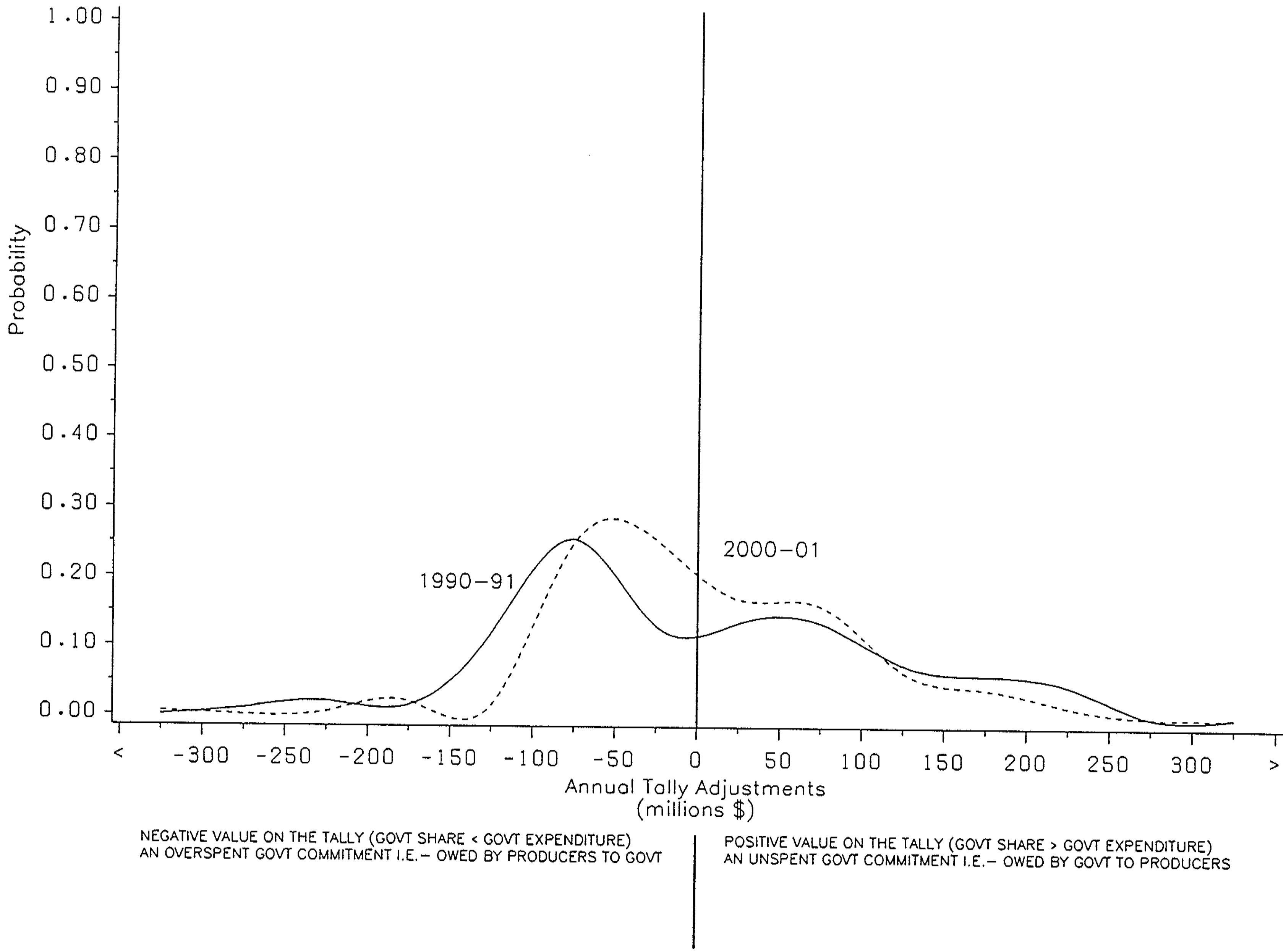
### 4.2.5 Annual Tally Adjustments and the Cumulative Tally

Figure 4.11 illustrates the probability distributions for the annual tally adjustments for two of the crop years under analysis. In 1986-87, the annual tally adjustment ranges from -$135 million to $131 million, with a mean of -$14.0 million and variance 9697.0. The likelihood of a negative adjustment (government expenditure exceeds the combined government commitment and shipper share limitation adjustment) is .56, and the likelihood of a positive adjustment (unspent government commitment plus shipper share limitation adjustment) is .44. The highest probability (.325) is related to the range of -$150 million to -$100 million.

In 1990-91, the annual tally adjustment ranges fom -$264 million to $236 million, with an average adjustment of -$5.0 million and variance 11547.2. The probability of a negative adjustment is .55, and the probability of a positive adjustment is .285. The highest probability (.455) is associated with the range of -$50 million to -$50.

In 1995-96, the range of the annual tally adjustment extends from -$351 million to $249 million with mean $3 million and variance 9035.2.

FIGURE 4.11: Probability Distributions of Annual Tally Adjustments



The probability of the adjustment taking on a negative value is .55, and of a positive value is .45. The greatest probabiliy (.295) is linked to the range -$100 to -$50 million.

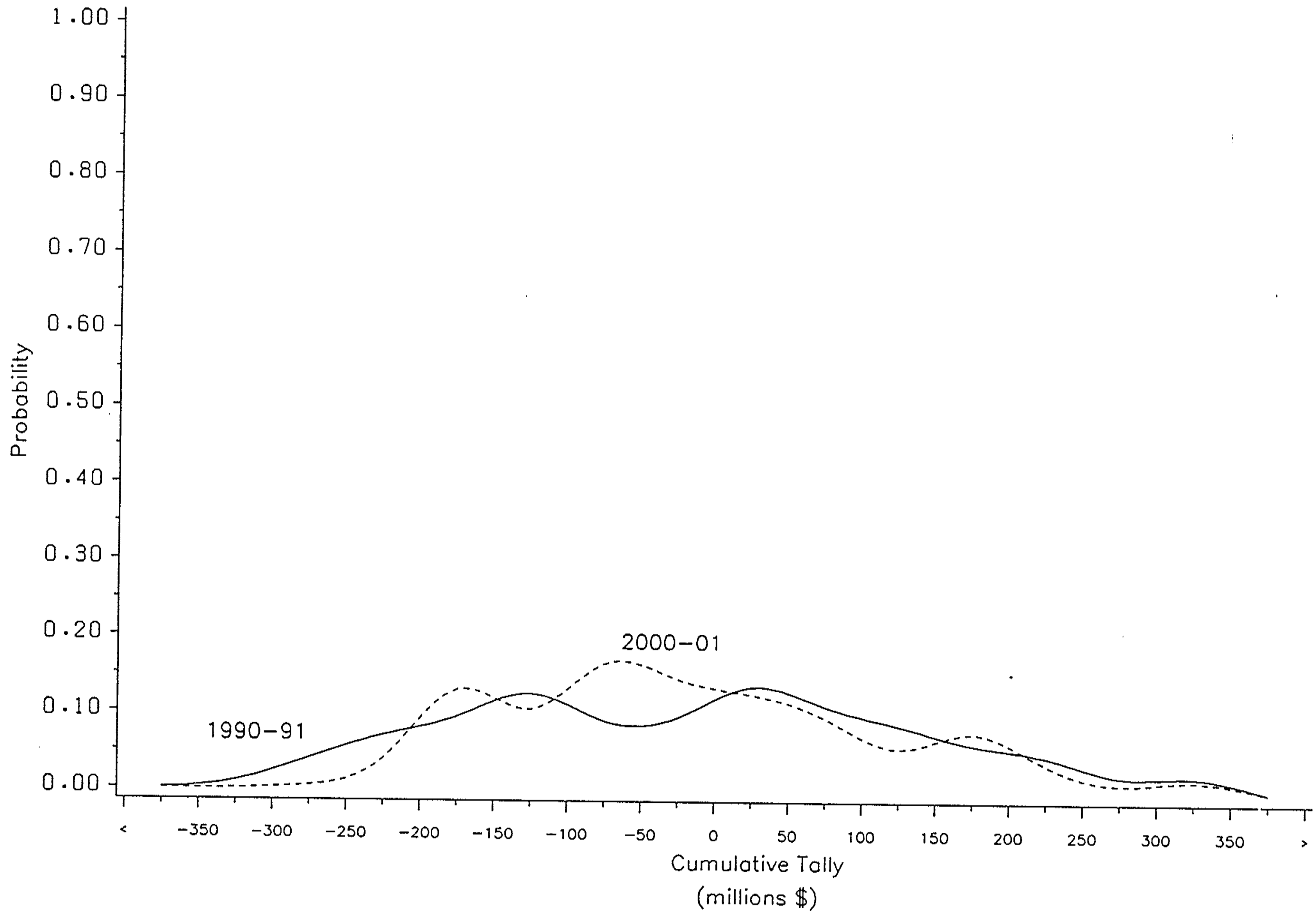
In the final period of the simulation, the annual tally ranges from -$224 million to $242 million, with a mean of -$0.8 million and variance 6731.8. The likelihood of a negative tally adjustment is .55, and of a positive adjustment is .45. The highest probability (.255) is associated with the range of -$50 to $0 million and the next highest (.25) with the range of -$100 to -$50 million.

As expected, these distributions indicate that the annual tally adjustment has a slightly greater probability of taking on a negative value because the probability of underforecasting exceeds that of overforecasting.

It should be noted that because the annual tally extends below -$150 million and above $150 million, the cumulative tally can exceed its legislated limits in just one crop year.

Figure 4.12 presents the probability distributions for the 1990-91 and 2000-01 cumulative tallies. In 1986-87, the cumulative tally ranges from -$70 million to $195 million, with mean $50.0 million and variance 9097.0 (the 1985-86 tally was fixed at $64.0 million). The highest probabilities are associated with the ranges -$50 to -$100 (.24) and $150 to $200 (.225). In 1990-91, the range of the tally extends from -$306 to $340 million with mean -$17.1 and variance 22358.8. The greatest probabilities exist on the range between $0 and $50 million (.135), $50 to $100 million (.11) and -$100 to -$150 million. In 1995-96, the

FIGURE 4.12: Probability Distributions of the Cumulative Tally



cumulative tally reaches a minimum of -\$262 million and a maximum of \$352 million, with an average of -\$7 million and variance 20028.9. The most likely range is that from \$0 to -\$50 million, with a probability equal to .18. In the final year of analysis, the cumulative tally ranges between -\$259 and \$308 million, with mean -\$16.6 million and variance 16555.3. The most probable ranges run from -\$50 million to \$0, \$0 to \$50 million, and \$50 to \$100 million, with probabilities of .165, .145 and .125 respectively.

## 4.3 COMPARATIVE ANALYSIS

This section performs the comparative analysis on each of the remaining scenarios in terms of the financial obligations of the federal government and grain shippers. Specifically, scenarios 2, 3 and 4 are analyzed and compared with the bench case.

### 4.3.1 Scenario 2

This scenario doubles the volume-related and line-related input price indices to 1.08 and 1.06, respectively, during the period from 1986-87 onward. Estimated eligible rail costs do not double, but they do increase substantially. As well, the rate of cost change on a per tonne basis increases from between three percent and four percent (under the bench scenario) to over six percent. The maximum shipper share of cost changes during this period is six percent. This means that shippers pick up their maximum share of inflation and because the federal government is responsible for the remainder, government contributions through the inflation protection increase. Thus, costs to both grain shippers and the federal government increase, as do their respective freight rates.

Because the average freight costs to shippers increases significantly, the safety net feature of the Act is invoked earlier, more frequently, and the amount of the adjustments is much greater under this scenario relative to the bench run. Since there is no change in the forecast volumes or actual shipments generated by the model under this scenario, no significant changes occur to the tally system. However, the government's cumulative share of cost changes on a per tonne basis increases (due to higher inflation). Although the forecast error has not changed, the size of the tally adjustment inscreases because there is a greater dicrepancy between what the total government inflationary contributions were and what they should have been.

#### 4.3.1.1 Financial Obligations of the Federal Government and Grain Shippers

Table 4.4 is a comparison of the type and level of government payments under scenario 2 with those generated from the bench case. In crop year 1986-87, the mean government's share of rail costs under this scenario is the same as that under the bench.

In crop year 1990-91, the government's share averages $52.4 million over that under the bench case. This increase is due to a substantial increase in the government's cumulative share of cost changes and to the existence of adjustments from the safety net feature (which did not occur under the bench simulation).

In 1995-96, the average government's share of railway costs exceeds that under the bench by $333.7 million. This increase is primarily the result of additional contributions through the inflation protection and

TABLE 4.4

Comparison of Type and Level of Government Payments Under Scenario 2 With Those Under the Bench Scenario

| Crop Year | Mean Government's Share (million $) Bench | Scenario 2 | Change | Crow Benefit (million $) All scenarios | Cum. Govt. Share of Cost Changes (million $) Bench | Scenario 2 |
|---|---|---|---|---|---|---|
| 1986-87 | 716.5 | 716.5 | 0 | 658.6 | 68.3 | 68.3 |
| 1990-91 | 725.6 | 778.0 | 52.4 | 658.6 | 72.5 | 119.9 |
| 1995-96 | 751.6 | 1085.3 | 333.7 | 658.6 | 77.8 | 266.9 |
| 2000-01 | 769.6 | 1549.7 | 780.1 | 658.6 | 83.0 | 540.0 |

Shipper Share Limitation Adjustment

| Crop Year | Bench Probability of Adjustment | Bench Mean Level of Adjustment (million $) | Scenario 2 Probability of Adjustment | Scenario 2 Mean Level of Adjustment (million $) |
|---|---|---|---|---|
| 1986-87 | 0.000 | 0 | 0.000 | 0 |
| 1990-91 | 0.000 | 0 | 0.145 | 3.8 |
| 1995-96 | 0.310 | 21.7 | 0.875 | 167.0 |
| 2000-01 | 0.290 | 41.6 | 0.915 | 364.2 |

safety net features of the Act. The cumulative government's share of cost changes in this scenario exceeds that under the bench by almost \$190 million, and the likelihood of a shipper share limitation adjustment is .875, with a mean adjustment level of \$167.0 million.

In 2000-01, the mean government's share under this scenario is greater than that under the bench case by \$780.1 million. Again this is the result of increased government payments through the inflation protection measure and through the safety net mechanism. Shipper share limitation adjustments from the 1999 calendar year occur with a probability of .915, while under the bench run a probability of .29 existed.

Table 4.5 compares the mean values of the shippers' share of rail

TABLE 4.5

Comparison of the Financial Obligations of Grain Shippers Under Scenario 2 With Those Under the Bench Scenario

| Crop Year | Mean Shippers' Share (million $) | | |
|---|---|---|---|
| | Bench | Scenario 2 | Change |
| 1986-87 | 306.5 | 306.5 | 0 |
| 1990-91 | 497.3 | 647.9 | 150.1 |
| 1995-96 | 810.3 | 1118.7 | 308.4 |
| 2000-01 | 1245.0 | 1887.5 | 642.5 |

costs under scenario 2 with those under the bench case. In 1986-87, the grain shippers' mean share of rail costs is the same under the two scenarios. In 1990-91, 1995-96 and 2000-01, shippers continue to be responsible for the maximum 6 percent of the resulting rail cost increases. Under the bench scenario, shipper contributions to cost increases are well below the maximum share (around 3 percent). Therefore, the average shippers' share under this scenario exceeds that under the bench by $150.1 million in 1990-91, $308.4 million in 1995-96, and by $642.5 million in 2000-01.

4.3.1.2 Freight Rates

Table 4.6 compares the mean government freight rate, mean shipper freight rate and overall freight rate under scenario 2 with those generated under the bench scenario. For any particular year, the sum of the changes in the mean government freight rate and mean shipper freight rate equals the change in the overall freight rate railways collect (rounding errors can alter this slighlty). In 1986-87, the federal government's freight rate is the same as that under the bench scenario. In 1990-91, shippers pick up a greater portion of the freight rate increase. The mean rate shippers pay increases by $4.22 per tonne relative to the mean shipper rate under the bench, while the mean government freight rate under this scenario exceeds that under the bench by $1.47 per tonne. In 1995-96 and 2000-01, the federal government is responsible for a greater share of the overall freight rate increase. The mean government freight rate in 1995-96 is $8.73 per tonne higher than the bench and the mean shipper rate is $8.06 per tonne higher. In the final forecast year, the average rate government pays on each tonne of grain shipped exceeds that under the bench case by $19.12 per tonne, and the mean shipper rate exceeds that under the bench by $15.75 per tonne.

TABLE 4.6

Comparison of Freight Rates Under Scenario 2 With Those Under the Bench Scenario

| Crop Year | Mean Government Freight Rate ($/tonne) Bench | Scenario 2 | Change | Mean Shipper Freight Rate ($/tonne) Bench | Scenario 2 | Change |
|---|---|---|---|---|---|---|
| 1986-87 | 21.34 | 21.34 | 0 | 9.13 | 9.13 | 0 |
| 1990-91 | 20.35 | 21.82 | 1.47 | 13.96 | 18.18 | 4.22 |
| 1995-96 | 19.66 | 28.39 | 8.73 | 21.20 | 29.26 | 8.06 |
| 2000-01 | 18.86 | 37.98 | 19.12 | 30.51 | 46.26 | 15.75 |

| Crop Year | Overall Freight Rate ($/tonne) Bench | Scenario 2 | Change |
|---|---|---|---|
| 1986-87 | 30.46 | 30.46 | 0 |
| 1990-91 | 34.32 | 40.00 | 5.68 |
| 1995-96 | 40.86 | 57.66 | 16.80 |
| 2000-01 | 49.37 | 84.23 | 34.86 |

### 4.3.2 Scenario 3

If the probability distributions of the Canada - United States exchange rates take on a pattern of decline, the Canadian dollar increases in value relative to its American counterpart. Since the model continues to establish wheat prices in U.S. markets, Canadian wheat prices will decrease with the appreciation of the Canadian dollar. Because other Canadian grain prices are tied to the price of wheat in terms of historic relationships, the basket price of grain in Canada declines. Thus, shipper share limitation adjustments will be triggered earlier, more frequently and of a slightly greater amount than what occurred under the bench scenario.

Government contributions through the inflation protection feature are identical to those under the bench because estimated railway costs do not change. As well, the tally system will behave in the manner as under the bench case as the forecasting and shipment determination procedures have not changed. Thus, the only component of the government's share which is altered under a scenario of an appreciating Canadian dollar is the shipper share limitation adjustment.

In early crop years, the probability distributions of the apportionment of costs between government and producers and their respective freight rates follow those under the bench scenario because shipper share limitation adjustments do not occur. However, in later years, the government's share of rail costs is slightly higher relative to the bench run, while the shippers' share is slightly lower. Because it is simply the sharing of the estimated eligible rail costs which is affected, the changes in the government's and shippers' shares are equal.

It should be acknowledged that the variance associated with both the government's share of rail costs and the shippers' share of rail costs will be greater under this scenario than under the bench case. This is because of the greater frequency of shipper share limitation.

#### 4.3.2.1 Financial Obligations of the Federal Government and Grain Shippers

Table 4.7 illustrates the comparison of shipper share limitation adjustments and the apportionment of railway costs between government and

TABLE 4.7

Comparison of the Financial Obligations of the Federal Government and Grain Shippers Under Scenario 3 With those Under the Bench Scenario

Shipper Share Limitation Adjustment

| Crop Year | Bench: Probability of Adjustment | Bench: Mean Level of Adjustment (million $) | Scenario 3: Probability of Adjustment | Scenario 3: Mean Level of Adjustment (million $) |
|---|---|---|---|---|
| 1986-87 | 0.000 | 0 | 0.000 | 0 |
| 1990-91 | 0.000 | 0 | 0.015 | .1 |
| 1995-97 | 0.310 | 21.7 | 0.585 | 51.6 |
| 2000-01 | 0.290 | 41.6 | 0.575 | 111.8 |

| Crop Year | Mean Government's Share (million $) | | | Mean Shippers' Share (million $) | | |
|---|---|---|---|---|---|---|
| | Bench | Scenario 3 | Change | Bench | Scenario 3 | Change |
| 1986-87 | 716.5 | 716.5 | 0 | 306.5 | 306.5 | 0 |
| 1990-91 | 725.6 | 725.7 | 0.1 | 497.8 | 487.6 | -0.2 |
| 1995-96 | 751.6 | 781.3 | 29.7 | 810.3 | 780.6 | -29.7 |
| 2000-01 | 769.6 | 839.8 | 70.2 | 1245.0 | 1174.8 | -70.2 |

grain shippers under scenario 3 with those under the bench case. Under this scenario, no shipper share limitaion adjustments result in 1986-87 as is the case under the bench scenario. However, in 1990-91, a small probability (.015) exists regarding the activation of the safety net feature. The mean value of the adjustment is $.1 million. In 1995-96, the likelihood of an adjustment increases substantially to greater than twice that under the bench case. The probability under this scenario of an adjustment is .585, with a mean adjustment level of $51.6 million.

In 2000-01, the probability of an adjustment is almost twice that under the bench. A probability of .575 exists that an adjustment will occur, with a mean adjustment level of $111.8 million.

The apportionment of rail costs between government and producers in 1986-87 is the same under scenario 3 as it is under the bench scenario. In 1990-91, the existence of shipper share limitation adjustments under scenario 3 increases the mean government financial obligation by $.1 million, while shipper obligations decline by this amount. In 1995-96, the mean government's share increases by $29.7 million from the bench run, while the shippers' share decreases by this amount. In the final year of simulation, the cost sharing changes by $70.2 million; the mean government's share increases by this amount and the mean shipper's share decreases.

#### 4.3.2.2 Freight Rates

Table 4.8 outlines the mean freight rates paid by government and shippers under scenario 3 and the bench scenario. The overall freight rate railways collect is not included in the table because it does not change from that under the bench case. Under this scenario of a strenghtening Canadian dollar, the mean freight rates for both government and producers in 1986-87 exhibit no change from the bench scenario. In 1990-91, the mean government freight rate shows a $.1 per tonne increase over the bench case due to the possibility of a shipper share limitation adjustment, although the mean shipper rate shows no change. In 1995-96, the apportionment of costs differs by about $.78 per tonne from the bench case. In 2000-01, the mean freight rate government pays exceeds that

TABLE 4.8

Comparison of Freight Rates Under Scenario 3 With Those Under the Bench Scenario

| Crop Year | Mean Government Freight Rate ($/tonne) Bench | Scenario 3 | Change | Mean Shipper Freight Rate ($/tonne) Bench | Scenario 3 | Change |
|---|---|---|---|---|---|---|
| 1986-87 | 21.34 | 21.34 | 0.00 | 9.13 | 9.13 | 0.00 |
| 1990-91 | 20.35 | 20.36 | 0.01 | 13.96 | 13.96 | 0.00 |
| 1995-96 | 19.66 | 20.44 | 0.78 | 21.20 | 20.42 | -0.78 |
| 2000-01 | 18.86 | 20.58 | 1.72 | 30.51 | 28.79 | -1.72 |

under the bench run by $1.72 per tonne, while the mean shipper freight rate is $1.72 per tonne less than that under the bench.

4.3.3 Scenario 4

This scenario involves changing the method of payment to a "pay the producer" approach through the establishment of the GTR. The economic status quo is maintained and it is assumed that estimated rail costs and grain shipment projections will be identical to those under the bench case. Thus, the freight rate producers pay under this structure is equal to the overall freight rate of the bench scenario. No within-year variability is associated with this rate. However, variation does arise with respect to the determination of the overall financial responsibilty of grain shippers as their total costs are dependent upon actual volumes of grain shipped (which are randomly generated by the model).

Within-year variation also arises in computing the level of funds the federal government will contribute to the GTR. No tally system exists and the Crow Benefit and contributions through the inflation protection component are constant and identical to those under the bench case. Therefore, the differential variation in the level of payments by the government to the GTR is due solely to the safety net feature of the Act. Funds in the GTR are paid directly to individual producers on the basis of net sales of eligible grains. Thus, the net cost to grain shippers (as a group) after the refund possesses a combination of the variance associated with actual grain shipments and of the variance related to government contributions to the GTR. The net freight cost to shippers on a per tonne basis will also be subject to these within-year variations.

Under this scenario, the financial obligations of the federal government and grain shippers will be evaluated in terms of government contributions to the GTR (type and level), the gross cost to shippers of hauling grain by rail and the net cost to shippers after the refund. Freight rates will be evaluated in terms of the full rate shippers pay, and the net freight rate shippers have actually paid after the refund.

#### 4.3.3.1 Financial Obligations of the Federal Government and Grain Shippers

Probability distributions depicting the government contribution to the GTR in 1990-91 and 2000-01 are presented in Figure 4.13. Figure 4.14 illustrates the probability distributions for 1990-91 and 2000-01 of adjustments due to the safety net feature under the changed method of payment. In 1986-87, the federal government contributes $716.5 million to

FIGURE 4.13: Probability Distributions of Government Contributions to the GTR

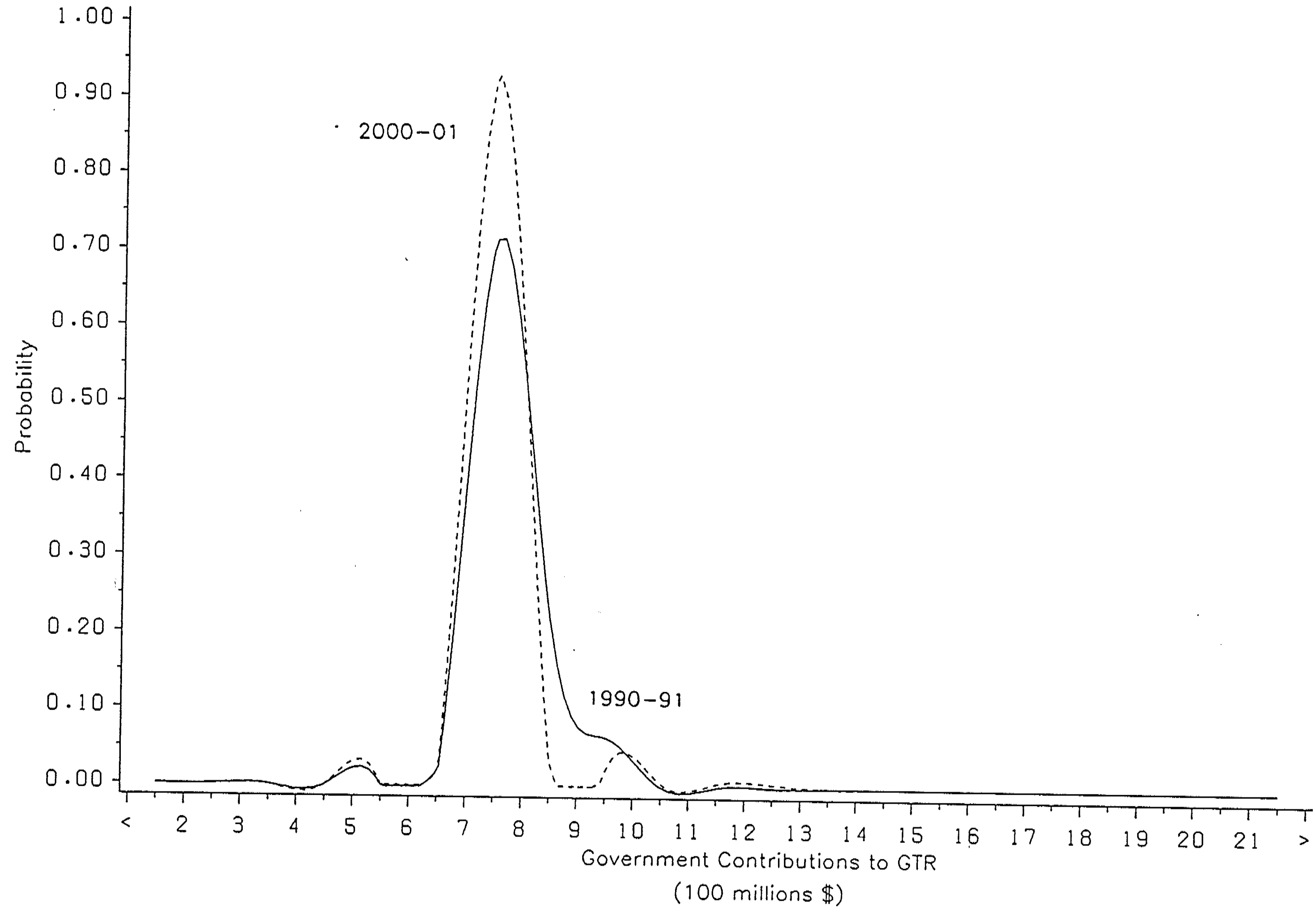
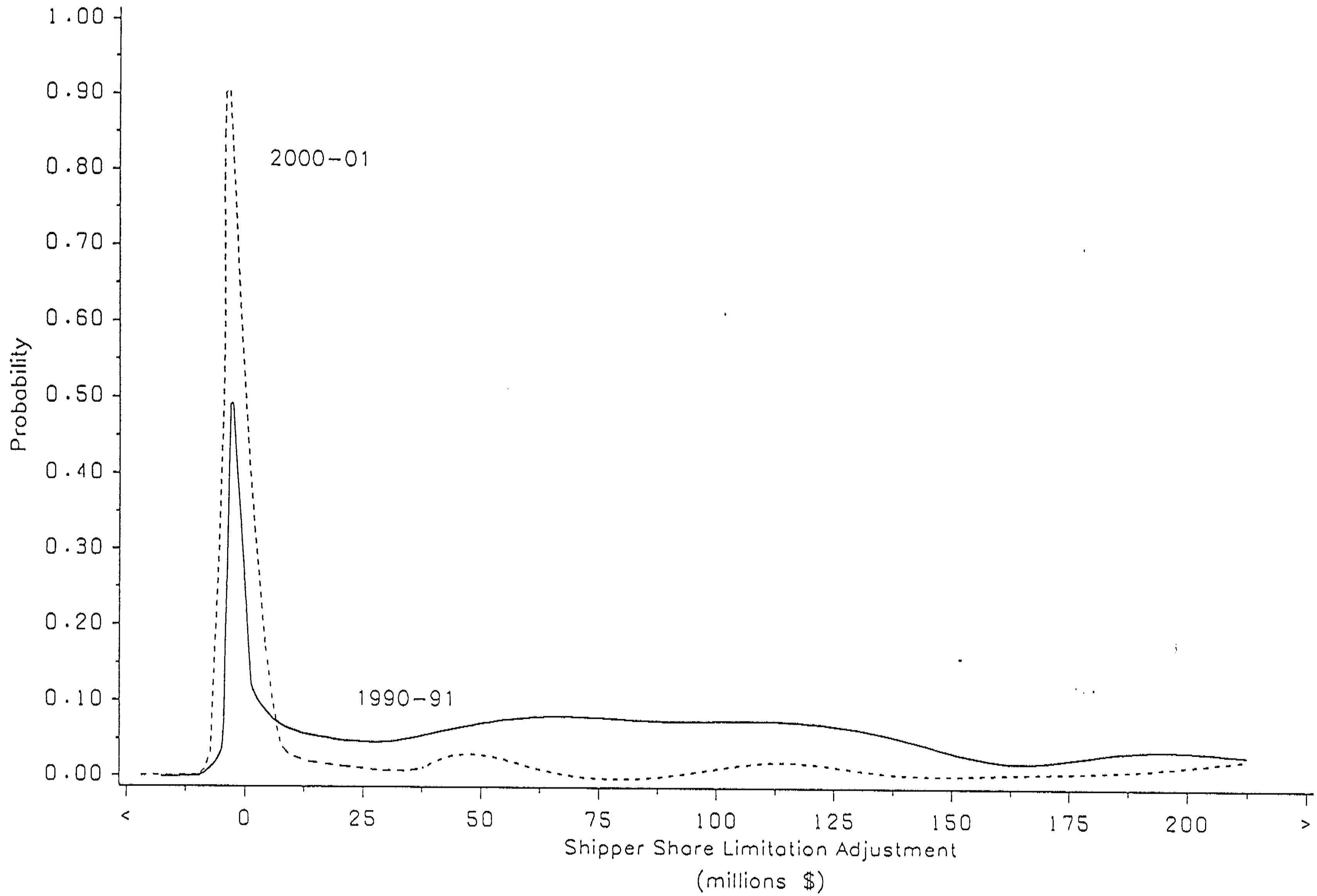


FIGURE 4.14: Probability Distributions of Shipper Share Limitation Adjustment



the GTR. No shipper share limitation adjustments occur and therefore, there is no variablity associated with the government's commitment.

In 1990-91, government payments range from $692.9 million to $959.7 million, with mean $768.8 million and variance 4045.8. The highest probability (.715) is associated with a range of $700 to $800 million. The probability of a shipper share limitation adjustment is .525. Adjustments range from $0 to $239 million, with a mean of $47.7 million and variance 4045.8. If an adjustment occurs, the most likely level is that from $0 to $25 million (probability equal to .10).

In 1995-96, government contributions range from $726.3 million to $1208.1 million, with an average contribution of $781.3 million and variance 8343.3. The highest probability (.72) is related to a range of $700 to $800 million. Adjustments due to the safety net feature occur with a likelihood of .39 and reach a maximum of $482 million. The mean adjustment level is $55.0 million and the variance associated with these adjustments is 8343.3. The probabilities of any particular range of adjustments are relatively evenly distributed.

In the final year of the simulation, the government's financial obligation to the GTR ranges from $731.6 million to $1183.2 million, with mean $747.0 million and variance 3941.3. The highest probability (.93) is linked to a range of $700 to $800 million. The likelihood of a shipper share limitation adjustment is .10. The maximum adjustment level is $492 million, the mean is $15.4 million, and the variance is 3941.3. All levels of adjustment up to the maximum have a relatively equal and very small probability of occurring.

It should be noted that the general appearance of the probability distributions depicting the financial obligations of the federal government are similar to those generated under the bench scenario with respect to skewness tendencies. Under both scenarios, these distributions are heavily skewed to the left. However, the trends related to the variance of these distributions differ substantially between the two scenarios. Under the bench scenario, the variance associated with the distributions reflecting the government's share of costs increases with time as additional rate-determining factors come into play. Under this scenario, the variance related to government payments to the GTR is dependent only on shipper share limitation adjustments and exhibits a pattern of increase in early crop years and decrease in later years.

Table 4.9 compares the probabilities and mean adjustment levels of shipper share limitation adjustments under this scenario with those under the bench case. Also included in the table is a comparison of the mean values of the government's financial obligations under this method of payment with those resulting under the bench. In 1986-87, the safety net feature is not activated under either scenario. In 1990-91, there is a substantial probability of an adjustment in the scenario involving a "pay the producer" method of payment, while there is no likelihood of an adjustment under the bench case. In 1995-96, both the chance of and level of an adjustment under the "pay the producer" scheme is greater relative to the bench scenario. In 2000-01, the likelihood of and adjustment under this scenario is small and much less than that under the bench run. As well, the mean adjustment level is smaller relative to the bench case.

TABLE 4.9

Comparison of Type and Level of Government Payments Under Scenario 4 With Those Under the Bench Scenario

Shipper Share Limitation Adjustment

| | Bench | | Scenario 4 | |
|---|---|---|---|---|
| Crop Year | Probability of Adjustment | Mean Level of Adjustment (million $) | Probability of Adjustment | Mean Level of Adjustment (million $) |
| 1986-87 | 0.000 | 0 | 0.000 | 0 |
| 1990-91 | 0.000 | 0 | 0.525 | 47.7 |
| 1995-96 | 0.310 | 21.7 | 0.390 | 55.0 |
| 2000-01 | 0.290 | 41.6 | 0.100 | 15.4 |

| | Mean Government Financial Obligation (million $) | | |
|---|---|---|---|
| Crop Year | Bench | Scenario 4 | Change |
| 1986-87 | 716.5 | 716.5 | 0.0 |
| 1990-91 | 725.6 | 768.8 | 43.2 |
| 1995-96 | 751.6 | 781.3 | 29.7 |
| 2000-01 | 769.6 | 747.0 | -22.6 |

In 1986-87, the government financial obligation under this method of payment is fixed and equal to the mean value of the government's share of rail costs under the bench scenario. In 1990-91 and 1995-96, the mean government payment to the GTR exceeds the mean government's share of rail costs under the bench case by $43.2 million and $29.7 million respectively. In the final forecast period, the average financial obligation of the federal government under this scenario is $22.6 million less than that under the bench.

Figure 4.15 presents the probability distributions reflecting the gross cost to producers of hauling grain by rail for crop years 1990-91 and 2000-01. These costs are determined by multiplying the shipper freight rate by actual (randomly generated) grain shipments. Figure 4.16 presents the probability distributions depicting the net cost to shippers after receiving payments from the GTR diluted by a factor of 15 percent (graphed for these same crop years). In 1986-87, the gross cost to shippers ranges from $551.0 million to $1233.4 million, with a mean of $1031.3 million and variance 30425.3. The most probable cost range is $1100 to $1200 million (probability equal to .24). The net cost to shippers ranges from $203.7 million to $455.9 million with mean $381.2 million and variance 4157.5. The highest probability (.465) is linked to the cost range $400 to $500 million, and the second highest probability (equal to .43) is associated with the range about the mean.

In 1990-91, the gross cost to producers ranges from $733.5 million to $1480.9 million, with mean $1224.8 million and variance 33432.1. The most likely cost range is that from $1300 to $1400 million, with a probability equal to .265. After payments from the GTR, the net cost to shippers ranges from $306.4 million to $673.3 million, with an average net cost of $530.6 million and variance 8378.5. The highest probability (.39) is associated with the range about the mean.

In 1995-96, gross shipping costs to producers ranges from $992.5 million to $1816.0 million, with mean $1547.2 million and variance 40413.4. The maximum likelihood of net shipping costs is associated with the range of $1700 to $1800 million (probability equal to .30). Net shipping costs range from $428.0 million to $105539 million, with an average

FIGURE 4.15: Probability Distributions of the Gross Cost to Shippers

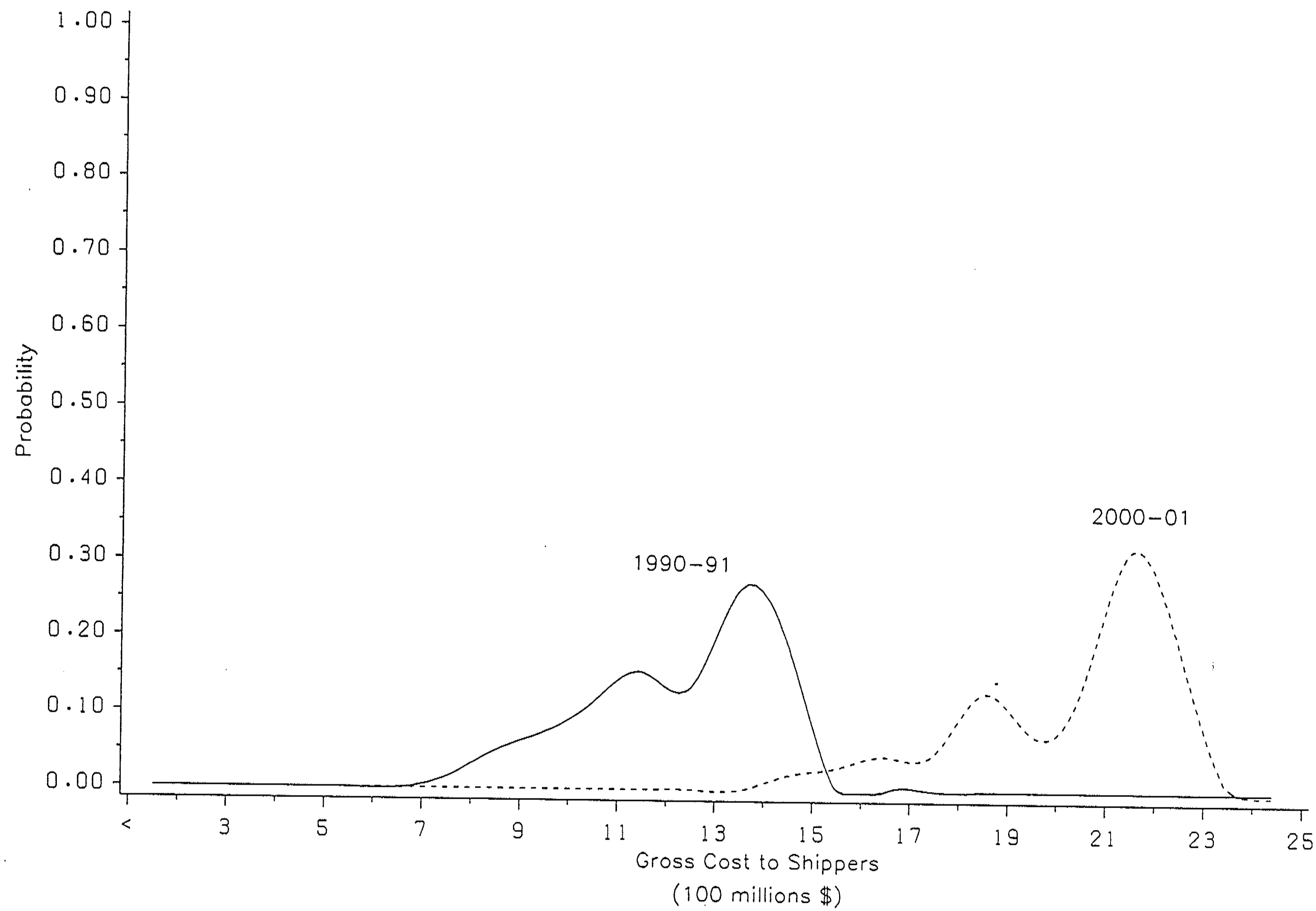
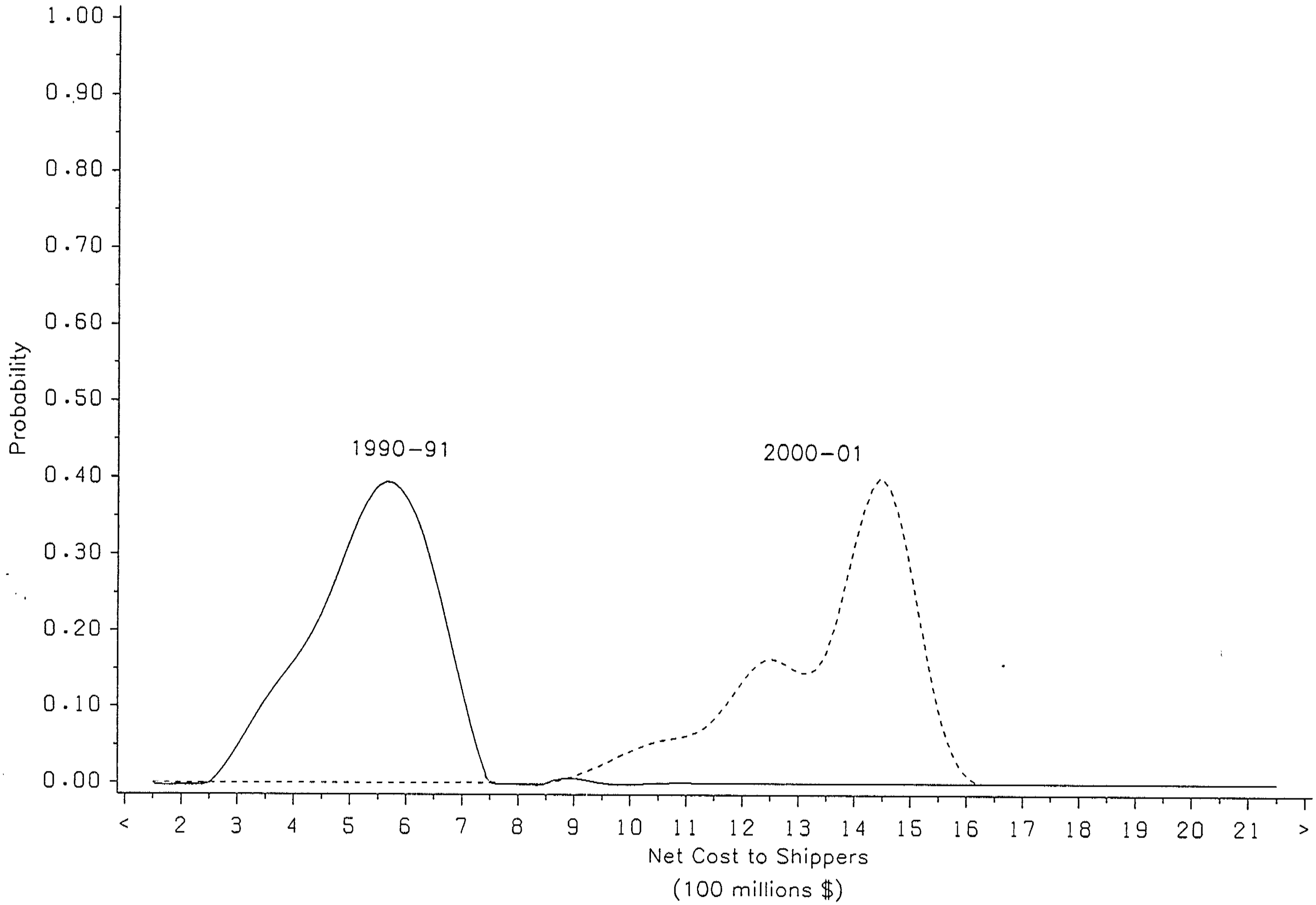


FIGURE 4.16: Probability Distributions of the Net Cost to Shippers



net cost of $850.7 million and variance 19174.2. The most probable cost range is $800 to $900 million, with a probability of .285.

In the final year of analysis, the minimum gross cost is $1411.9 million, the maximum is $2311.2 million, the mean value is $2026.3 million and the variance related to this cost distribution is 43221.8. The highest probability (.515) is associated with the cost range about the mean. Net shipping costs range from $940.5 million to $1555.8 million, with mean $1349.6 and variance 21527.6. The most likely cost range is $1400 to $1500, with a probability of .40.

The general skewness patterns of the probability distributions reflecting the financial responsibilities of shippers correspond to the distributions reflecting the shippers share of rail costs under the bench scenario. Both sets of distributions are substantially skewed to the right. However, the variances of the distributions under the two scenarios differ significantly. Under the bench case, the variance associated with the shippers' share of costs increases through time and is tied to all rate-determining components. Under scenario 4, the variance associated with the gross cost to shippers decreases through time and is related only to the variance associated with actual grain shipments. The variance associated with the net cost to shippers fluctuates throughout the simulation as it is dependent upon the variablity of both shipper share limitation adjustments and randomly generated actual grain shipments

Table 4.10 illustrates a comparison of the financial obligations of grain shippers under the two methods of payment based on the economic

TABLE 4.10

Comparison of the Financial Obligations of Grain Shippers Under Scenario 4 With Those Under the Bench Scenario

| Crop Year | Bench Scenario Mean Shippers' Share of Rail Costs (million $) | Mean Gross Cost to Shippers (million $) | Scenario 4 Mean Shipper Refund (dilution=10%) (million $) | Mean Net Cost to Shippers (million $) |
|---|---|---|---|---|
| 1986-87 | 306.5 | 1031.3 | 650.1 | 381.2 |
| 1990-91 | 497.8 | 1224.8 | 694.2 | 530.6 |
| 1995-96 | 810.3 | 1547.2 | 696.5 | 850.7 |
| 2000-01 | 1245.0 | 2026.3 | 676.7 | 1349.6 |

status quo. In general, grain shippers will pay more to ship their grain by rail under a method of payment whereby the Crow subsidy is paid directly to producers through the establishment of a GTR. Under this method of payment, a dilution of the rebate results in a higher net shipping cost to producers relative to what occurs under the present method of payment.

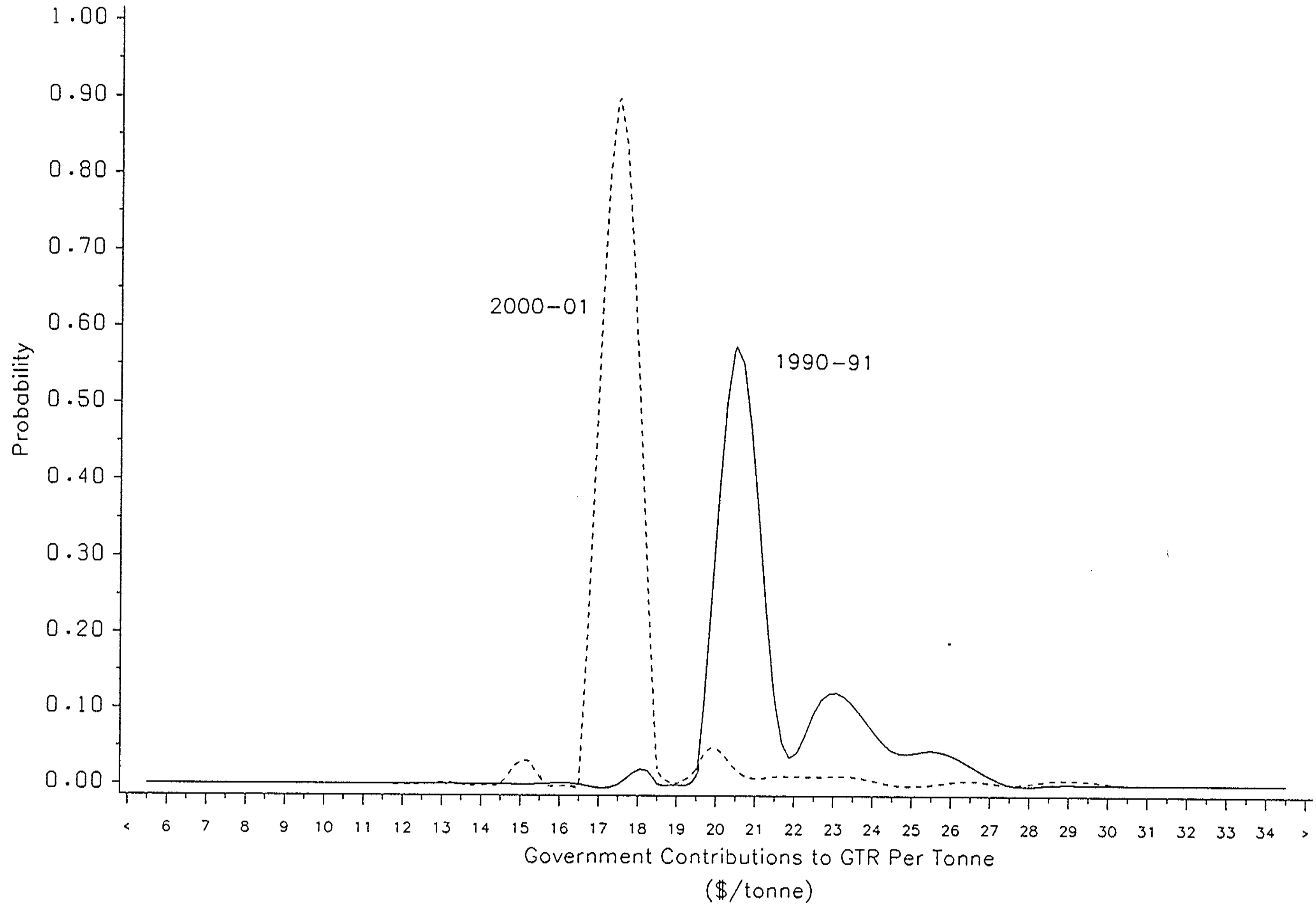
However, because of the expansion of the prairie livestock industry under the GTR approach, additional grain is fed on the prairies. Interpolating Agriculture Canada's 1984 forecast of the increase in prairie livestock output and applying current feed use (see section 3.2.4), the additional grain consumed in Western Canada as livestock feed can be estimated. Thus, additional grain to be fed on the prairies is .36 million tonnes in 1986-87, .84 million tonnes in 1990-91, and 1.4 million tonnes in 1995-96 and 2000-01. In consequence, on-farm grain inventories are reduced, which in turn reduces the costs to producers of storing grain. The interests costs on the value of grain no longer stored reflect the savings in storage costs. Using the weighted average grain prices generated in the simulation, and assuming a real interest rate of 8 percent, the reduction in inventory costs is $4.4 million (.36 million tonnes x $154/t x .08) in 1986-87, $11.3 million in 1990-91, $26.0 million in 1995-96 and $35.0 million in 2000-01.

Although these savings help to offset shipping costs, producers pay more to ship grain under a payment structure whereby the subsidy is paid directly through the GTR. In crop year 1986-87, producers' costs increase by $70.3 as a direct result of a change in the method of payment (after accounting for savings in storage costs). In 1990-91, shipping costs increase by $21.5 million. In 1995-96, costs under this scenario exceed those under the bench by $14.4 million and in the final forecast period, shippers' financial obligations increase by $69.6 million.

#### 4.3.3.2 Freight Rates

The probability distributions of the "freight rates" paid by the government in the form of contributions to the GTR on a per tonne basis for the years 1986-87 and 2000-01 are shown in Figure 4.17. In 1986-87, the government has paid $21.34 per tonne into the GTR. In 1990-91, the government contributions per tonne to the GTR ranges from $20.23 to $26.92 per tonne, with mean $21.57 and variance 3.2. The most probable range is $20 to $21 per tonne (probability equal to .575). In 1995-96, the government "freight rate" covers a range of $19.00 per tonne to $30.81

FIGURE 4.17: Probability Distributions of Government Contributions to GTR On a Per Tonne Basis



per tonne, with an average of $20.43 per tonne and variance 5.7. The highest probability (.67) is related to the range just before the mean, $19 to $20 per tonne. In 2000-01, the freight rate the government has paid into the GTR extends over the range of $17.93 per tonne to $29.99 per tonne, with mean $18.31 per tonne and variance 2.4. The most likely rate range is $17 to $18 per tonne with a probability equal to .90.

Table 4.12 illustrates a comparison of the government contributions on a per tonne basis to the GTR under this scenario with the government

TABLE 4.11

Comparison of Government "Freight Rates" Under Scenario 4 With Those Under the Bench Scenario

| Crop Year | Bench Scenario Mean Government Freight Rate ($/tonne) | Scenario 4 Mean Government "Freight Rate" ($/tonne) | Change |
|---|---|---|---|
| 1986-87 | 21.34 | 21.34 | 0.00 |
| 1990-91 | 20.35 | 21.57 | 1.22 |
| 1995-96 | 19.66 | 20.43 | 0.77 |
| 2000-01 | 18.86 | 18.31 | -0.55 |

freight rate generated under the bench run. Under this GTR form of the "pay the producer" approach, the government's contributions to the Fund on a per tonne basis are higher than the freight rates they pay under the current rate structure except under the final years of analysis (in 1999-2000 and 2000-01). This is the result of different safety net percentages under the two methods of payment.

The full freight rate which producers pay under this scenario is identical to the overall freight rate generated under the bench scenario (see Table 4.1, column 20). No within-year variation exists with respect to this rate. However, after receiving compensatory payments from the GTR, the net freight rate shippers have paid does possess within-year variation. Figure 4.18 graphically illustrates the probability distributions depiciting the net shipper freight rate for crop years 1990-91 and 2000-01. In 1986-87, the net freight rate shippers have paid is \$11.24 per tonne. No variability is incorporated into this figure because government contributions to the GTR are fixed for this particular crop year (no shipper share limitation adjustments). In 1990-91, the net shipper freight rate ranges from \$10.09 per tonne to \$16.11 per tonne, with mean \$14.91 and variance 2.6. The most probable range is \$16 to \$17 per tonne (probability equal to .495). In 1995-96, the net shipper freight rate covers a range of \$12.42 per tonne to \$23.76 per tonne, with an average of \$22.46 per tonne and variance 4.6. The highest probability (.665) is related to the range about the mean, \$23 to \$24 per tonne. In 2000-01, the net freight rate shippers have paid extends over the range of \$22.38 per tonne to \$33.23 per tonne, with mean \$32.90 per tonne and variance 1.9. The most likely rate range is \$33 to \$34 per tonne with a probability equal to .905.

The variance associated with the net shipper freight rate fluctuates throughout the simulation period in a manner corresponding to the variance of the net freight cost to grain shippers (in total dollars).

Table 4.11 illustrates a comparison of the net shipper freight rates under this scenario with the shipper freight rate generated under the

FIGURE 4.18: Probability Distributions of the Net Cost to Shippers Per Tonne

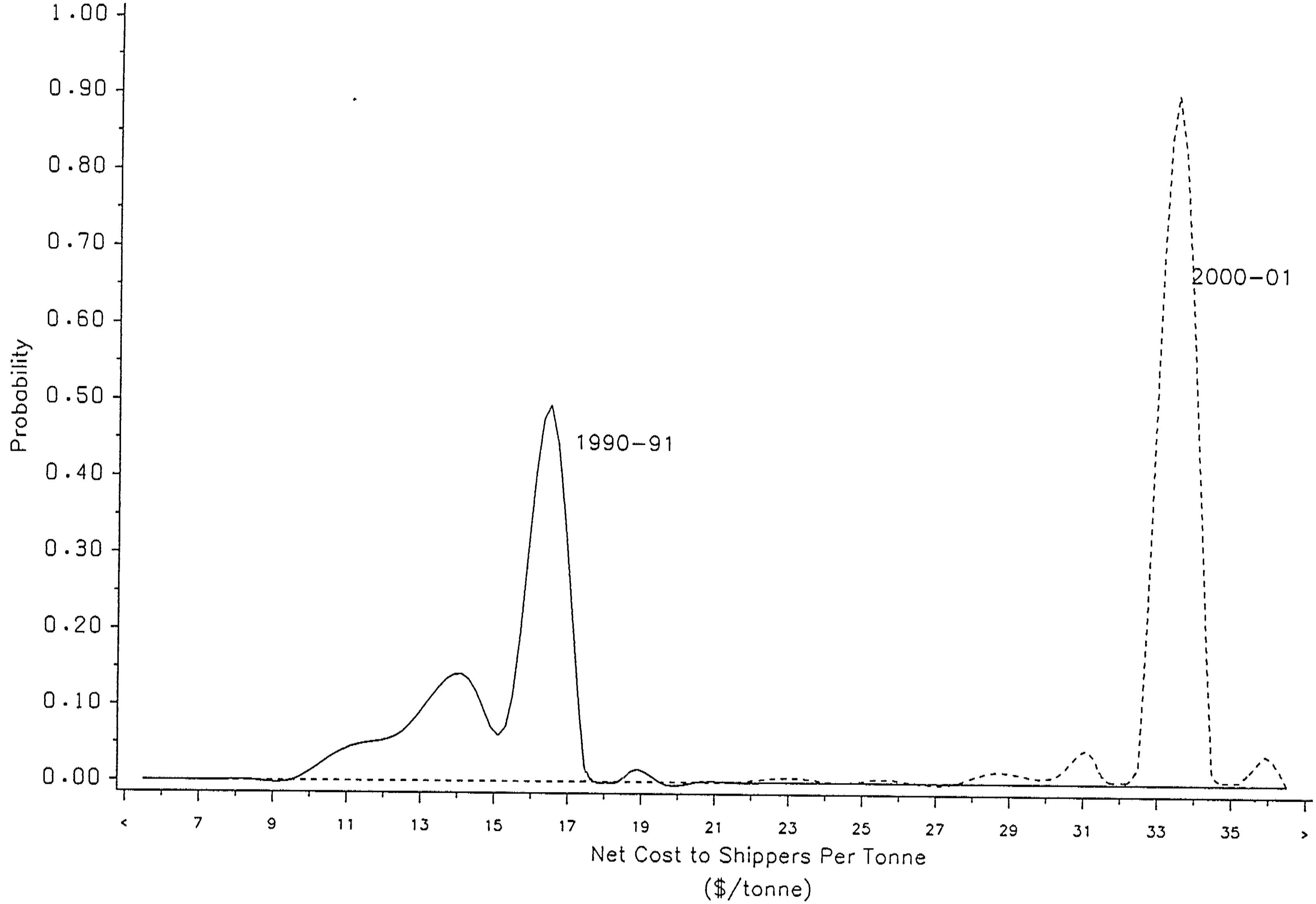


TABLE 4.12

Comparison of Shipper Freight Rates Under Scenario 4 With Those Under the Bench Scenario

| Crop Year | Bench Scenario Mean Shipper Freight Rate ($/tonne) | Scenario 4 Mean Net Shipper Freight Rate ($/tonne) | Change |
|---|---|---|---|
| 1986-87 | 9.13 | 11.26 | 2.16 |
| 1990-91 | 13.96 | 14.91 | 0.95 |
| 1995-96 | 21.20 | 22.46 | 1.26 |
| 2000-01 | 30.51 | 32.90 | 2.39 |

bench run. Under a "pay the producer" approach, grain shippers pay the full freight rate to ship their grain to ports of export. Even after compensation, their net shipping costs on a per tonne basis exceed the shared rate they pay under a "pay the railways" method of payment. The actual shipper freight rate under this scenario increases by $2.16 per tonne in 1986-87, $0.95 per tonne in 1990-91, $1.46 per tonne in 1995-96, and by $2.39 per tonne in 2000-01 relative to the bench case.

## 4.4 STABILITY OF DISTRIBUTIONS

To obtain stable probability distributions, a specific number of trials must be performed such that the resulting distributions are not statistically different from what is expected. The probability distributions of the three stochastic input variables (U.S. export wheat price, Canada - United States exchange rate and potential grain shipments) proved to be statistically stable when each twenty-year simulation (one trial) was replicated two hundred times. A chi-sqiuare test for uniformity was used to test if the cell frequencies generated under the observed two hundred repetitions differed from the expected frequencies generated under one thousand repetions. It was assumed that one thousand replications would represent the uniform expected results.

However, a test for uniformity could not be applied to the results of the study (in terms of testing for the stability of the distributions depicting the payment responsibilities of shippers and government). To accomplish this, the entire model would require one thousand repetions for each year of the analytical period. Although this was attempted, the simulation-run using one thousand replications was constrained by input/ouput counts and memory capacities of the university's mainframe computer system. The expected cell frequencies associated with the financial obligations of government and shippers which would result from one thousand replications of the model could not be determined. Therefore, because the randomly generated input variables were stable at two hundred replications, it was assumed that the distributions of the output variables were also stable.

# Chapter V

## SUMMARY AND CONCLUSIONS

The sophistication of the rate-setting cycle as defined in the Western Grain Transportation Act and the uncertainty of future economic events give rise to the uncertainty of the financial obligations of both the federal government and grain shippers with respect to the costs of shipping grain by rail. Uncertainty is compounded further by speculation that a "pay the producer" scheme may replace the current method of direct payments to the railways.

The general objective of this study was to evaluate how the freight rates legislated in the WGTA influence the type and level of payments from shippers and government. This objective was accomplished by first developing a model to simulate the range of future payment responsibilities of shippers and government in terms of hypothetical probability distributions. The model was then used to determine the effects of various economic events and structural change on these future financial obligations. Economic events examined were a bench case reflecting the economic status quo, an increase in railway costs, and a decrease in the Canada - United States currency exchange rate (which results in a drop in Canadian grain prices). The two rate structures examined were a bench case depicting the current method of payment of the Crow subsidy and an alternate case involving a change in the method of payment to a "pay the producer" approach based on net sales of eligible grains.

The model simulated twenty crop reporting years, from 1981-82 to 2000-01 (with actual events overriding the random nature of the simulation for crop years to 1986-87). Each twenty year sequence, considered to be one trial, was replicated two hundred times to achieve a stable distribution of possible outcomes. In order to satisfy the general objective, the model produces probability distributions for the financial obligations of the federal government including contributions through the inflation protection and safety net features and adjustments resulting from the tally system; the financial obligations of grain shippers; the government freight rate; the shipper freight rate; and the annual tally adjustment. As well, the model produces distributions for each stochastically based element of the rate-determining process: the weighted average grain price in Canada based on a randomly generated U.S. wheat price and Canada - U.S. exchange rate; actual grain shipments of statutory grains by rail; and the forecast of grain volumes to be shipped. This Monte Carlo process of sampling from several probability distributions allowed the model to simulate a range of possible outcomes within a given structure.

Four scenarios based on the economic and structural conditions mentioned previously were analyzed. The first scenario depicted the bench case (the current method of payment under the current economic situation). Scenario 2 increased railway costs under the current rate structure. Scenario 3 differed from the bench case by introducing an appreciating Canadian dollar relative to U.S. currency. Scenario 4 altered the method of payment to a "pay the producer" option and utilized the economic status quo. The results of these scenarios in terms of the payment responsibilities of the federal government and grain shippers were analyzed and compared using four specific crop years - 1986-87, 1990-91, 1995-96, and 2000-01.

## 5.1 SUMMARY OF RESULTS

The results indicate that under the economic and structural conditions assumed in the bench scenario, the total freight rates for grain will rise to an expected level of $49.37 per tonne by 2000-01. Throughout the simulation period, the financial obligations of both shippers and government increase. The expected freight rates paid by shippers also increase to an average of $30.51 per tonne by 2000-01 (62% of the total freight bill). However, because forecast volumes of grain are increasing and because the government's absolute payment responsibilities are only increasing slightly, the average freight rates paid by the government decrease over time. By 2000-01, the average government freight rate is expected to be $18.86 per tonne.

If projected railway cost inflation doubles to 8 percent per year (scenario 2), grain freight rates are projected to increase to $84.24 per tonne by 2000-01. Total financial commitments and freight rates increase throughout the simulation for both shippers and government. By 2000-01, shippers pay an expected rate of $46.26 per tonne (55% of the total rate) and the government freight rate averages $37.98 per tonne. Relative to the bench case, shippers rates have risen as they are now liable for the maximum 6% inflationary cost increases. Government rates have increased due to greater contributions through the inflation protection measure and more frequent and larger adjustments resulting from the safety net feature.

If the Canada - United States exchange rates become comparable (scenario 3), Canadian grain prices drop. This does not impact the total grain freight rate, but affects the respective shares of shippers and government. The reduction in grain prices in Canada causes shippers to receive greater financial assistance through the safety net feature, thus reducing their share of the rate. Although the payment obligations of producers and the freight rates they pay increase throughout the period under analysis, the average shipper rate is only $28.79 per tonne by 2000-01 (or 58% of the total $49.37 per tonne grain freight charge). Due to increased requirements of shipper share limitation adjustments, the financial obligations of the federal government are higher relative to the bench case. Consequently, the average freight rates paid by the government increase throughout the simulation time frame. By 2000-01, the expected government freight rate will be aprroximately $20.58 per tonne.

Should a change in the method of payment occur (scenario 4 analyzed the Grain Transportation Refund based on net sales of eligible grains), shippers pay the full freight rate ($49.37 per tonne) by 2000-01. Despite a refund payment, the net cost to shippers will be greater than what they would pay under the present rate structure because the total subsidy is spread over a larger volume of grain. The net costs to shippers increase throughout time and by 2000-01, their net cost (after the refund payment) is expected to be $32.90 per tonne. Under the formula determining the government's payment responsibilities, revisions were made to the safety net percentages to try to give producers a measure of protection equivalent to that under the current method of payment. Government contributions to the GTR begin to drop toward the end of the analytical period. On a per tonne basis, the subsidy amounts to an average of $18.31 per tonne. This reduction occurs because the shipper share limitation adjustments which have been triggered throughout the simulation become lower and less frequent in later years. This occurs because the freight rate--grain price ratios decrease (freight rates increase at a lesser rate than do grain prices).

In order to summarize the results, Table 5.1 illustrates the average government and shipper freight rates (and their respective shares of the total grain freight rate) for each of the four years examined and for

TABLE 5.1

Summary of Freight Rates

Average Government Freight Rate and Percent of Total Rate

| Crop Year | Bench $/tonne | % | Scenario 2 $/tonne | % | Scenario 3 $/tonne | % | Scenario 4 $/tonne | % |
|---|---|---|---|---|---|---|---|---|
| 1986-87 | 21.34 | 70% | 21.34 | 70% | 21.34 | 70% | 21.34 | 70% |
| 1990-91 | 20.35 | 59% | 21.82 | 55% | 20.36 | 59% | 21.57 | 65% |
| 1995-96 | 19.66 | 48% | 28.39 | 49% | 20.44 | 50% | 20.43 | 48% |
| 2000-01 | 18.86 | 38% | 37.98 | 45% | 20.58 | 42% | 18.31 | 36% |

Average Shipper Freight Rate and Percent of Total Rate

| Crop Year | Bench $/tonne | % | Scenario 2 $/tonne | % | Scenario 3 $/tonne | % | Scenario 4 $/tonne | % |
|---|---|---|---|---|---|---|---|---|
| 1986-87 | 9.13 | 30% | 9.13 | 30% | 9.13 | 30% | 11.26 | 30% |
| 1990-91 | 13.96 | 41% | 18.18 | 45% | 13.96 | 41% | 14.91 | 41% |
| 1995-96 | 21.20 | 62% | 29.26 | 51% | 20.42 | 50% | 22.46 | 52% |
| 2000-01 | 30.51 | 62% | 46.26 | 55% | 28.79 | 58% | 32.90 | 64% |

each of the four scenarios analyzed. Because the volume forecast used in any particular year is the same for each of the scenarios, the comparison of rates is just as valid as that of absolute financial obligations.

Aside from the freight rates themselves, two other components of the rate-determining process should be summarized. The first is the safety net feature of the Act. Under the economic status quo and the current rate structure, shipper share limitation adjustments could be triggered around 1991-92. By the end of the simulation period (2000-01), the probability of an adjustment has risen to some 30% with an average level of $41.6 million. When railway costs increase (scenario 2) and the shipper freight rate increases, the safety net feature is activated earlier and the financial assistance shippers receive is greater than that under the base case. By 2000-01, the shipper share limitation adjustment averages $364.2 million under scenario 2 with a likelihood of 91.5%. When Canadian grain prices drop, shippers again receive additional financial aid through more frequent and larger adjustments from the safety net feature. By 2000-01, the probability of an adjustment under scenario 3 is 57.5%, with an average level of $111.8 million. Under the fourth scenario, the revised safety net percentages (20%) result in frequent shipper assistance in early years as producers are paying the full freight rate. In later years, the aid is reduced as grain prices rise and the full rate producers pay drops below 20% of the basket price of grain in Canada.

With respect to the tally system and volume forecast errors, the analysis indicated that there is a tendency toward negative annual tally adjustments (monies owed by producers to the government). This is because negative tally adjustments are the result of underforecasting grain shipments which is more probable than overforecasting.[23] Negative annual tally adjustments can be subject to a lower limit if the forecast error which caused it was constrained. For example, all of a bumper crop may not be able to be shipped to port if the grain handling and transportation system does not have the available capacity to handle that entire volume. Positive annual tally adjustments caused by overforecasting have no limit as there are no constraints on crop failures. However, the results indicated that the range in negative and positive annual tally adjustments is comparable meaning the range of up-side and down-side forecast errors is also comparable.

The result was that over the long term, the cumulative tally averaged $16.6 million by 2000-01. However, during the simulation period, the cumulative tally often exceeded its legislated limits. This required an adjustment to be made to the government's share of costs in order to avoid having to large a sum owed to either party. It should also be noted that the magnitudes of the annual tally adjustment (both positive and negative adjustments) were such that the cumulative tally could exceed its bounds in just one year.

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[23] The use of a least squares technique (which assumes a normally distributed error term) will produce mostly underestimates because grain shipments are characterized by Beta distributions skewed to lower levels of shipments.

## 5.2 POLICY IMPLICATIONS

Because the model forecasts the probabilities of future freight rates for both shippers and government, policy makers have some idea of the range of financial obligations of both parties in terms of transportation costs. Furthermore, the results generated under the four scenarios produce differing distributions of outcomes. Therefore, policy makers and advisors have some some a priori information regarding the expected impacts of various economic and structural changes and the magnitude of those impacts. Given government intervention in the producers' freight rate to date,[24] future estimates of their expected rates will likely be useful.

Relevant information is also generated as to the effectiveness of the tally system. The tally adjustments are more likely to be negative owing to the greater probability of underforecasting. Under consecutive underestimation, policy advisors can see that there will be a tendency for the cumulative tally to build towards its legislated lower limit (-$150 million) even if forecast errors are small. If this should begin to occur, advisors can suggest that the volume forecast be set such that an overestimation will likely occur. This will result in a positive annual tally adjustment which will bring the cumulative tally back in line (towards zero). Furthermore, policy makers may find that the current legislated bounds for the cumulative tally are too low as the model re-

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[24] In August of 1984, an amendment to the WGTA froze the shipper freight rate for two years. In the second year of the freeze, the government intervened by advising the GTA to adjust the grain volume estimate upon which freight rates hinge. The volume forecast was lowered, freeing up more government subsidy per tonne, and keeping shipper freight rates lower than they would have been without the forecast reduction.

sults indicate that these limits can be exceeded in one year.

The results of the fourth scenario of the model provide results on the rate implications of a change in the method of payment to "pay the producer" through the Grain Transportation Refund approach. In addition, policy makers have some idea of the level of protection producers receive with respect to a "pay the producer" option and revised safety net percentages of 20 percent. The frequency and amount of shipper share limitation adjustments was higher under these conditions relative to the current rate structure and legislated safety net percentages. Therefore, if producers were to receive the Crow Benefit subsidy directly, those in the policy arena may want to adjust these percentages to give producers the same amount of protection as they have under the current method of payment.

## 5.3 LIMITATION OF THE RESEARCH

Any research which is attempting to forecast future events is subject to limitations. With respect to this study, these limitations occur in the assumptions underlying the the forecasts. The estimation of eligible railway costs was based on various assumptions regarding future productivity, branch line abandonment, the changing mix of rail traffic and adjustments relating to hauling grain over high cost lines. If these assumptions prove to be way off base, the financial responsibilities of the federal government and grain shippers may be over/underestimated. In addition, the forecast volumes upon which estimated rail costs are based and upon which the freight rates are derived may not be accurate. In all scenarios, perfect knowledge of the future was assumed in terms of the probability distributions for grain production and prices. Structural changes in terms of technology and government policy could affect the range of future events not included in the assumed distributions. Further, the 'future' which was assumed was stochastically determined and subject to conditions such as rail capacity limitations.

Under this section dealing with limitations of the study, it is also important to assess the model's tally system. In order to evaluate the payment responsibilities of government and producers, it was felt that the tally system should be forced to behave as intended and fluctuate around zero. The tally system was established to account for disparities between projected and actual grain shipments. In years of better than average crops, the amount owed by producers would increase and in years of worse than average crops, the amount owed by the government would increase. If the volume projections are done properly, the number of years where actual exceed projection should equal the number of years where actual is below projection, and the cumulative amount owed to or owed by the government should fluctuate around zero.[25]

Thus, the econometric procedure applied to generate forecast volumes was used to theoretically force the cumulative tally to fluctuate around zero. This occurs if the assumptions of the linear stochastic regression are satisfied; specifically that the random error term is normally distributed with mean zero. Providing these assumptions are valid, the cumulative tally should be normally distributed with an expected value of zero since the tally is, in concept, the random error term.

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[25] Grain Transportation Agency, 'Proposal to Remove the 31.5 million tonne Cap', Winnipeg, 1984.

However, the least squares technique used to estimated future volumes shipped was applied to all 3600 observations representing actual grain shipments (200 observation per crop year from 1983-84 through 2000-01). Because each of these observations is a randomly derived value subject to truncation from a capacity function, the distributions of actual grain shipments for any particular crop year exhibited tendencies of negative skewness. Therefore, the distributions of the error term arising from the regression procedure also showed negative skewness, and the assumptions of the general linear model were violated. The probability that actual shipments exceed forecast shipments was greater than the probability that forecast shipments exceed actual shipments, and the expected value of the cumulative tally was greater than zero. Thus, the attempt to force the tally system to perform as it was theoretically intended was not fully successful. However, the tally adjustments generated in this research probably give a good idea of how the tally will behave in the "real world".

Another limitation of the study is related to the stability of the resulting probability distributions of the payment obligations of the federal government and grain shippers. The reliability of a simulation model in representing the system under analysis is partly dependent on whether the random variables employed are uniformly distributed throughout the assumed distributions from which they are sampled. A chi-square test for uniformity was applied to the distributions of the various stochastic elements of the rate-determining process (i.e. the U.S. wheat price, the Canada - U.S. exchange rate and potential grain shipments). Although these input variables proved to be statistically stable at two hundred repetitions, the stability distributions of the output variables (financial responsibilities of government and shippers) could not be tested. This was due to limitations of computer capacity. Therefore, although it was assumed that two hundred replications of the stochastic input variables generated stable distributions for these output variables, this could not be verified.

## 5.4 SUGGESTIONS FOR FURTHER RESEARCH

Several aspects of this research could be extended in the form of additional scenarios.

Firstly, an alternative economic event could be examined which involves a reduction in railway transportation costs. Under the present provisions of the WGTA, shippers, rather than the government, will be the most affected by future transportation cost changes. This holds true for both cost increases and costs decreases. With more and more emphasis being placed on the reduction of transportation costs to producers, a study could be undertaken to determine the savings accruing to shippers (producers) if transporation costs are reduced.

A study by the Senior Grain Transportation Committee has indicated that no other measure has as much potential for reducing tranportation costs as does the removal of high cost branchlines from the grain gathering network.[26] There are almost 11,000 miles of branchlines in the Canadian Wheat Board Designated Area. Of these, 6987.7 miles were de-

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[26] Administrative Constraints to System Efficiency (A.C.S.E.) Working Group of the Efficiency Measures Subcommittee of the Senior Grain Transportation Committee, "High Cost Branch Line Study, Final Report", Winnipeg, Sept. 26, 1986.

fined as grain dependent in 1986-87, and therefore, costs attributable to these lines are included in WGTA eligible costs. The scenario could be structured such that the line cost component of estimated eligible costs could decrease over time as a result of the abandonment of costly and uneconomic branchlines. This would occur through a reduction in the productivity index applied to line-related costs, indicating a reduction in the number of grain dependent miles. The probability distributions of the range of savings associated with various degrees of branchline rationalization could be identified.

Concurrent with the rationalization of prairie branchlines is the trend toward a consolidated elevator system with large high-throughput elevators. This results in an increasing feasibilty of unit or solid train operations for grain. Therefore, the research could be further detailed to account for savings in volume-related costs which would result with the simultaneous consolidation of the branchline and elevation system and the movement toward unit trains for grain.

Further research could also be performed with respect to the "pay the producer" scenarios. Useful infomation regarding the payment obligations of producers could result by analyzing these scenarios under varying dilution factors. Dilution of the Crow subsidy is dependent upon how much grain currently fed on the prairies is eligible for compensatory payments from the GTR. Because of the uncertainty surrounding net sales of eligible grains, estimates of dilution have ranged from six percent to eighteen percent.[27] However, any further study on the GTR may

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[27] The Western Producer, 'Special Report: WGTA Hearings', October 17, 1985 p. 34.

be outdated as the Review of the Western Grain Transportation Act has recommended the GTR not be implemented.[28] What has been recommended by the Grain Transportation Agency under the Review is that the government pay out its Crow Benefit obligation while maintaining the statutory freight rates. This would mean paying producers a sum sufficient to provide them with income equivalent to what they would have received under the subsidy. If the "pay out" is implemented, the GTA further recommends a simple rate setting process for the interim, in which the government commitment is set at a fixed rate regardless of volumes. If the "pay out" is not implemented the GTA recommend a hold back alternative to the existing tally system, whereby a portion of the Crow Benefit would be withheld from the calculations of the rate determination (based on forecast volumes). If actual shipments exceed the forecast, the government would have funds on hand to continue to pay its share of the rate without overspending its commitment. Any funds remaining at the end of the year would be paid out to producers in a rebate manner corresponding to their individual deliveries during the year.

An analysis of the hold back alternative in terms of the expected level of freight rates shippers will pay up front, and the subsequent rebates they would receive would be useful. As well, this research could incorporate several scenarios to determine the impact of changing economic conditions on the level of the rates and rebates.

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[28] Grain Transportation Agency, "Review of the Western Grain Transportation Act", Winnipeg, April 1986.

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# Appendix A

## STATISTICS FOR MODEL VARIABLES

Detailed statistics were generated for each of the variables important to the the determination of freight rates under the Western Grain Transportation Act. Below is an expanation of the variable name abbreviations. The following pages provide descriptive statistics for the relevant rate-setting variables under each of the four scenarios.

Definition of Variables:

CROPYR = crop year

PREDSHIP = forecast grain shipments (million tonnes)

SHIP = actual grain shipments (million tonnes)

CGSCC = cumulative government share of cost changes (million $)

GCOM = government commitment (million $)

USPRICE = U.S. export wheat price (U.S. $ per tonne)

CANUS = Canada - United States exchange rate

WTP = weighted average price of 6 major grains (Cdn. $ per tonne)

FPRATIO = freight rate to grain price ratio (percent)

SSLADJ = shipper share limitation adjustment (million $)

GSH = government's share of eligible costs (million $)

SSH = shippers' share of eligible costs (million $)

GSHT = government freight rate ($ per tonne)

SSHT = shipper freight rate ($ per tonne)

RATE = total grain freight rate ($ per tonne)

GOVTEXP = total expenditure by government (million $)

| | |
|---|---|
| TALADJ | = annual tally adjustment (million $) |
| CTALLY | = cumulative tally (million $) |
| TALEXC | = adjustment due to cumulative tally exceeding its limits (million $) |
| GTR | = government contributions to Grain Transportation Refund (million $) |
| GTRT | = government contributions to Grain Transportation Refund ($ per tonne) |
| GRSCOST | = gross cost to shippers (million $) |
| NSCOST | = net cost to shippers after refund (million $) |
| NSCOSTT | = net cost to shipper after refund ($ per tonne) |

BENCH SCENARIO - DESCRIPTIVE STATISTICS

| VARIABLE | MINIMUM VALUE | MAXIMUM VALUE | MEAN | VARIANCE |
|---|---|---|---|---|
| CROPYR=8182 | | | | |
| PREDSHIP | 31.500 | 31.500 | 31.500 | 0 |
| SHIP | 31.500 | 31.500 | 31.500 | 0 |
| CGSCC | 0.000 | 0.000 | 0.000 | 0 |
| GCOM | 0.000 | 0.000 | 0.000 | 0 |
| USPRICE | 0.000 | 0.000 | 0.000 | 0 |
| CANUS | 0.000 | 0.000 | 0.000 | 0 |
| WTP | . | . | . | . |
| FPRATIO | 0.000 | 0.000 | 0.000 | 0 |
| SSLADJ | 0.000 | 0.000 | 0.000 | 0 |
| GSH | 0.000 | 0.000 | 0.000 | 0 |
| SSH | 0.000 | 0.000 | 0.000 | 0 |
| GSHT | 0.000 | 0.000 | 0.000 | 0 |
| SSHT | 0.000 | 0.000 | 0.000 | 0 |
| RATE | 0.000 | 0.000 | 0.000 | 0 |
| GOVTEXP | 0.000 | 0.000 | 0.000 | 0 |
| TALADJ | 0.000 | 0.000 | 0.000 | 0 |
| CTALLY | 0.000 | 0.000 | 0.000 | 0 |
| TALEXC | 0.000 | 0.000 | 0.000 | 0 |
| CROPYR=8283 | | | | |
| PREDSHIP | 32.900 | 32.900 | 32.900 | 0 |
| SHIP | 32.900 | 32.900 | 32.900 | 0 |
| CGSCC | 32.445 | 32.445 | 32.445 | 0 |
| GCOM | 573.045 | 573.045 | 573.045 | 0 |
| USPRICE | 0.000 | 0.000 | 0.000 | 0 |
| CANUS | 0.000 | 0.000 | 0.000 | 0 |
| WTP | . | . | . | . |
| FPRATIO | 0.000 | 0.000 | 0.000 | 0 |
| SSLADJ | 0.000 | 0.000 | 0.000 | 0 |
| GSH | 0.000 | 0.000 | 0.000 | 0 |
| SSH | 0.000 | 0.000 | 0.000 | 0 |
| GSHT | 0.000 | 0.000 | 0.000 | 0 |
| SSHT | 0.000 | 0.000 | 0.000 | 0 |
| RATE | 0.000 | 0.000 | 0.000 | 0 |
| GOVTEXP | 0.000 | 0.000 | 0.000 | 0 |
| TALADJ | 0.000 | 0.000 | 0.000 | 0 |
| CTALLY | 0.000 | 0.000 | 0.000 | 0 |
| TALEXC | 0.000 | 0.000 | 0.000 | 0 |

BENCH SCENARIO - DESCRIPTIVE STATISTICS

| VARIABLE | MINIMUM VALUE | MAXIMUM VALUE | MEAN | VARIANCE |
|---|---|---|---|---|
| CROPYR=8384 | | | | |
| PREDSHIP | 31.700 | 31.700 | 31.700 | 0.000 |
| SHIP | 34.550 | 34.550 | 34.550 | 0.000 |
| CGSCC | 40.616 | 40.616 | 40.616 | 0.000 |
| GCOM | 610.716 | 610.716 | 610.716 | 0.000 |
| USPRICE | 0.000 | 0.000 | 0.000 | 0.000 |
| CANUS | 1.196 | 1.434 | 1.327 | 0.003 |
| WTP | . | . | . | . |
| FPRATIO | 0.000 | 0.000 | 0.000 | 0.000 |
| SSLADJ | 0.000 | 0.000 | 0.000 | 0.000 |
| GSH | 596.720 | 596.720 | 596.720 | 0.000 |
| SSH | 181.730 | 181.730 | 181.730 | 0.000 |
| GSHT | 18.820 | 18.820 | 18.820 | 0.000 |
| SSHT | 5.730 | 5.730 | 5.730 | 0.000 |
| RATE | 24.550 | 24.550 | 24.550 | 0.000 |
| GOVTEXP | 664.231 | 664.231 | 664.231 | 0.000 |
| TALADJ | 0.000 | 0.000 | 0.000 | 0.000 |
| CTALLY | 0.000 | 0.000 | 0.000 | 0.000 |
| TALEXC | 0.000 | 0.000 | 0.000 | 0.000 |
| CROPYR=8485 | | | | |
| PREDSHIP | 31.800 | 31.800 | 31.800 | 0.000 |
| SHIP | 25.700 | 25.700 | 25.700 | 0.000 |
| CGSCC | 39.356 | 39.356 | 39.356 | 0.000 |
| GCOM | 638.956 | 638.956 | 638.956 | 0.000 |
| USPRICE | 0.000 | 0.000 | 0.000 | 0.000 |
| CANUS | 1.194 | 1.439 | 1.319 | 0.003 |
| WTP | 0.000 | 0.000 | 0.000 | 0.000 |
| FPRATIO | 0.000 | 0.000 | 0.000 | 0.000 |
| SSLADJ | 0.000 | 0.000 | 0.000 | 0.000 |
| GSH | 560.860 | 560.860 | 560.860 | 0.000 |
| SSH | 244.810 | 244.810 | 244.810 | 0.000 |
| GSHT | 17.630 | 17.630 | 17.630 | 0.000 |
| SSHT | 7.700 | 7.700 | 7.700 | 0.000 |
| RATE | 25.330 | 25.330 | 25.330 | 0.000 |
| GOVTEXP | 471.091 | 471.091 | 471.091 | 0.000 |
| TALADJ | 0.000 | 0.000 | 0.000 | 0.000 |
| CTALLY | 0.000 | 0.000 | 0.000 | 0.000 |
| TALEXC | 0.000 | 0.000 | 0.000 | 0.000 |

## BENCH SCENARIO - DESCRIPTIVE STATISTICS

| VARIABLE | MINIMUM VALUE | MAXIMUM VALUE | MEAN | VARIANCE |
|---|---|---|---|---|
| CROPYR=8586 | | | | |
| PREDSHIP | 31.800 | 31.800 | 31.800 | 0.000 |
| SHIP | 18.069 | 40.307 | 34.279 | 31.474 |
| CGSCC | 64.087 | 64.087 | 64.087 | 0.000 |
| GCOM | 693.187 | 693.187 | 693.187 | 0.000 |
| USPRICE | 137.000 | 137.000 | 137.000 | 0.000 |
| CANUS | 1.186 | 1.441 | 1.323 | 0.004 |
| WTP | 0.000 | 0.000 | 0.000 | 0.000 |
| FPRATIO | 0.000 | 0.000 | 0.000 | 0.000 |
| SSLADJ | 0.000 | 0.000 | 0.000 | 0.000 |
| GSH | 701.700 | 701.700 | 701.700 | 0.000 |
| SSH | 190.500 | 190.500 | 190.500 | 0.000 |
| GSHT | 22.070 | 22.070 | 22.070 | 0.000 |
| SSHT | 5.990 | 5.990 | 5.990 | 0.000 |
| RATE | 28.060 | 28.060 | 28.060 | 0.000 |
| GOVTEXP | 410.481 | 901.272 | 768.243 | 15330.433 |
| TALADJ | 64.000 | 64.000 | 64.000 | 0.000 |
| CTALLY | 64.000 | 64.000 | 64.000 | 0.000 |
| TALEXC | 0.000 | 0.000 | 0.000 | 0.000 |
| CROPYR=8687 | | | | |
| PREDSHIP | 33.583 | 33.583 | 33.583 | 0.000 |
| SHIP | 16.088 | 40.487 | 33.852 | 32.785 |
| CGSCC | 68.324 | 68.324 | 68.324 | 0.000 |
| GCOM | 726.924 | 726.924 | 726.924 | 0.000 |
| USPRICE | 116.156 | 127.910 | 121.561 | 11.489 |
| CANUS | 1.183 | 1.445 | 1.324 | 0.003 |
| WTP | 153.201 | 195.221 | 173.425 | 80.569 |
| FPRATIO | 3.454 | 4.401 | 3.898 | 0.042 |
| SSLADJ | 0.000 | 0.000 | 0.000 | 0.000 |
| GSH | 716.524 | 716.524 | 716.524 | 0.000 |
| SSH | 306.522 | 306.522 | 306.522 | 0.000 |
| GSHT | 21.336 | 21.336 | 21.336 | 0.000 |
| SSHT | 9.127 | 9.127 | 9.127 | 0.000 |
| RATE | 30.463 | 30.463 | 30.463 | 0.000 |
| GOVTEXP | 396.330 | 874.234 | 732.677 | 14924.750 |
| TALADJ | -134.516 | 131.225 | -14.045 | 9096.994 |
| CTALLY | -70.516 | 195.225 | 49.955 | 9096.994 |
| TALEXC | 0.000 | 45.225 | 7.486 | 216.630 |

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## BENCH SCENARIO - DESCRIPTIVE STATISTICS

| VARIABLE | MINIMUM VALUE | MAXIMUM VALUE | MEAN | VARIANCE |
|---|---|---|---|---|
| CROPYR=8788 | | | | |
| PREDSHIP | 34.099 | 34.099 | 34.099 | 0.000 |
| SHIP | 21.260 | 40.982 | 34.371 | 31.620 |
| CGSCC | 69.374 | 69.374 | 69.374 | 0.000 |
| GCOM | 727.974 | 727.974 | 727.974 | 0.000 |
| USPRICE | 112.812 | 132.970 | 123.904 | 34.989 |
| CANUS | 1.189 | 1.430 | 1.324 | 0.003 |
| WTP | 129.876 | 174.751 | 153.879 | 76.530 |
| FPRATIO | 4.457 | 5.997 | 5.078 | 0.086 |
| SSLADJ | 0.000 | 0.000 | 0.000 | 0.000 |
| GSH | 717.974 | 717.974 | 717.974 | 0.000 |
| SSH | 350.883 | 350.883 | 350.883 | 0.000 |
| GSHT | 21.056 | 21.056 | 21.056 | 0.000 |
| SSHT | 10.290 | 10.290 | 10.290 | 0.000 |
| RATE | 31.346 | 31.346 | 31.346 | 0.000 |
| GOVTEXP | 457.643 | 872.910 | 733.703 | 14018.421 |
| TALADJ | -132.016 | 158.304 | -10.699 | 9544.179 |
| CTALLY | -198.689 | 308.304 | 31.769 | 20721.692 |
| TALEXC | -48.689 | 158.304 | 14.779 | 1941.887 |
| CROPYR=8889 | | | | |
| PREDSHIP | 34.615 | 34.615 | 34.615 | 0.000 |
| SHIP | 20.186 | 41.956 | 34.617 | 27.827 |
| CGSCC | 70.423 | 70.423 | 70.423 | 0.000 |
| GCOM | 729.023 | 729.023 | 729.023 | 0.000 |
| USPRICE | 110.209 | 138.213 | 125.982 | 61.082 |
| CANUS | 1.181 | 1.438 | 1.328 | 0.004 |
| WTP | 133.233 | 180.447 | 156.553 | 107.463 |
| FPRATIO | 5.422 | 7.343 | 6.276 | 0.175 |
| SSLADJ | 0.000 | 0.000 | 0.000 | 0.000 |
| GSH | 719.023 | 764.248 | 726.510 | 216.630 |
| SSH | 352.746 | 397.971 | 390.484 | 216.630 |
| GSHT | 20.772 | 22.079 | 20.989 | 0.181 |
| SSHT | 10.191 | 11.497 | 11.281 | 0.181 |
| RATE | 32.269 | 32.269 | 32.269 | 0.000 |
| GOVTEXP | 429.308 | 885.723 | 736.347 | 12130.099 |
| TALADJ | -146.895 | 182.635 | -9.721 | 9042.711 |
| CTALLY | -288.554 | 332.635 | 7.270 | 23104.925 |
| TALEXC | -138.554 | 182.635 | 4.513 | 2905.869 |

BENCH SCENARIO - DESCRIPTIVE STATISTICS

| VARIABLE | MINIMUM VALUE | MAXIMUM VALUE | MEAN | VARIANCE |
|---|---|---|---|---|
| CROPYR=8990 | | | | |
| PREDSHIP | 35.131 | 35.131 | 35.131 | 0.000 |
| SHIP | 20.111 | 42.353 | 34.909 | 28.851 |
| CGSCC | 71.473 | 71.473 | 71.473 | 0.000 |
| GCOM | 730.073 | 730.073 | 730.073 | 0.000 |
| USPRICE | 107.454 | 165.106 | 128.838 | 97.782 |
| CANUS | 1.180 | 1.438 | 1.329 | 0.003 |
| WTP | 129.778 | 191.025 | 159.260 | 149.849 |
| FPRATIO | 5.500 | 8.453 | 6.852 | 0.292 |
| SSLADJ | 0.000 | 0.000 | 0.000 | 0.000 |
| GSH | 671.384 | 876.377 | 734.852 | 1941.887 |
| SSH | 289.799 | 496.792 | 433.324 | 1941.887 |
| GSHT | 19.111 | 25.003 | 20.918 | 1.573 |
| SSHT | 8.249 | 14.141 | 12.335 | 1.573 |
| RATE | 33.252 | 33.252 | 33.252 | 0.000 |
| GOVTEXP | 422.223 | 998.921 | 740.085 | 14450.951 |
| TALADJ | -260.310 | 223.152 | -12.436 | 11399.163 |
| CTALLY | -284.169 | 346.513 | -9.680 | 21472.849 |
| TALEXC | -134.169 | 196.513 | 2.412 | 2376.532 |
| CROPYR=9091 | | | | |
| PREDSHIP | 35.646 | 35.646 | 35.646 | 0.000 |
| SHIP | 21.373 | 43.151 | 35.688 | 26.384 |
| CGSCC | 72.523 | 72.523 | 72.523 | 0.000 |
| GCOM | 731.123 | 731.123 | 731.123 | 0.000 |
| USPRICE | 109.228 | 226.574 | 133.145 | 219.131 |
| CANUS | 1.180 | 1.445 | 1.323 | 0.004 |
| WTP | 132.643 | 210.353 | 162.747 | 232.375 |
| FPRATIO | 5.003 | 9.545 | 7.361 | 0.724 |
| SSLADJ | 0.000 | 0.000 | 0.000 | 0.000 |
| GSH | 582.569 | 903.758 | 725.636 | 2905.869 |
| SSH | 319.632 | 640.821 | 497.754 | 2905.869 |
| GSHT | 16.343 | 25.353 | 20.356 | 2.287 |
| SSHT | 8.967 | 17.977 | 13.964 | 2.287 |
| RATE | 34.320 | 34.320 | 34.320 | 0.000 |
| GOVTEXP | 442.380 | 1004.375 | 735.806 | 13822.770 |
| TALADJ | -263.728 | 235.624 | -5.025 | 11547.223 |
| CTALLY | -305.594 | 340.104 | -17.117 | 22358.774 |
| TALEXC | -155.594 | 190.104 | -2.883 | 2455.901 |

BENCH SCENARIO - DESCRIPTIVE STATISTICS

| VARIABLE | MINIMUM VALUE | MAXIMUM VALUE | MEAN | VARIANCE |
|---|---|---|---|---|
| CROPYR=9192 | | | | |
| PREDSHIP | 36.162 | 36.162 | 36.162 | 0.000 |
| SHIP | 22.056 | 42.330 | 35.912 | 28.689 |
| CGSCC | 73.572 | 73.572 | 73.572 | 0.000 |
| GCOM | 732.172 | 732.172 | 732.172 | 0.000 |
| USPRICE | 110.964 | 217.058 | 140.515 | 290.823 |
| CANUS | 1.179 | 1.444 | 1.328 | 0.003 |
| WTP | 129.569 | 315.052 | 167.559 | 456.010 |
| FPRATIO | 3.998 | 11.271 | 8.023 | 1.371 |
| SSLADJ | 0.000 | 59.151 | 0.934 | 31.675 |
| GSH | 588.003 | 918.685 | 725.519 | 2382.655 |
| SSH | 363.988 | 694.670 | 557.154 | 2382.655 |
| GSHT | 16.260 | 25.404 | 20.063 | 1.822 |
| SSHT | 10.065 | 19.210 | 15.407 | 1.822 |
| RATE | 35.470 | 35.470 | 35.470 | 0.000 |
| GOVTEXP | 444.967 | 1012.355 | 730.561 | 13874.651 |
| TALADJ | -271.600 | 261.821 | 2.043 | 11777.862 |
| CTALLY | -260.080 | 323.246 | -12.191 | 21221.998 |
| TALEXC | -110.080 | 173.246 | -0.720 | 1965.615 |
| CROPYR=9293 | | | | |
| PREDSHIP | 36.678 | 36.678 | 36.678 | 0.000 |
| SHIP | 21.976 | 43.887 | 36.380 | 28.179 |
| CGSCC | 74.622 | 74.622 | 74.622 | 0.000 |
| GCOM | 733.222 | 733.222 | 733.222 | 0.000 |
| USPRICE | 112.957 | 238.655 | 148.374 | 511.925 |
| CANUS | 1.196 | 1.432 | 1.322 | 0.003 |
| WTP | 131.594 | 294.780 | 177.583 | 588.393 |
| FPRATIO | 4.916 | 12.000 | 8.477 | 1.822 |
| SSLADJ | 0.000 | 94.950 | 5.014 | 238.534 |
| GSH | 567.628 | 913.326 | 725.353 | 2644.118 |
| SSH | 432.759 | 778.456 | 620.731 | 2644.118 |
| GSHT | 15.476 | 24.901 | 19.776 | 1.965 |
| SSHT | 11.799 | 21.224 | 16.924 | 1.965 |
| RATE | 36.700 | 36.700 | 36.700 | 0.000 |
| GOVTEXP | 350.098 | 1025.204 | 728.919 | 12835.910 |
| TALADJ | -283.941 | 354.229 | 8.731 | 10195.320 |
| CTALLY | -263.553 | 392.868 | -2.741 | 23540.539 |
| TALEXC | -113.553 | 242.868 | 7.048 | 2932.669 |

BENCH SCENARIO - DESCRIPTIVE STATISTICS

| VARIABLE | MINIMUM VALUE | MAXIMUM VALUE | MEAN | VARIANCE |
|---|---|---|---|---|
| CROPYR=9394 | | | | |
| PREDSHIP | 37.194 | 37.194 | 37.194 | 0.000 |
| SHIP | 22.676 | 43.534 | 36.888 | 25.813 |
| CGSCC | 75.672 | 75.672 | 75.672 | 0.000 |
| GCOM | 734.272 | 734.272 | 734.272 | 0.000 |
| USPRICE | 113.441 | 253.678 | 158.484 | 1004.371 |
| CANUS | 1.188 | 1.440 | 1.328 | 0.004 |
| WTP | 136.221 | 297.985 | 186.087 | 874.861 |
| FPRATIO | 4.526 | 12.392 | 8.948 | 2.160 |
| SSLADJ | 0.000 | 129.083 | 10.622 | 622.814 |
| GSH | 614.191 | 921.370 | 734.174 | 2456.849 |
| SSH | 492.328 | 799.507 | 679.524 | 2456.849 |
| GSHT | 16.513 | 24.772 | 19.739 | 1.776 |
| SSHT | 13.237 | 21.496 | 18.270 | 1.776 |
| RATE | 38.009 | 38.009 | 38.009 | 0.000 |
| GOVTEXP | 451.556 | 1019.421 | 737.676 | 11785.135 |
| TALADJ | -262.688 | 256.492 | 6.613 | 9182.713 |
| CTALLY | -257.761 | 404.024 | -3.176 | 19224.221 |
| TALEXC | -107.761 | 254.024 | 3.517 | 1633.181 |
| CROPYR=9495 | | | | |
| PREDSHIP | 37.710 | 37.710 | 37.710 | 0.000 |
| SHIP | 21.107 | 43.988 | 37.659 | 22.917 |
| CGSCC | 76.721 | 76.721 | 76.721 | 0.000 |
| GCOM | 735.321 | 735.321 | 735.321 | 0.000 |
| USPRICE | 114.805 | 263.872 | 170.689 | 1158.244 |
| CANUS | 1.181 | 1.446 | 1.315 | 0.004 |
| WTP | 138.181 | 323.226 | 199.252 | 1762.047 |
| FPRATIO | 5.143 | 12.923 | 9.214 | 3.031 |
| SSLADJ | 0.000 | 138.219 | 20.977 | 1338.442 |
| GSH | 617.627 | 995.153 | 753.346 | 3643.067 |
| SSH | 490.455 | 867.981 | 732.263 | 3643.067 |
| GSHT | 16.378 | 26.390 | 19.977 | 2.562 |
| SSHT | 13.006 | 23.017 | 19.418 | 2.562 |
| RATE | 39.396 | 39.396 | 39.396 | 0.000 |
| GOVTEXP | 458.636 | 1036.789 | 761.680 | 12048.492 |
| TALADJ | -296.937 | 248.126 | -5.484 | 9419.434 |
| CTALLY | -278.078 | 349.982 | -12.177 | 20407.824 |
| TALEXC | -128.078 | 199.982 | -1.769 | 1871.153 |

BENCH SCENARIO - DESCRIPTIVE STATISTICS

| VARIABLE | MINIMUM VALUE | MAXIMUM VALUE | MEAN | VARIANCE |
|---|---|---|---|---|
| CROPYR=9596 | | | | |
| PREDSHIP | 38.226 | 38.226 | 38.226 | 0.000 |
| SHIP | 24.291 | 44.444 | 37.865 | 24.206 |
| CGSCC | 77.771 | 77.771 | 77.771 | 0.000 |
| GCOM | 736.371 | 736.371 | 736.371 | 0.000 |
| USPRICE | 120.477 | 275.632 | 185.564 | 1847.868 |
| CANUS | 1.189 | 1.442 | 1.326 | 0.003 |
| WTP | 135.672 | 338.867 | 211.619 | 1761.087 |
| FPRATIO | 5.259 | 13.501 | 9.238 | 2.708 |
| SSLADJ | 0.000 | 204.432 | 21.722 | 1650.435 |
| GSH | 618.610 | 980.395 | 751.610 | 2931.431 |
| SSH | 581.530 | 943.316 | 810.315 | 2931.431 |
| GSHT | 16.183 | 25.647 | 19.662 | 2.006 |
| SSHT | 15.213 | 24.677 | 21.198 | 2.006 |
| RATE | 40.860 | 40.860 | 40.860 | 0.000 |
| GOVTEXP | 459.297 | 1095.914 | 754.359 | 11901.250 |
| TALADJ | -351.343 | 249.300 | 3.016 | 9035.225 |
| CTALLY | -262.268 | 352.021 | -7.392 | 20028.888 |
| TALEXC | -112.268 | 202.021 | 2.221 | 1843.750 |
| CROPYR=9697 | | | | |
| PREDSHIP | 38.742 | 38.742 | 38.742 | 0.000 |
| SHIP | 23.879 | 45.090 | 38.796 | 23.327 |
| CGSCC | 78.820 | 78.820 | 78.820 | 0.000 |
| GCOM | 737.420 | 737.420 | 737.420 | 0.000 |
| USPRICE | 117.531 | 286.723 | 202.412 | 2258.644 |
| CANUS | 1.189 | 1.438 | 1.322 | 0.003 |
| WTP | 135.570 | 364.374 | 232.095 | 2998.223 |
| FPRATIO | 5.383 | 14.183 | 9.239 | 3.946 |
| SSLADJ | 0.000 | 218.546 | 32.927 | 3166.445 |
| GSH | 599.342 | 956.869 | 758.578 | 4656.997 |
| SSH | 685.907 | 1043.434 | 884.198 | 4656.997 |
| GSHT | 15.470 | 24.699 | 19.580 | 3.103 |
| SSHT | 17.705 | 26.933 | 22.823 | 3.103 |
| RATE | 42.403 | 42.403 | 42.403 | 0.000 |
| GOVTEXP | 398.032 | 1058.508 | 770.634 | 15272.772 |
| TALADJ | -258.075 | 309.669 | -0.179 | 8802.647 |
| CTALLY | -355.302 | 408.969 | -9.792 | 19105.444 |
| TALEXC | -205.302 | 258.969 | 2.896 | 1878.291 |

BENCH SCENARIO - DESCRIPTIVE STATISTICS

| VARIABLE | MINIMUM VALUE | MAXIMUM VALUE | MEAN | VARIANCE |
|---|---|---|---|---|
| CROPYR=9798 | | | | |
| PREDSHIP | 39.258 | 39.258 | 39.258 | 0.000 |
| SHIP | 24.047 | 45.914 | 39.506 | 19.427 |
| CGSCC | 79.870 | 79.870 | 79.870 | 0.000 |
| GCOM | 738.470 | 738.470 | 738.470 | 0.000 |
| USPRICE | 124.552 | 299.335 | 214.863 | 2300.636 |
| CANUS | 1.187 | 1.443 | 1.327 | 0.003 |
| WTP | 143.699 | 379.921 | 252.221 | 3751.248 |
| FPRATIO | 5.516 | 14.597 | 9.248 | 4.344 |
| SSLADJ | 0.000 | 290.315 | 38.272 | 4489.432 |
| GSH | 616.202 | 1059.132 | 768.963 | 5846.444 |
| SSH | 669.171 | 1112.100 | 959.340 | 5846.444 |
| GSHT | 15.696 | 26.979 | 19.588 | 3.793 |
| SSHT | 17.046 | 28.328 | 24.437 | 3.793 |
| RATE | 44.024 | 44.024 | 44.024 | 0.000 |
| GOVTEXP | 472.678 | 1171.144 | 784.035 | 13886.610 |
| TALADJ | -272.722 | 328.303 | -6.795 | 8285.026 |
| CTALLY | -281.360 | 386.428 | -19.483 | 18478.339 |
| TALEXC | -131.360 | 236.428 | -2.852 | 1545.026 |
| CROPYR=9899 | | | | |
| PREDSHIP | 39.774 | 39.774 | 39.774 | 0.000 |
| SHIP | 23.443 | 46.395 | 39.569 | 23.365 |
| CGSCC | 80.920 | 80.920 | 80.920 | 0.000 |
| GCOM | 739.520 | 739.520 | 739.520 | 0.000 |
| USPRICE | 128.143 | 310.467 | 226.891 | 2270.209 |
| CANUS | 1.186 | 1.444 | 1.316 | 0.004 |
| WTP | 152.683 | 399.053 | 268.204 | 3783.599 |
| FPRATIO | 5.959 | 14.672 | 9.264 | 3.664 |
| SSLADJ | 0.000 | 333.859 | 37.126 | 4206.170 |
| GSH | 524.218 | 1088.863 | 769.541 | 6228.195 |
| SSH | 729.800 | 1294.445 | 1049.122 | 6228.195 |
| GSHT | 13.180 | 27.376 | 19.348 | 3.937 |
| SSHT | 18.349 | 32.545 | 26.377 | 3.937 |
| RATE | 45.725 | 45.725 | 45.725 | 0.000 |
| GOVTEXP | 474.431 | 1225.089 | 775.504 | 15263.523 |
| TALADJ | -279.114 | 302.590 | 0.730 | 8774.591 |
| CTALLY | -254.170 | 386.042 | -15.901 | 19793.270 |
| TALEXC | -104.170 | 236.042 | -3.534 | 1808.382 |

BENCH SCENARIO - DESCRIPTIVE STATISTICS

| VARIABLE | MINIMUM VALUE | MAXIMUM VALUE | MEAN | VARIANCE |
|---|---|---|---|---|
| CROPYR=9900 | | | | |
| PREDSHIP | 40.290 | 40.290 | 40.290 | 0.000 |
| SHIP | 26.005 | 46.972 | 40.561 | 21.484 |
| CGSCC | 81.969 | 81.969 | 81.969 | 0.000 |
| GCOM | 740.569 | 740.569 | 740.569 | 0.000 |
| USPRICE | 132.767 | 323.367 | 251.985 | 2022.078 |
| CANUS | 1.187 | 1.422 | 1.320 | 0.004 |
| WTP | 153.798 | 410.045 | 280.822 | 3696.075 |
| FPRATIO | 6.194 | 15.484 | 9.489 | 3.768 |
| SSLADJ | 0.000 | 337.313 | 46.421 | 6127.582 |
| GSH | 627.570 | 1142.142 | 774.138 | 7393.856 |
| SSH | 771.888 | 1286.460 | 1139.892 | 7393.856 |
| GSHT | 15.576 | 28.348 | 19.214 | 4.555 |
| SSHT | 19.158 | 31.930 | 28.292 | 4.555 |
| RATE | 47.507 | 47.507 | 47.507 | 0.000 |
| GOVTEXP | 481.550 | 1133.742 | 789.332 | 15439.513 |
| TALADJ | -203.262 | 255.011 | -1.795 | 6767.857 |
| CTALLY | -257.722 | 332.883 | -14.163 | 18725.384 |
| TALEXC | -107.722 | 182.883 | 1.608 | 1636.359 |
| CROPYR=200001 | | | | |
| PREDSHIP | 40.806 | 40.806 | 40.806 | 0.000 |
| SHIP | 28.599 | 46.814 | 41.043 | 17.732 |
| CGSCC | 83.019 | 83.019 | 83.019 | 0.000 |
| GCOM | 741.619 | 741.619 | 741.619 | 0.000 |
| USPRICE | 148.401 | 336.572 | 260.431 | 2097.874 |
| CANUS | 1.191 | 1.444 | 1.318 | 0.003 |
| WTP | 166.333 | 427.549 | 312.525 | 3494.817 |
| FPRATIO | 5.456 | 16.074 | 9.125 | 3.660 |
| SSLADJ | 0.000 | 323.014 | 41.553 | 6143.128 |
| GSH | 627.449 | 1077.117 | 769.639 | 8047.145 |
| SSH | 937.474 | 1387.142 | 1244.953 | 8047.145 |
| GSHT | 16.377 | 26.396 | 18.861 | 4.833 |
| SSHT | 22.974 | 33.994 | 30.509 | 4.833 |
| RATE | 49.371 | 49.371 | 49.371 | 0.000 |
| GOVTEXP | 494.275 | 1142.018 | 784.449 | 15173.252 |
| TALADJ | -304.395 | 223.790 | -0.798 | 6731.805 |
| CTALLY | -259.090 | 307.748 | -16.568 | 16555.323 |
| TALEXC | -109.090 | 157.748 | 1.280 | 1153.315 |

SCENARIO 2 - DESCRIPTIVE STATISTICS

| VARIABLE | MINIMUM VALUE | MAXIMUM VALUE | MEAN | VARIANCE |
|---|---|---|---|---|
| CROPYR=8182 | | | | |
| PREDSHIP | 31.500 | 31.500 | 31.500 | 0 |
| SHIP | 31.500 | 31.500 | 31.500 | 0 |
| CGSCC | 0.000 | 0.000 | 0.000 | 0 |
| GCOM | 0.000 | 0.000 | 0.000 | 0 |
| USPRICE | 0.000 | 0.000 | 0.000 | 0 |
| CANUS | 0.000 | 0.000 | 0.000 | 0 |
| WTP | . | . | . | . |
| FPRATIO | 0.000 | 0.000 | 0.000 | 0 |
| SSLADJ | 0.000 | 0.000 | 0.000 | 0 |
| GSH | 0.000 | 0.000 | 0.000 | 0 |
| SSH | 0.000 | 0.000 | 0.000 | 0 |
| GSHT | 0.000 | 0.000 | 0.000 | 0 |
| SSHT | 0.000 | 0.000 | 0.000 | 0 |
| RATE | 0.000 | 0.000 | 0.000 | 0 |
| GOVTEXP | 0.000 | 0.000 | 0.000 | 0 |
| TALADJ | 0.000 | 0.000 | 0.000 | 0 |
| CTALLY | 0.000 | 0.000 | 0.000 | 0 |
| TALEXC | 0.000 | 0.000 | 0.000 | 0 |
| CROPYR=8283 | | | | |
| PREDSHIP | 32.900 | 32.900 | 32.900 | 0 |
| SHIP | 32.900 | 32.900 | 32.900 | 0 |
| CGSCC | 32.445 | 32.445 | 32.445 | 0 |
| GCOM | 573.045 | 573.045 | 573.045 | 0 |
| USPRICE | 0.000 | 0.000 | 0.000 | 0 |
| CANUS | 0.000 | 0.000 | 0.000 | 0 |
| WTP | . | . | . | . |
| FPRATIO | 0.000 | 0.000 | 0.000 | 0 |
| SSLADJ | 0.000 | 0.000 | 0.000 | 0 |
| GSH | 0.000 | 0.000 | 0.000 | 0 |
| SSH | 0.000 | 0.000 | 0.000 | 0 |
| GSHT | 0.000 | 0.000 | 0.000 | 0 |
| SSHT | 0.000 | 0.000 | 0.000 | 0 |
| RATE | 0.000 | 0.000 | 0.000 | 0 |
| GOVTEXP | 0.000 | 0.000 | 0.000 | 0 |
| TALADJ | 0.000 | 0.000 | 0.000 | 0 |
| CTALLY | 0.000 | 0.000 | 0.000 | 0 |
| TALEXC | 0.000 | 0.000 | 0.000 | 0 |

SCENARIO 2 - DESCRIPTIVE STATISTICS

| VARIABLE | MINIMUM VALUE | MAXIMUM VALUE | MEAN | VARIANCE |
|---|---|---|---|---|
| CROPYR=8384 | | | | |
| PREDSHIP | 31.700 | 31.700 | 31.700 | 0.000 |
| SHIP | 34.550 | 34.550 | 34.550 | 0.000 |
| CGSCC | 40.616 | 40.616 | 40.616 | 0.000 |
| GCOM | 610.716 | 610.716 | 610.716 | 0.000 |
| USPRICE | 0.000 | 0.000 | 0.000 | 0.000 |
| CANUS | 1.196 | 1.434 | 1.327 | 0.003 |
| WTP | . | . | . | . |
| FPRATIO | 0.000 | 0.000 | 0.000 | 0.000 |
| SSLADJ | 0.000 | 0.000 | 0.000 | 0.000 |
| GSH | 596.720 | 596.720 | 596.720 | 0.000 |
| SSH | 181.730 | 181.730 | 181.730 | 0.000 |
| GSHT | 18.820 | 18.820 | 18.820 | 0.000 |
| SSHT | 5.730 | 5.730 | 5.730 | 0.000 |
| RATE | 24.550 | 24.550 | 24.550 | 0.000 |
| GOVTEXP | 664.231 | 664.231 | 664.231 | 0.000 |
| TALADJ | 0.000 | 0.000 | 0.000 | 0.000 |
| CTALLY | 0.000 | 0.000 | 0.000 | 0.000 |
| TALEXC | 0.000 | 0.000 | 0.000 | 0.000 |
| CROPYR=8485 | | | | |
| PREDSHIP | 31.800 | 31.800 | 31.800 | 0.000 |
| SHIP | 25.700 | 25.700 | 25.700 | 0.000 |
| CGSCC | 39.356 | 39.356 | 39.356 | 0.000 |
| GCOM | 638.956 | 638.956 | 638.956 | 0.000 |
| USPRICE | 0.000 | 0.000 | 0.000 | 0.000 |
| CANUS | 1.194 | 1.439 | 1.319 | 0.003 |
| WTP | 0.000 | 0.000 | 0.000 | 0.000 |
| FPRATIO | 0.000 | 0.000 | 0.000 | 0.000 |
| SSLADJ | 0.000 | 0.000 | 0.000 | 0.000 |
| GSH | 560.860 | 560.860 | 560.860 | 0.000 |
| SSH | 244.810 | 244.810 | 244.810 | 0.000 |
| GSHT | 17.630 | 17.630 | 17.630 | 0.000 |
| SSHT | 7.700 | 7.700 | 7.700 | 0.000 |
| RATE | 25.330 | 25.330 | 25.330 | 0.000 |
| GOVTEXP | 471.091 | 471.091 | 471.091 | 0.000 |
| TALADJ | 0.000 | 0.000 | 0.000 | 0.000 |
| CTALLY | 0.000 | 0.000 | 0.000 | 0.000 |
| TALEXC | 0.000 | 0.000 | 0.000 | 0.000 |

## SCENARIO 2 - DESCRIPTIVE STATISTICS

| VARIABLE | MINIMUM VALUE | MAXIMUM VALUE | MEAN | VARIANCE |
|---|---|---|---|---|
| | | CROPYR=8586 | | |
| PREDSHIP | 31.800 | 31.800 | 31.800 | 0.000 |
| SHIP | 18.069 | 40.307 | 34.279 | 31.474 |
| CGSCC | 64.087 | 64.087 | 64.087 | 0.000 |
| GCOM | 693.187 | 693.187 | 693.187 | 0.000 |
| USPRICE | 137.000 | 137.000 | 137.000 | 0.000 |
| CANUS | 1.186 | 1.441 | 1.323 | 0.004 |
| WTP | 0.000 | 0.000 | 0.000 | 0.000 |
| FPRATIO | 0.000 | 0.000 | 0.000 | 0.000 |
| SSLADJ | 0.000 | 0.000 | 0.000 | 0.000 |
| GSH | 701.700 | 701.700 | 701.700 | 0.000 |
| SSH | 190.500 | 190.500 | 190.500 | 0.000 |
| GSHT | 22.070 | 22.070 | 22.070 | 0.000 |
| SSHT | 5.990 | 5.990 | 5.990 | 0.000 |
| RATE | 28.060 | 28.060 | 28.060 | 0.000 |
| GOVTEXP | 410.481 | 901.272 | 768.243 | 15330.433 |
| TALADJ | 64.000 | 64.000 | 64.000 | 0.000 |
| CTALLY | 64.000 | 64.000 | 64.000 | 0.000 |
| TALEXC | 0.000 | 0.000 | 0.000 | 0.000 |
| | | CROPYR=8687 | | |
| PREDSHIP | 33.583 | 33.583 | 33.583 | 0.000 |
| SHIP | 18.088 | 40.487 | 33.852 | 32.785 |
| CGSCC | 68.324 | 68.324 | 68.324 | 0.000 |
| GCOM | 726.924 | 726.924 | 726.924 | 0.000 |
| USPRICE | 116.156 | 127.910 | 121.561 | 11.489 |
| CANUS | 1.183 | 1.445 | 1.324 | 0.003 |
| WTP | 153.201 | 195.221 | 173.425 | 80.569 |
| FPRATIO | 3.454 | 4.401 | 3.898 | 0.042 |
| SSLADJ | 0.000 | 0.000 | 0.000 | 0.000 |
| GSH | 716.524 | 716.524 | 716.524 | 0.000 |
| SSH | 306.522 | 306.522 | 306.522 | 0.000 |
| GSHT | 21.336 | 21.336 | 21.336 | 0.000 |
| SSHT | 9.127 | 9.127 | 9.127 | 0.000 |
| RATE | 30.463 | 30.463 | 30.463 | 0.000 |
| GOVTEXP | 396.330 | 874.234 | 732.677 | 14924.750 |
| TALADJ | -134.516 | 131.225 | -14.045 | 9096.994 |
| CTALLY | -70.516 | 195.225 | 49.955 | 9096.994 |
| TALEXC | 0.000 | 45.225 | 7.486 | 216.630 |

## SCENARIO 2 - DESCRIPTIVE STATISTICS

| VARIABLE | MINIMUM VALUE | MAXIMUM VALUE | MEAN | VARIANCE |
|---|---|---|---|---|
| | | CROPYR=8788 | | |
| PREDSHIP | 34.099 | 34.099 | 34.099 | 0.000 |
| SHIP | 21.260 | 40.982 | 34.371 | 31.620 |
| CGSCC | 77.687 | 77.687 | 77.687 | 0.000 |
| GCOM | 736.287 | 736.287 | 736.287 | 0.000 |
| USPRICE | 112.812 | 132.970 | 123.904 | 34.989 |
| CANUS | 1.189 | 1.430 | 1.324 | 0.003 |
| WTP | 129.876 | 174.751 | 153.879 | 76.530 |
| FPRATIO | 4.457 | 5.997 | 5.078 | 0.086 |
| SSLADJ | 0.000 | 0.000 | 0.000 | 0.000 |
| GSH | 726.287 | 726.287 | 726.287 | 0.000 |
| SSH | 384.208 | 384.208 | 384.208 | 0.000 |
| GSHT | 21.300 | 21.300 | 21.300 | 0.000 |
| SSHT | 11.268 | 11.268 | 11.268 | 0.000 |
| RATE | 32.567 | 32.567 | 32.567 | 0.000 |
| GOVTEXP | 462.827 | 882.902 | 742.083 | 14344.933 |
| TALADJ | -132.135 | 179.027 | -8.423 | 10347.921 |
| CTALLY | -198.804 | 324.173 | 34.045 | 21731.501 |
| TALEXC | -48.804 | 174.173 | 16.656 | 2367.008 |
| | | CROPYR=8889 | | |
| PREDSHIP | 34.615 | 34.615 | 34.615 | 0.000 |
| SHIP | 20.186 | 41.956 | 34.617 | 27.827 |
| CGSCC | 88.845 | 88.845 | 88.845 | 0.000 |
| GCOM | 747.445 | 747.445 | 747.445 | 0.000 |
| USPRICE | 110.209 | 138.213 | 125.982 | 61.082 |
| CANUS | 1.181 | 1.438 | 1.328 | 0.004 |
| WTP | 133.233 | 180.447 | 156.553 | 107.463 |
| FPRATIO | 5.727 | 7.756 | 6.630 | 0.195 |
| SSLADJ | 0.000 | 0.000 | 0.000 | 0.000 |
| GSH | 737.445 | 782.670 | 744.932 | 216.630 |
| SSH | 423.120 | 468.345 | 460.859 | 216.630 |
| GSHT | 21.304 | 22.611 | 21.521 | 0.181 |
| SSHT | 12.224 | 13.530 | 13.314 | 0.181 |
| RATE | 34.835 | 34.835 | 34.835 | 0.000 |
| GOVTEXP | 440.051 | 906.892 | 754.770 | 12750.959 |
| TALADJ | -147.061 | 217.882 | -8.055 | 9724.618 |
| CTALLY | -288.790 | 349.546 | 9.334 | 23833.972 |
| TALEXC | -138.790 | 199.546 | 5.641 | 3184.142 |

SCENARIO 2 - DESCRIPTIVE STATISTICS

---------------------------- CROPYR=8990 ----------------------------

| VARIABLE | MINIMUM VALUE | MAXIMUM VALUE | MEAN | VARIANCE |
|---|---|---|---|---|
| PREDSHIP | 35.131 | 35.131 | 35.131 | 0.000 |
| SHIP | 20.111 | 42.353 | 34.909 | 28.851 |
| CGSCC | 102.563 | 102.563 | 102.563 | 0.000 |
| GCOM | 761.163 | 761.163 | 761.163 | 0.000 |
| USPRICE | 107.454 | 165.106 | 128.838 | 97.782 |
| CANUS | 1.180 | 1.438 | 1.329 | 0.003 |
| WTP | 129.778 | 191.025 | 159.260 | 149.849 |
| FPRATIO | 6.344 | 9.665 | 7.845 | 0.378 |
| SSLADJ | 0.000 | 0.000 | 0.000 | 0.000 |
| GSH | 702.359 | 925.337 | 767.819 | 2367.008 |
| SSH | 384.971 | 607.949 | 542.488 | 2367.008 |
| GSHT | 19.993 | 26.340 | 21.856 | 1.918 |
| SSHT | 10.958 | 17.305 | 15.442 | 1.918 |
| RATE | 37.298 | 37.298 | 37.298 | 0.000 |
| GOVTEXP | 440.022 | 1039.100 | 772.801 | 15964.058 |
| TALADJ | -265.665 | 252.483 | -12.448 | 12611.339 |
| CTALLY | -284.496 | 402.483 | -8.755 | 22884.873 |
| TALEXC | -134.496 | 252.483 | 3.596 | 2905.162 |

---------------------------- CROPYR=9091 ----------------------------

| VARIABLE | MINIMUM VALUE | MAXIMUM VALUE | MEAN | VARIANCE |
|---|---|---|---|---|
| PREDSHIP | 35.646 | 35.646 | 35.646 | 0.000 |
| SHIP | 21.373 | 43.151 | 35.688 | 28.384 |
| CGSCC | 119.939 | 119.939 | 119.939 | 0.000 |
| GCOM | 778.539 | 778.539 | 778.539 | 0.000 |
| USPRICE | 109.228 | 226.574 | 133.145 | 219.131 |
| CANUS | 1.180 | 1.445 | 1.323 | 0.004 |
| WTP | 132.643 | 210.353 | 162.747 | 232.375 |
| FPRATIO | 6.228 | 11.507 | 8.997 | 1.001 |
| SSLADJ | 0.000 | 72.573 | 3.801 | 142.551 |
| GSH | 629.749 | 968.086 | 777.981 | 3291.127 |
| SSH | 457.775 | 796.112 | 647.880 | 3291.127 |
| GSHT | 17.667 | 27.158 | 21.825 | 2.590 |
| SSHT | 12.842 | 22.334 | 18.175 | 2.590 |
| RATE | 40.000 | 40.000 | 40.000 | 0.000 |
| GOVTEXP | 470.811 | 1111.580 | 788.331 | 16114.100 |
| TALADJ | -317.260 | 261.907 | -5.858 | 12052.180 |
| CTALLY | -326.166 | 356.493 | -18.209 | 23037.808 |
| TALEXC | -176.166 | 206.493 | -3.490 | 2693.155 |

SCENARIO 2 - DESCRIPTIVE STATISTICS

---------------------------- CROPYR=9192 ----------------------------

| VARIABLE | MINIMUM VALUE | MAXIMUM VALUE | MEAN | VARIANCE |
|---|---|---|---|---|
| PREDSHIP | 36.162 | 36.162 | 36.162 | 0.000 |
| SHIP | 22.056 | 42.330 | 35.912 | 28.689 |
| CGSCC | 140.957 | 140.957 | 140.957 | 0.000 |
| GCOM | 799.557 | 799.557 | 799.557 | 0.000 |
| USPRICE | 110.964 | 217.058 | 140.515 | 290.823 |
| CANUS | 1.179 | 1.444 | 1.328 | 0.003 |
| WTP | 129.559 | 315.052 | 167.559 | 456.010 |
| FPRATIO | 5.214 | 13.845 | 10.279 | 1.940 |
| SSLADJ | 0.000 | 181.141 | 36.344 | 2110.241 |
| GSH | 660.971 | 1042.040 | 829.497 | 4236.756 |
| SSH | 511.308 | 892.377 | 723.851 | 4236.756 |
| GSHT | 18.278 | 28.816 | 22.938 | 3.240 |
| SSHT | 14.139 | 24.677 | 20.017 | 3.240 |
| RATE | 42.955 | 42.955 | 42.955 | 0.000 |
| GOVTEXP | 491.560 | 1133.244 | 833.996 | 19542.546 |
| TALADJ | -322.718 | 316.518 | 0.969 | 13425.546 |
| CTALLY | -278.330 | 343.786 | -13.750 | 22289.469 |
| TALEXC | -128.330 | 193.786 | -1.659 | 2233.132 |

---------------------------- CROPYR=9293 ----------------------------

| VARIABLE | MINIMUM VALUE | MAXIMUM VALUE | MEAN | VARIANCE |
|---|---|---|---|---|
| PREDSHIP | 36.678 | 36.678 | 36.678 | 0.000 |
| SHIP | 21.976 | 43.887 | 36.380 | 28.179 |
| CGSCC | 165.936 | 165.936 | 165.936 | 0.000 |
| GCOM | 824.536 | 824.536 | 824.536 | 0.000 |
| USPRICE | 112.957 | 238.655 | 148.374 | 511.925 |
| CANUS | 1.196 | 1.432 | 1.322 | 0.003 |
| WTP | 131.594 | 294.780 | 177.583 | 588.393 |
| FPRATIO | 6.768 | 15.095 | 11.007 | 2.549 |
| SSLADJ | 0.000 | 261.833 | 69.219 | 4554.513 |
| GSH | 702.393 | 1109.550 | 880.266 | 6368.140 |
| SSH | 584.208 | 991.364 | 813.492 | 6368.140 |
| GSHT | 19.150 | 30.251 | 24.000 | 4.734 |
| SSHT | 15.928 | 27.029 | 22.179 | 4.734 |
| RATE | 46.179 | 46.179 | 46.179 | 0.000 |
| GOVTEXP | 451.274 | 1244.137 | 884.601 | 25176.182 |
| TALADJ | -284.920 | 392.303 | 7.845 | 12145.253 |
| CTALLY | -279.917 | 410.453 | -4.242 | 26097.929 |
| TALEXC | -129.917 | 260.453 | 6.807 | 3640.935 |

## SCENARIO 2 - DESCRIPTIVE STATISTICS

| VARIABLE | MINIMUM VALUE | MAXIMUM VALUE | MEAN | VARIANCE |
|---|---|---|---|---|
| CROPYR=9394 | | | | |
| PREDSHIP | 37.194 | 37.194 | 37.194 | 0.000 |
| SHIP | 22.676 | 43.534 | 36.888 | 25.813 |
| CGSCC | 195.161 | 195.161 | 195.161 | 0.000 |
| GCOM | 853.761 | 853.761 | 853.761 | 0.000 |
| USPRICE | 113.441 | 253.678 | 158.484 | 1004.371 |
| CANUS | 1.188 | 1.440 | 1.328 | 0.004 |
| WTP | 136.221 | 297.985 | 186.087 | 874.861 |
| FPRATIO | 6.792 | 16.730 | 11.650 | 2.973 |
| SSLADJ | 0.000 | 329.222 | 107.619 | 7009.613 |
| GSH | 739.538 | 1219.679 | 949.722 | 8107.733 |
| SSH | 628.498 | 1108.638 | 898.454 | 8107.733 |
| GSHT | 19.883 | 32.792 | 25.534 | 5.861 |
| SSHT | 16.898 | 29.807 | 24.156 | 5.861 |
| RATE | 49.690 | 49.690 | 49.690 | 0.000 |
| GOVTEXP | 559.324 | 1359.759 | 952.429 | 25816.083 |
| TALADJ | -306.420 | 306.802 | 7.390 | 11889.179 |
| CTALLY | -269.729 | 456.802 | -3.659 | 22735.168 |
| TALEXC | -119.729 | 306.802 | 2.715 | 2522.774 |
| CROPYR=9495 | | | | |
| PREDSHIP | 37.710 | 37.710 | 37.710 | 0.000 |
| SHIP | 21.107 | 43.988 | 37.659 | 22.917 |
| CGSCC | 228.504 | 228.504 | 228.504 | 0.000 |
| GCOM | 887.104 | 887.104 | 887.104 | 0.000 |
| USPRICE | 114.805 | 263.872 | 170.689 | 1158.244 |
| CANUS | 1.181 | 1.446 | 1.315 | 0.004 |
| WTP | 138.181 | 323.226 | 199.252 | 1762.047 |
| FPRATIO | 7.562 | 16.527 | 12.060 | 3.772 |
| SSLADJ | 0.000 | 378.541 | 141.272 | 9538.706 |
| GSH | 768.948 | 1327.930 | 1025.183 | 10929.950 |
| SSH | 689.867 | 1248.849 | 992.614 | 10929.950 |
| GSHT | 20.391 | 35.214 | 27.186 | 7.686 |
| SSHT | 18.294 | 33.117 | 26.322 | 7.686 |
| RATE | 53.508 | 53.508 | 53.508 | 0.000 |
| GOVTEXP | 593.216 | 1449.607 | 1033.486 | 27998.382 |
| TALADJ | -318.298 | 274.473 | -5.413 | 12930.929 |
| CTALLY | -287.196 | 389.495 | -11.787 | 25190.957 |
| TALEXC | -137.196 | 239.495 | -1.886 | 3285.859 |

## SCENARIO 2 - DESCRIPTIVE STATISTICS

| VARIABLE | MINIMUM VALUE | MAXIMUM VALUE | MEAN | VARIANCE |
|---|---|---|---|---|
| CROPYR=9596 | | | | |
| PREDSHIP | 38.226 | 38.226 | 38.226 | 0.000 |
| SHIP | 24.291 | 44.444 | 37.865 | 24.206 |
| CGSCC | 266.944 | 266.944 | 266.944 | 0.000 |
| GCOM | 925.544 | 925.544 | 925.544 | 0.000 |
| USPRICE | 120.477 | 275.632 | 185.564 | 1847.868 |
| CANUS | 1.189 | 1.442 | 1.326 | 0.003 |
| WTP | 135.672 | 338.867 | 211.619 | 1761.087 |
| FPRATIO | 8.225 | 17.298 | 12.319 | 3.621 |
| SSLADJ | 0.000 | 450.647 | 166.993 | 11665.643 |
| GSH | 823.078 | 1382.515 | 1085.251 | 13232.562 |
| SSH | 821.410 | 1380.847 | 1118.674 | 13232.562 |
| GSHT | 21.532 | 36.167 | 28.390 | 9.056 |
| SSHT | 21.488 | 36.123 | 29.265 | 9.056 |
| RATE | 57.655 | 57.655 | 57.655 | 0.000 |
| GOVTEXP | 592.308 | 1542.555 | 1085.026 | 32327.901 |
| TALADJ | -421.006 | 287.798 | 5.039 | 13267.694 |
| CTALLY | -299.838 | 381.038 | -4.862 | 24802.745 |
| TALEXC | -149.838 | 231.038 | 3.848 | 3299.340 |
| CROPYR=9697 | | | | |
| PREDSHIP | 38.742 | 38.742 | 38.742 | 0.000 |
| SHIP | 23.879 | 45.090 | 38.796 | 23.327 |
| CGSCC | 309.862 | 309.862 | 309.862 | 0.000 |
| GCOM | 968.462 | 968.462 | 968.462 | 0.000 |
| USPRICE | 117.531 | 286.723 | 202.412 | 2258.644 |
| CANUS | 1.189 | 1.438 | 1.322 | 0.003 |
| WTP | 135.570 | 364.374 | 232.095 | 2998.223 |
| FPRATIO | 8.040 | 19.266 | 12.587 | 6.038 |
| SSLADJ | 0.000 | 586.345 | 200.840 | 21089.055 |
| GSH | 821.265 | 1473.588 | 1157.415 | 23162.476 |
| SSH | 934.405 | 1586.728 | 1250.578 | 23162.476 |
| GSHT | 21.196 | 38.036 | 29.875 | 15.432 |
| SSHT | 24.119 | 40.956 | 32.280 | 15.432 |
| RATE | 62.155 | 62.155 | 62.155 | 0.000 |
| GOVTEXP | 540.133 | 1621.781 | 1170.946 | 49749.612 |
| TALADJ | -331.497 | 388.651 | -1.220 | 14558.081 |
| CTALLY | -384.109 | 434.618 | -9.930 | 24999.626 |
| TALEXC | -234.109 | 284.618 | 3.008 | 3937.348 |

## SCENARIO 2 - DESCRIPTIVE STATISTICS

| VARIABLE | MINIMUM VALUE | MAXIMUM VALUE | MEAN | VARIANCE |
|---|---|---|---|---|
| **CROPYR=9798** | | | | |
| PREDSHIP | 39.258 | 39.258 | 39.258 | 0.000 |
| SHIP | 24.047 | 45.914 | 39.606 | 19.427 |
| CGSCC | 358.561 | 358.561 | 358.561 | 0.000 |
| GCOM | 1017.161 | 1017.161 | 1017.161 | 0.000 |
| USPRICE | 124.552 | 299.335 | 214.863 | 2300.636 |
| CANUS | 1.187 | 1.443 | 1.327 | 0.003 |
| WTP | 143.699 | 379.921 | 252.221 | 3751.248 |
| FPRATIO | 8.207 | 19.766 | 12.862 | 6.843 |
| SSLADJ | 0.000 | 605.427 | 238.104 | 28375.709 |
| GSH | 933.538 | 1692.838 | 1249.114 | 28350.151 |
| SSH | 938.727 | 1698.027 | 1382.451 | 28350.151 |
| GSHT | 23.780 | 43.121 | 31.818 | 18.395 |
| SSHT | 23.912 | 43.253 | 35.215 | 18.395 |
| RATE | 67.033 | 67.033 | 67.033 | 0.000 |
| GOVTEXP | 785.246 | 1847.922 | 1268.685 | 53459.432 |
| TALADJ | -319.262 | 451.371 | -11.185 | 14272.313 |
| CTALLY | -325.884 | 466.982 | -24.124 | 24960.718 |
| TALEXC | -175.884 | 316.982 | -4.665 | 3694.612 |
| **CROPYR=9899** | | | | |
| PREDSHIP | 39.774 | 39.774 | 39.774 | 0.000 |
| SHIP | 23.443 | 46.395 | 39.569 | 23.365 |
| CGSCC | 412.696 | 412.696 | 412.696 | 0.000 |
| GCOM | 1071.296 | 1071.296 | 1071.296 | 0.000 |
| USPRICE | 128.143 | 310.467 | 226.891 | 2270.209 |
| CANUS | 1.186 | 1.444 | 1.316 | 0.004 |
| WTP | 152.683 | 399.053 | 268.204 | 3783.599 |
| FPRATIO | 8.608 | 19.714 | 13.186 | 6.668 |
| SSLADJ | 0.000 | 763.406 | 288.347 | 35350.387 |
| GSH | 961.724 | 1896.075 | 1352.651 | 40478.307 |
| SSH | 980.276 | 1914.627 | 1523.699 | 40478.307 |
| GSHT | 24.180 | 47.672 | 34.009 | 25.588 |
| SSHT | 24.646 | 48.138 | 38.309 | 25.588 |
| RATE | 72.318 | 72.318 | 72.318 | 0.000 |
| GOVTEXP | 833.247 | 2125.876 | 1354.602 | 66560.108 |
| TALADJ | -452.210 | 429.674 | 2.938 | 17678.994 |
| CTALLY | -408.377 | 475.773 | -16.522 | 28231.730 |
| TALEXC | -258.377 | 325.773 | -3.137 | 4621.420 |

## SCENARIO 2 - DESCRIPTIVE STATISTICS

| VARIABLE | MINIMUM VALUE | MAXIMUM VALUE | MEAN | VARIANCE |
|---|---|---|---|---|
| **CROPYR=9900** | | | | |
| PREDSHIP | 40.290 | 40.290 | 40.290 | 0.000 |
| SHIP | 26.005 | 46.972 | 40.561 | 21.484 |
| CGSCC | 473.077 | 473.077 | 473.077 | 0.000 |
| GCOM | 1131.677 | 1131.677 | 1131.677 | 0.000 |
| USPRICE | 132.767 | 323.367 | 251.985 | 2022.078 |
| CANUS | 1.187 | 1.422 | 1.320 | 0.004 |
| WTP | 153.798 | 410.045 | 280.822 | 3696.075 |
| FPRATIO | 8.081 | 21.585 | 13.714 | 7.937 |
| SSLADJ | 0.000 | 968.402 | 355.071 | 45335.928 |
| GSH | 1041.563 | 2007.551 | 1472.083 | 48250.341 |
| SSH | 1136.669 | 2102.657 | 1672.137 | 48250.341 |
| GSHT | 25.852 | 49.828 | 36.538 | 29.724 |
| SSHT | 28.212 | 52.189 | 41.503 | 29.724 |
| RATE | 78.040 | 78.040 | 78.040 | 0.000 |
| GOVTEXP | 891.517 | 2159.368 | 1490.348 | 73682.528 |
| TALADJ | -301.634 | 399.220 | -0.443 | 15389.284 |
| CTALLY | -341.531 | 479.114 | -13.827 | 27077.354 |
| TALEXC | -191.531 | 329.114 | 7.179 | 4436.695 |
| **CROPYR=200001** | | | | |
| PREDSHIP | 40.806 | 40.806 | 40.806 | 0.000 |
| SHIP | 28.599 | 46.814 | 41.043 | 17.732 |
| CGSCC | 540.041 | 540.041 | 540.041 | 0.000 |
| GCOM | 1198.641 | 1198.641 | 1198.641 | 0.000 |
| USPRICE | 148.401 | 336.572 | 260.431 | 2097.874 |
| CANUS | 1.191 | 1.444 | 1.318 | 0.003 |
| WTP | 166.333 | 427.549 | 312.525 | 3494.817 |
| FPRATIO | 8.204 | 23.238 | 13.323 | 8.285 |
| SSLADJ | 0.000 | 1025.293 | 364.216 | 64869.413 |
| GSH | 930.264 | 2152.962 | 1549.720 | 68301.947 |
| SSH | 1284.251 | 2506.949 | 1887.493 | 68301.947 |
| GSHT | 22.797 | 52.761 | 37.978 | 41.020 |
| SSHT | 31.472 | 61.436 | 46.256 | 41.020 |
| RATE | 84.234 | 84.234 | 84.234 | 0.000 |
| GOVTEXP | 915.786 | 2334.098 | 1568.997 | 96885.666 |
| TALADJ | -430.154 | 436.386 | -3.020 | 16645.060 |
| CTALLY | -455.676 | 443.119 | -24.027 | 27147.485 |
| TALEXC | -305.676 | 293.119 | 0.160 | 4696.666 |

SCENARIO 3 - DESCRIPTIVE STATISTICS

| VARIABLE | MINIMUM VALUE | MAXIMUM VALUE | MEAN | VARIANCE |
|---|---|---|---|---|
| CROPYR=8182 | | | | |
| PREDSHIP | 31.500 | 31.500 | 31.500 | 0 |
| SHIP | 31.500 | 31.500 | 31.500 | 0 |
| CGSCC | 0.000 | 0.000 | 0.000 | 0 |
| GCOM | 0.000 | 0.000 | 0.000 | 0 |
| USPRICE | 0.000 | 0.000 | 0.000 | 0 |
| CANUS | 0.000 | 0.000 | 0.000 | 0 |
| WTP | . | . | . | . |
| FPRATIO | 0.000 | 0.000 | 0.000 | 0 |
| SSLADJ | 0.000 | 0.000 | 0.000 | 0 |
| GSH | 0.000 | 0.000 | 0.000 | 0 |
| SSH | 0.000 | 0.000 | 0.000 | 0 |
| GSHT | 0.000 | 0.000 | 0.000 | 0 |
| SSHT | 0.000 | 0.000 | 0.000 | 0 |
| RATE | 0.000 | 0.000 | 0.000 | 0 |
| GOVTEXP | 0.000 | 0.000 | 0.000 | 0 |
| TALADJ | 0.000 | 0.000 | 0.000 | 0 |
| CTALLY | 0.000 | 0.000 | 0.000 | 0 |
| TALEXC | 0.000 | 0.000 | 0.000 | 0 |
| CROPYR=8283 | | | | |
| PREDSHIP | 32.900 | 32.900 | 32.900 | 0 |
| SHIP | 32.900 | 32.900 | 32.900 | 0 |
| CGSCC | 32.445 | 32.445 | 32.445 | 0 |
| GCOM | 573.045 | 573.045 | 573.045 | 0 |
| USPRICE | 0.000 | 0.000 | 0.000 | 0 |
| CANUS | 0.000 | 0.000 | 0.000 | 0 |
| WTP | . | . | . | . |
| FPRATIO | 0.000 | 0.000 | 0.000 | 0 |
| SSLADJ | 0.000 | 0.000 | 0.000 | 0 |
| GSH | 0.000 | 0.000 | 0.000 | 0 |
| SSH | 0.000 | 0.000 | 0.000 | 0 |
| GSHT | 0.000 | 0.000 | 0.000 | 0 |
| SSHT | 0.000 | 0.000 | 0.000 | 0 |
| RATE | 0.000 | 0.000 | 0.000 | 0 |
| GOVTEXP | 0.000 | 0.000 | 0.000 | 0 |
| TALADJ | 0.000 | 0.000 | 0.000 | 0 |
| CTALLY | 0.000 | 0.000 | 0.000 | 0 |
| TALEXC | 0.000 | 0.000 | 0.000 | 0 |

SCENARIO 3 - DESCRIPTIVE STATISTICS

| VARIABLE | MINIMUM VALUE | MAXIMUM VALUE | MEAN | VARIANCE |
|---|---|---|---|---|
| CROPYR=8384 | | | | |
| PREDSHIP | 31.700 | 31.700 | 31.700 | 0.000 |
| SHIP | 34.550 | 34.550 | 34.550 | 0.000 |
| CGSCC | 40.616 | 40.616 | 40.616 | 0.000 |
| GCOM | 610.716 | 610.716 | 610.716 | 0.000 |
| USPRICE | 0.000 | 0.000 | 0.000 | 0.000 |
| CANUS | 1.196 | 1.434 | 1.327 | 0.003 |
| WTP | . | . | . | . |
| FPRATIO | 0.000 | 0.000 | 0.000 | 0.000 |
| SSLADJ | 0.000 | 0.000 | 0.000 | 0.000 |
| GSH | 596.720 | 596.720 | 596.720 | 0.000 |
| SSH | 181.730 | 181.730 | 181.730 | 0.000 |
| GSHT | 18.820 | 18.820 | 18.820 | 0.000 |
| SSHT | 5.730 | 5.730 | 5.730 | 0.000 |
| RATE | 24.550 | 24.550 | 24.550 | 0.000 |
| GOVTEXP | 664.231 | 664.231 | 664.231 | 0.000 |
| TALADJ | 0.000 | 0.000 | 0.000 | 0.000 |
| CTALLY | 0.000 | 0.000 | 0.000 | 0.000 |
| TALEXC | 0.000 | 0.000 | 0.000 | 0.000 |
| CROPYR=8485 | | | | |
| PREDSHIP | 31.800 | 31.800 | 31.800 | 0.000 |
| SHIP | 25.700 | 25.700 | 25.700 | 0.000 |
| CGSCC | 39.356 | 39.356 | 39.356 | 0.000 |
| GCOM | 638.956 | 638.956 | 638.956 | 0.000 |
| USPRICE | 0.000 | 0.000 | 0.000 | 0.000 |
| CANUS | 1.176 | 1.418 | 1.299 | 0.003 |
| WTP | 0.000 | 0.000 | 0.000 | 0.000 |
| FPRATIO | 0.000 | 0.000 | 0.000 | 0.000 |
| SSLADJ | 0.000 | 0.000 | 0.000 | 0.000 |
| GSH | 560.860 | 560.860 | 560.860 | 0.000 |
| SSH | 244.810 | 244.810 | 244.810 | 0.000 |
| GSHT | 17.630 | 17.630 | 17.630 | 0.000 |
| SSHT | 7.700 | 7.700 | 7.700 | 0.000 |
| RATE | 25.330 | 25.330 | 25.330 | 0.000 |
| GOVTEXP | 471.091 | 471.091 | 471.091 | 0.000 |
| TALADJ | 0.000 | 0.000 | 0.000 | 0.000 |
| CTALLY | 0.000 | 0.000 | 0.000 | 0.000 |
| TALEXC | 0.000 | 0.000 | 0.000 | 0.000 |

## SCENARIO 3 - DESCRIPTIVE STATISTICS

| VARIABLE | MINIMUM VALUE | MAXIMUM VALUE | MEAN | VARIANCE |
|---|---|---|---|---|
| | | CROPYR=8586 | | |
| PREDSHIP | 31.800 | 31.800 | 31.800 | 0.000 |
| SHIP | 18.069 | 40.307 | 34.279 | 31.474 |
| CGSCC | 64.087 | 64.087 | 64.087 | 0.000 |
| GCOM | 693.187 | 693.187 | 693.187 | 0.000 |
| USPRICE | 137.000 | 137.000 | 137.000 | 0.000 |
| CANUS | 1.151 | 1.398 | 1.284 | 0.004 |
| WTP | 0.000 | 0.000 | 0.000 | 0.000 |
| FPRATIO | 0.000 | 0.000 | 0.000 | 0.000 |
| SSLADJ | 0.000 | 0.000 | 0.000 | 0.000 |
| GSH | 701.700 | 701.700 | 701.700 | 0.000 |
| SSH | 190.500 | 190.500 | 190.500 | 0.000 |
| GSHT | 22.070 | 22.070 | 22.070 | 0.000 |
| SSHT | 5.990 | 5.990 | 5.990 | 0.000 |
| RATE | 28.060 | 28.060 | 28.060 | 0.000 |
| GOVTEXP | 410.481 | 901.272 | 768.243 | 15330.433 |
| TALADJ | 64.000 | 64.000 | 64.000 | 0.000 |
| CTALLY | 64.000 | 64.000 | 64.000 | 0.000 |
| TALEXC | 0.000 | 0.000 | 0.000 | 0.000 |
| | | CROPYR=8687 | | |
| PREDSHIP | 33.583 | 33.583 | 33.583 | 0.000 |
| SHIP | 18.088 | 40.487 | 33.852 | 32.785 |
| CGSCC | 68.324 | 68.324 | 68.324 | 0.000 |
| GCOM | 726.924 | 726.924 | 726.924 | 0.000 |
| USPRICE | 116.156 | 127.910 | 121.561 | 11.489 |
| CANUS | 1.131 | 1.382 | 1.266 | 0.003 |
| WTP | 148.706 | 189.494 | 168.337 | 75.910 |
| FPRATIO | 3.558 | 4.534 | 4.016 | 0.044 |
| SSLADJ | 0.000 | 0.000 | 0.000 | 0.000 |
| GSH | 716.524 | 716.524 | 716.524 | 0.000 |
| SSH | 306.522 | 306.522 | 306.522 | 0.000 |
| GSHT | 21.336 | 21.336 | 21.336 | 0.000 |
| SSHT | 9.127 | 9.127 | 9.127 | 0.000 |
| RATE | 30.463 | 30.463 | 30.463 | 0.000 |
| GOVTEXP | 396.330 | 874.234 | 732.677 | 14924.750 |
| TALADJ | -134.516 | 131.225 | -14.045 | 9096.994 |
| CTALLY | -70.516 | 195.225 | 49.955 | 9096.994 |
| TALEXC | 0.000 | 45.225 | 7.486 | 216.630 |

## SCENARIO 3 - DESCRIPTIVE STATISTICS

| VARIABLE | MINIMUM VALUE | MAXIMUM VALUE | MEAN | VARIANCE |
|---|---|---|---|---|
| | | CROPYR=8788 | | |
| PREDSHIP | 34.099 | 34.099 | 34.099 | 0.000 |
| SHIP | 21.260 | 40.982 | 34.371 | 31.620 |
| CGSCC | 69.374 | 69.374 | 69.374 | 0.000 |
| GCOM | 727.974 | 727.974 | 727.974 | 0.000 |
| USPRICE | 112.812 | 132.970 | 123.904 | 34.989 |
| CANUS | 1.120 | 1.347 | 1.247 | 0.003 |
| WTP | 124.203 | 167.117 | 147.157 | 69.990 |
| FPRATIO | 4.661 | 6.271 | 5.310 | 0.094 |
| SSLADJ | 0.000 | 0.000 | 0.000 | 0.000 |
| GSH | 717.974 | 717.974 | 717.974 | 0.000 |
| SSH | 350.883 | 350.883 | 350.883 | 0.000 |
| GSHT | 21.056 | 21.056 | 21.056 | 0.000 |
| SSHT | 10.290 | 10.290 | 10.290 | 0.000 |
| RATE | 31.346 | 31.346 | 31.346 | 0.000 |
| GOVTEXP | 457.643 | 872.910 | 733.703 | 14018.421 |
| TALADJ | -132.016 | 158.304 | -10.699 | 9544.179 |
| CTALLY | -198.689 | 308.304 | 31.769 | 20721.692 |
| TALEXC | -48.689 | 158.304 | 14.779 | 1941.887 |
| | | CROPYR=8889 | | |
| PREDSHIP | 34.615 | 34.615 | 34.615 | 0.000 |
| SHIP | 20.186 | 41.956 | 34.617 | 27.827 |
| CGSCC | 70.423 | 70.423 | 70.423 | 0.000 |
| GCOM | 729.023 | 729.023 | 729.023 | 0.000 |
| USPRICE | 110.209 | 138.213 | 125.982 | 61.082 |
| CANUS | 1.096 | 1.335 | 1.233 | 0.003 |
| WTP | 125.530 | 170.014 | 147.501 | 95.396 |
| FPRATIO | 5.754 | 7.793 | 6.662 | 0.197 |
| SSLADJ | 0.000 | 0.000 | 0.000 | 0.000 |
| GSH | 719.023 | 764.248 | 726.510 | 216.630 |
| SSH | 352.746 | 397.971 | 390.484 | 216.630 |
| GSHT | 20.772 | 22.079 | 20.989 | 0.181 |
| SSHT | 10.191 | 11.497 | 11.281 | 0.181 |
| RATE | 32.269 | 32.269 | 32.269 | 0.000 |
| GOVTEXP | 429.308 | 885.723 | 736.347 | 12130.099 |
| TALADJ | -146.895 | 182.635 | -9.721 | 9042.711 |
| CTALLY | -288.554 | 332.635 | 7.270 | 23104.925 |
| TALEXC | -138.554 | 182.635 | 4.513 | 2805.869 |

SCENARIO 3 - DESCRIPTIVE STATISTICS

| VARIABLE | MINIMUM VALUE | MAXIMUM VALUE | MEAN | VARIANCE |
|---|---|---|---|---|
| CROPYR=8990 | | | | |
| PREDSHIP | 35.131 | 35.131 | 35.131 | 0.000 |
| SHIP | 20.111 | 42.353 | 34.909 | 28.851 |
| CGSCC | 71.473 | 71.473 | 71.473 | 0.000 |
| GCOM | 730.073 | 730.073 | 730.073 | 0.000 |
| USPRICE | 107.454 | 165.106 | 128.838 | 97.782 |
| CANUS | 1.079 | 1.315 | 1.215 | 0.003 |
| WTP | 120.467 | 177.321 | 147.835 | 129.120 |
| FPRATIO | 5.925 | 9.107 | 7.381 | 0.339 |
| SSLADJ | 0.000 | 0.000 | 0.000 | 0.000 |
| GSH | 671.384 | 878.377 | 734.852 | 1941.887 |
| SSH | 289.799 | 496.792 | 433.324 | 1941.887 |
| GSHT | 19.111 | 25.003 | 20.918 | 1.573 |
| SSHT | 8.249 | 14.141 | 12.335 | 1.573 |
| RATE | 33.252 | 33.252 | 33.252 | 0.000 |
| GOVTEXP | 422.223 | 998.921 | 740.085 | 14450.951 |
| TALADJ | -260.310 | 223.152 | -12.436 | 11399.163 |
| CTALLY | -284.169 | 346.513 | -9.680 | 21472.849 |
| TALEXC | -134.169 | 196.513 | 2.412 | 2378.532 |
| CROPYR=9091 | | | | |
| PREDSHIP | 35.646 | 35.646 | 35.646 | 0.000 |
| SHIP | 21.373 | 43.151 | 35.688 | 28.384 |
| CGSCC | 72.523 | 72.523 | 72.523 | 0.000 |
| GCOM | 731.123 | 731.123 | 731.123 | 0.000 |
| USPRICE | 109.228 | 226.574 | 133.145 | 219.131 |
| CANUS | 1.063 | 1.302 | 1.192 | 0.003 |
| WTP | 121.308 | 192.377 | 148.839 | 194.355 |
| FPRATIO | 5.470 | 10.436 | 8.049 | 0.865 |
| SSLADJ | 0.000 | 19.220 | 0.111 | 1.882 |
| GSH | 582.569 | 903.758 | 725.747 | 2906.744 |
| SSH | 319.632 | 640.821 | 497.643 | 2906.744 |
| GSHT | 16.343 | 25.353 | 20.360 | 2.288 |
| SSHT | 8.967 | 17.977 | 13.961 | 2.288 |
| RATE | 34.320 | 34.320 | 34.320 | 0.000 |
| GOVTEXP | 442.380 | 1004.375 | 735.937 | 13857.130 |
| TALADJ | -263.728 | 235.624 | -5.045 | 11551.529 |
| CTALLY | -305.594 | 340.104 | -17.137 | 22366.869 |
| TALEXC | -155.594 | 190.104 | -2.902 | 2458.713 |

SCENARIO 3 - DESCRIPTIVE STATISTICS

| VARIABLE | MINIMUM VALUE | MAXIMUM VALUE | MEAN | VARIANCE |
|---|---|---|---|---|
| CROPYR=9192 | | | | |
| PREDSHIP | 36.162 | 36.162 | 36.162 | 0.000 |
| SHIP | 22.056 | 42.330 | 35.912 | 28.689 |
| CGSCC | 73.572 | 73.572 | 73.572 | 0.000 |
| GCOM | 732.172 | 732.172 | 732.172 | 0.000 |
| USPRICE | 110.964 | 217.058 | 140.515 | 290.823 |
| CANUS | 1.047 | 1.282 | 1.179 | 0.003 |
| WTP | 116.745 | 283.870 | 150.975 | 370.212 |
| FPRATIO | 4.437 | 12.509 | 8.903 | 1.683 |
| SSLADJ | 0.000 | 105.200 | 6.520 | 292.195 |
| GSH | 588.003 | 918.685 | 731.104 | 2441.316 |
| SSH | 363.988 | 694.670 | 551.569 | 2441.316 |
| GSHT | 16.260 | 25.404 | 20.217 | 1.867 |
| SSHT | 10.065 | 19.210 | 15.253 | 1.867 |
| RATE | 35.470 | 35.470 | 35.470 | 0.000 |
| GOVTEXP | 450.461 | 1012.355 | 736.164 | 14190.888 |
| TALADJ | -271.600 | 280.541 | 2.026 | 11943.964 |
| CTALLY | -267.131 | 323.797 | -12.209 | 21383.412 |
| TALEXC | -117.131 | 173.797 | -0.865 | 2010.595 |
| CROPYR=9293 | | | | |
| PREDSHIP | 36.678 | 36.678 | 36.678 | 0.000 |
| SHIP | 21.976 | 43.887 | 36.380 | 28.179 |
| CGSCC | 74.622 | 74.622 | 74.622 | 0.000 |
| GCOM | 733.222 | 733.222 | 733.222 | 0.000 |
| USPRICE | 112.957 | 238.655 | 148.374 | 511.925 |
| CANUS | 1.046 | 1.253 | 1.156 | 0.002 |
| WTP | 116.818 | 261.680 | 157.643 | 463.672 |
| FPRATIO | 5.538 | 13.518 | 9.490 | 2.236 |
| SSLADJ | 0.000 | 148.245 | 18.191 | 1096.171 |
| GSH | 567.628 | 913.326 | 738.511 | 3429.619 |
| SSH | 432.759 | 778.456 | 607.573 | 3429.619 |
| GSHT | 15.476 | 24.901 | 20.135 | 2.549 |
| SSHT | 11.799 | 21.224 | 16.565 | 2.549 |
| RATE | 36.700 | 36.700 | 36.700 | 0.000 |
| GOVTEXP | 350.098 | 1025.204 | 742.627 | 15003.505 |
| TALADJ | -283.941 | 354.229 | 8.200 | 10500.676 |
| CTALLY | -265.948 | 392.868 | -3.143 | 23941.074 |
| TALEXC | -115.948 | 242.868 | 7.142 | 3052.163 |

## SCENARIO 3 - DESCRIPTIVE STATISTICS

| VARIABLE | MINIMUM VALUE | MAXIMUM VALUE | MEAN | VARIANCE |
|---|---|---|---|---|
| CROPYR=9394 | | | | |
| PREDSHIP | 37.194 | 37.194 | 37.194 | 0.000 |
| SHIP | 22.676 | 43.534 | 36.888 | 25.813 |
| CGSCC | 75.672 | 75.672 | 75.672 | 0.000 |
| GCOM | 734.272 | 734.272 | 734.272 | 0.000 |
| USPRICE | 113.441 | 253.678 | 158.484 | 1004.371 |
| CANUS | 1.023 | 1.241 | 1.144 | 0.003 |
| WTP | 119.138 | 260.615 | 162.750 | 669.192 |
| FPRATIO | 5.175 | 14.169 | 10.052 | 2.596 |
| SSLADJ | 0.000 | 172.572 | 33.946 | 2042.408 |
| GSH | 607.140 | 970.082 | 757.352 | 3549.085 |
| SSH | 443.616 | 806.558 | 656.346 | 3549.085 |
| GSHT | 16.324 | 26.082 | 20.362 | 2.565 |
| SSHT | 11.927 | 21.685 | 17.646 | 2.565 |
| RATE | 38.009 | 38.009 | 38.009 | 0.000 |
| GOVTEXP | 452.735 | 1083.543 | 761.176 | 14251.898 |
| TALADJ | -269.419 | 273.716 | 6.437 | 9774.991 |
| CTALLY | -257.761 | 423.716 | -3.848 | 19862.592 |
| TALEXC | -107.761 | 273.716 | 3.354 | 1775.849 |
| CROPYR=9495 | | | | |
| PREDSHIP | 37.710 | 37.710 | 37.710 | 0.000 |
| SHIP | 21.107 | 43.988 | 37.659 | 22.917 |
| CGSCC | 76.721 | 76.721 | 76.721 | 0.000 |
| GCOM | 735.321 | 735.321 | 735.321 | 0.000 |
| USPRICE | 114.805 | 263.872 | 170.689 | 1158.244 |
| CANUS | 1.002 | 1.228 | 1.116 | 0.003 |
| WTP | 119.066 | 278.513 | 171.688 | 1308.268 |
| FPRATIO | 5.968 | 14.656 | 10.358 | 3.437 |
| SSLADJ | 0.000 | 218.431 | 50.529 | 3155.579 |
| GSH | 617.627 | 1041.002 | 782.992 | 4897.291 |
| SSH | 444.607 | 867.981 | 702.616 | 4897.291 |
| GSHT | 16.378 | 27.605 | 20.763 | 3.444 |
| SSHT | 11.790 | 23.017 | 18.632 | 3.444 |
| RATE | 39.396 | 39.396 | 39.396 | 0.000 |
| GOVTEXP | 458.636 | 1104.998 | 791.450 | 14361.287 |
| TALADJ | -296.937 | 248.126 | -5.701 | 10144.926 |
| CTALLY | -278.078 | 349.736 | -12.903 | 21441.011 |
| TALEXC | -128.078 | 199.736 | -2.181 | 2133.466 |

## SCENARIO 3 - DESCRIPTIVE STATISTICS

| VARIABLE | MINIMUM VALUE | MAXIMUM VALUE | MEAN | VARIANCE |
|---|---|---|---|---|
| CROPYR=9596 | | | | |
| PREDSHIP | 38.226 | 38.226 | 38.226 | 0.000 |
| SHIP | 24.291 | 44.444 | 37.865 | 24.206 |
| CGSCC | 77.771 | 77.771 | 77.771 | 0.000 |
| GCOM | 736.371 | 736.371 | 736.371 | 0.000 |
| USPRICE | 120.477 | 275.632 | 185.564 | 1847.868 |
| CANUS | 0.994 | 1.206 | 1.109 | 0.002 |
| WTP | 115.176 | 287.675 | 179.650 | 1269.194 |
| FPRATIO | 6.195 | 14.960 | 10.438 | 3.037 |
| SSLADJ | 0.000 | 275.935 | 51.622 | 3785.787 |
| GSH | 634.340 | 1020.380 | 781.347 | 5093.575 |
| SSH | 541.545 | 927.585 | 780.578 | 5093.575 |
| GSHT | 16.594 | 26.693 | 20.440 | 3.486 |
| SSHT | 14.167 | 24.266 | 20.420 | 3.486 |
| RATE | 40.860 | 40.860 | 40.860 | 0.000 |
| GOVTEXP | 459.297 | 1124.821 | 783.752 | 14646.132 |
| TALADJ | -373.154 | 249.300 | 3.522 | 9733.487 |
| CTALLY | -262.268 | 352.021 | -7.200 | 20883.468 |
| TALEXC | -112.268 | 202.021 | 2.543 | 2058.546 |
| CROPYR=9697 | | | | |
| PREDSHIP | 38.742 | 38.742 | 38.742 | 0.000 |
| SHIP | 23.879 | 45.090 | 38.796 | 23.327 |
| CGSCC | 78.820 | 78.820 | 78.820 | 0.000 |
| GCOM | 737.420 | 737.420 | 737.420 | 0.000 |
| USPRICE | 117.531 | 286.723 | 202.412 | 2258.644 |
| CANUS | 0.980 | 1.185 | 1.090 | 0.002 |
| WTP | 113.389 | 304.758 | 194.121 | 2097.389 |
| FPRATIO | 6.437 | 16.144 | 10.584 | 4.604 |
| SSLADJ | 0.000 | 306.714 | 68.516 | 6422.952 |
| GSH | 599.342 | 1058.930 | 793.755 | 7941.889 |
| SSH | 583.846 | 1043.434 | 849.021 | 7941.889 |
| GSHT | 15.470 | 27.333 | 20.488 | 5.291 |
| SSHT | 15.070 | 26.933 | 21.915 | 5.291 |
| RATE | 42.403 | 42.403 | 42.403 | 0.000 |
| GOVTEXP | 398.032 | 1168.237 | 806.220 | 20315.184 |
| TALADJ | -290.177 | 309.669 | -0.176 | 9949.146 |
| CTALLY | -363.287 | 408.969 | -9.919 | 20262.492 |
| TALEXC | -213.287 | 258.969 | 3.133 | 2237.556 |

SCENARIO 3 - DESCRIPTIVE STATISTICS

| VARIABLE | MINIMUM VALUE | MAXIMUM VALUE | MEAN | VARIANCE |
|---|---|---|---|---|
| | | CROPYR=9798 | | |
| PREDSHIP | 39.258 | 39.258 | 39.258 | 0.000 |
| SHIP | 24.047 | 45.914 | 39.506 | 19.427 |
| CGSCC | 79.870 | 79.870 | 79.870 | 0.000 |
| GCOM | 738.470 | 738.470 | 738.470 | 0.000 |
| USPRICE | 124.552 | 299.335 | 214.863 | 2300.636 |
| CANUS | 0.964 | 1.171 | 1.077 | 0.002 |
| WTP | 118.412 | 313.065 | 207.837 | 2547.174 |
| FPRATIO | 6.695 | 16.598 | 10.733 | 4.915 |
| SSLADJ | 0.000 | 343.366 | 78.202 | 8355.503 |
| GSH | 624.107 | 1128.863 | 809.215 | 9348.396 |
| SSH | 599.440 | 1104.196 | 919.087 | 9348.396 |
| GSHT | 15.898 | 28.755 | 20.613 | 6.066 |
| SSHT | 15.269 | 28.127 | 23.412 | 6.066 |
| RATE | 44.024 | 44.024 | 44.024 | 0.000 |
| GOVTEXP | 504.860 | 1231.609 | 825.073 | 19106.224 |
| TALADJ | -272.722 | 348.293 | -7.904 | 9137.580 |
| CTALLY | -288.773 | 402.484 | -20.956 | 19443.578 |
| TALEXC | -138.773 | 252.484 | -3.456 | 1858.774 |
| | | CROPYR=9899 | | |
| PREDSHIP | 39.774 | 39.774 | 39.774 | 0.000 |
| SHIP | 23.443 | 46.395 | 39.569 | 23.365 |
| CGSCC | 80.920 | 80.920 | 80.920 | 0.000 |
| GCOM | 739.520 | 739.520 | 739.520 | 0.000 |
| USPRICE | 128.143 | 310.467 | 226.891 | 2270.209 |
| CANUS | 0.948 | 1.155 | 1.053 | 0.002 |
| WTP | 123.956 | 323.970 | 217.741 | 2493.767 |
| FPRATIO | 7.124 | 16.174 | 10.898 | 4.483 |
| SSLADJ | 0.000 | 348.687 | 91.706 | 9741.473 |
| GSH | 599.011 | 1195.922 | 824.358 | 12579.179 |
| SSH | 622.741 | 1215.652 | 994.305 | 12579.179 |
| GSHT | 15.060 | 30.068 | 20.726 | 7.952 |
| SSHT | 15.657 | 30.665 | 24.999 | 7.952 |
| RATE | 45.725 | 45.725 | 45.725 | 0.000 |
| GOVTEXP | 510.009 | 1344.559 | 829.757 | 22822.318 |
| TALADJ | -325.375 | 330.899 | 1.057 | 10460.850 |
| CTALLY | -262.262 | 406.349 | -16.443 | 21275.051 |
| TALEXC | -112.262 | 256.349 | -3.664 | 2179.775 |

SCENARIO 3 - DESCRIPTIVE STATISTICS

| VARIABLE | MINIMUM VALUE | MAXIMUM VALUE | MEAN | VARIANCE |
|---|---|---|---|---|
| | | CROPYR=9900 | | |
| PREDSHIP | 40.290 | 40.290 | 40.290 | 0.000 |
| SHIP | 26.005 | 46.972 | 40.561 | 21.484 |
| CGSCC | 81.969 | 81.969 | 81.969 | 0.000 |
| GCOM | 740.569 | 740.569 | 740.569 | 0.000 |
| USPRICE | 132.767 | 323.367 | 251.985 | 2022.078 |
| CANUS | 0.935 | 1.121 | 1.040 | 0.002 |
| WTP | 123.015 | 327.975 | 224.616 | 2364.610 |
| FPRATIO | 6.992 | 17.840 | 11.271 | 5.145 |
| SSLADJ | 0.000 | 433.873 | 114.904 | 14077.812 |
| GSH | 647.358 | 1231.977 | 842.018 | 15117.708 |
| SSH | 682.053 | 1266.672 | 1072.012 | 15117.708 |
| GSHT | 16.068 | 30.578 | 20.899 | 9.313 |
| SSHT | 16.929 | 31.439 | 26.608 | 9.313 |
| RATE | 47.507 | 47.507 | 47.507 | 0.000 |
| GOVTEXP | 534.840 | 1316.686 | 857.284 | 24233.899 |
| TALADJ | -224.539 | 297.237 | -1.264 | 8408.587 |
| CTALLY | -287.431 | 365.322 | -14.043 | 20540.522 |
| TALEXC | -137.431 | 215.322 | 3.293 | 2101.380 |
| | | CROPYR=200001 | | |
| PREDSHIP | 40.806 | 40.806 | 40.806 | 0.000 |
| SHIP | 28.599 | 46.814 | 41.043 | 17.732 |
| CGSCC | 83.019 | 83.019 | 83.019 | 0.000 |
| GCOM | 741.619 | 741.619 | 741.619 | 0.000 |
| USPRICE | 148.401 | 336.572 | 260.431 | 2097.874 |
| CANUS | 0.924 | 1.121 | 1.023 | 0.002 |
| WTP | 131.076 | 336.922 | 246.279 | 2170.256 |
| FPRATIO | 6.295 | 18.993 | 10.918 | 5.424 |
| SSLADJ | 0.000 | 438.126 | 111.805 | 16988.108 |
| GSH | 619.357 | 1192.400 | 839.760 | 18991.297 |
| SSH | 822.192 | 1395.235 | 1174.832 | 18991.297 |
| GSHT | 15.178 | 29.221 | 20.580 | 11.406 |
| SSHT | 20.149 | 34.192 | 28.791 | 11.406 |
| RATE | 49.371 | 49.371 | 49.371 | 0.000 |
| GOVTEXP | 496.794 | 1273.654 | 854.977 | 27857.496 |
| TALADJ | -334.125 | 284.506 | -1.075 | 8543.369 |
| CTALLY | -298.263 | 357.460 | -18.411 | 18927.412 |
| TALEXC | -148.263 | 207.460 | 0.528 | 1800.591 |

SCENARIO 4 - DESCRIPTIVE STATISTICS

| VARIABLE | MINIMUM VALUE | MAXIMUM VALUE | MEAN | VARIANCE |
|---|---|---|---|---|
| ------------------------- CROPYR=8182 | | | | |
| PREDSHIP | 31.500 | 31.500 | 31.500 | 0 |
| SHIP | 31.500 | 31.500 | 31.500 | 0 |
| CGSCC | 0.000 | 0.000 | 0.000 | 0 |
| GCOM | 0.000 | 0.000 | 0.000 | 0 |
| USPRICE | 0.000 | 0.000 | 0.000 | 0 |
| CANUS | 0.000 | 0.000 | 0.000 | 0 |
| WTP | . | . | . | . |
| FPRATIO | 0.000 | 0.000 | 0.000 | 0 |
| SSLADJ | 0.000 | 0.000 | 0.000 | 0 |
| GTR | 0.000 | 0.000 | 0.000 | 0 |
| GTRT | 0.000 | 0.000 | 0.000 | 0 |
| SSHT | 0.000 | 0.000 | 0.000 | 0 |
| GRSCOST | 0.000 | 0.000 | 0.000 | 0 |
| NSCOST | 0.000 | 0.000 | 0.000 | 0 |
| NSCOSTT | 0.000 | 0.000 | 0.000 | 0 |
| ------------------------- CROPYR=8283 | | | | |
| PREDSHIP | 32.900 | 32.900 | 32.900 | 0 |
| SHIP | 32.900 | 32.900 | 32.900 | 0 |
| CGSCC | 32.445 | 32.445 | 32.445 | 0 |
| GCOM | 573.045 | 573.045 | 573.045 | 0 |
| USPRICE | 0.000 | 0.000 | 0.000 | 0 |
| CANUS | 0.000 | 0.000 | 0.000 | 0 |
| WTP | . | . | . | . |
| FPRATIO | 0.000 | 0.000 | 0.000 | 0 |
| SSLADJ | 0.000 | 0.000 | 0.000 | 0 |
| GTR | 0.000 | 0.000 | 0.000 | 0 |
| GTRT | 0.000 | 0.000 | 0.000 | 0 |
| SSHT | 0.000 | 0.000 | 0.000 | 0 |
| GRSCOST | 0.000 | 0.000 | 0.000 | 0 |
| NSCOST | 0.000 | 0.000 | 0.000 | 0 |
| NSCOSTT | 0.000 | 0.000 | 0.000 | 0 |
| ------------------------- CROPYR=8384 | | | | |
| PREDSHIP | 31.700 | 31.700 | 31.700 | 0.000 |
| SHIP | 34.550 | 34.550 | 34.550 | 0.000 |
| CGSCC | 40.616 | 40.616 | 40.616 | 0.000 |
| GCOM | 610.716 | 610.716 | 610.716 | 0.000 |
| USPRICE | 0.000 | 0.000 | 0.000 | 0.000 |
| CANUS | 1.196 | 1.434 | 1.327 | 0.003 |
| WTP | . | . | . | . |
| FPRATIO | 0.000 | 0.000 | 0.000 | 0.000 |
| SSLADJ | 0.000 | 0.000 | 0.000 | 0.000 |
| GTR | 596.720 | 596.720 | 596.720 | 0.000 |
| GTRT | 18.824 | 18.824 | 18.824 | 0.000 |
| SSHT | 24.550 | 24.550 | 24.550 | 0.000 |
| GRSCOST | 848.435 | 848.435 | 848.435 | 0.000 |
| NSCOST | 263.107 | 263.107 | 263.107 | 0.000 |
| NSCOSTT | 7.615 | 7.615 | 7.615 | 0.000 |

SCENARIO 4 - DESCRIPTIVE STATISTICS

| VARIABLE | MINIMUM VALUE | MAXIMUM VALUE | MEAN | VARIANCE |
|---|---|---|---|---|
| ------------------------- CROPYR=8485 | | | | |
| PREDSHIP | 31.800 | 31.800 | 31.800 | 0.000 |
| SHIP | 25.700 | 25.700 | 25.700 | 0.000 |
| CGSCC | 39.356 | 39.356 | 39.356 | 0.000 |
| GCOM | 638.956 | 638.956 | 638.956 | 0.000 |
| USPRICE | 0.000 | 0.000 | 0.000 | 0.000 |
| CANUS | 1.194 | 1.439 | 1.319 | 0.003 |
| WTP | 0.000 | 0.000 | 0.000 | 0.000 |
| FPRATIO | 0.000 | 0.000 | 0.000 | 0.000 |
| SSLADJ | 0.000 | 0.000 | 0.000 | 0.000 |
| GTR | 560.860 | 560.860 | 560.860 | 0.000 |
| GTRT | 19.527 | 19.527 | 19.527 | 0.000 |
| SSHT | 24.550 | 24.550 | 24.550 | 0.000 |
| GRSCOST | 651.118 | 651.118 | 651.118 | 0.000 |
| NSCOST | 199.460 | 199.460 | 199.460 | 0.000 |
| NSCOSTT | 7.761 | 7.761 | 7.761 | 0.000 |
| ------------------------- CROPYR=8586 | | | | |
| PREDSHIP | 31.800 | 31.800 | 31.800 | 0.000 |
| SHIP | 18.069 | 40.307 | 34.279 | 31.474 |
| CGSCC | 64.087 | 64.087 | 64.087 | 0.000 |
| GCOM | 693.187 | 693.187 | 693.187 | 0.000 |
| USPRICE | 137.000 | 137.000 | 137.000 | 0.000 |
| CANUS | 1.186 | 1.441 | 1.323 | 0.004 |
| WTP | 0.000 | 0.000 | 0.000 | 0.000 |
| FPRATIO | 0.000 | 0.000 | 0.000 | 0.000 |
| SSLADJ | 0.000 | 0.000 | 0.000 | 0.000 |
| GTR | 701.700 | 701.700 | 701.700 | 0.000 |
| GTRT | 21.430 | 21.430 | 21.430 | 0.000 |
| SSHT | 28.060 | 26.060 | 28.060 | 0.000 |
| GRSCOST | 506.948 | 1130.862 | 961.750 | 24774.889 |
| NSCOST | 158.446 | 353.450 | 300.594 | 2420.180 |
| NSCOSTT | 8.769 | 8.769 | 8.769 | 0.000 |
| ------------------------- CROPYR=8687 | | | | |
| PREDSHIP | 33.583 | 33.583 | 33.583 | 0.000 |
| SHIP | 18.088 | 40.487 | 33.852 | 32.785 |
| CGSCC | 68.324 | 68.324 | 68.324 | 0.000 |
| GCOM | 726.924 | 726.924 | 726.924 | 0.000 |
| USPRICE | 116.156 | 127.910 | 121.561 | 11.489 |
| CANUS | 1.183 | 1.445 | 1.324 | 0.003 |
| WTP | 153.201 | 195.221 | 173.425 | 80.569 |
| FPRATIO | 13.582 | 17.308 | 15.331 | 0.647 |
| SSLADJ | 0.000 | 0.000 | 0.000 | 0.000 |
| GTR | 716.524 | 716.524 | 716.524 | 0.000 |
| GTRT | 21.336 | 21.336 | 21.336 | 0.000 |
| SSHT | 30.463 | 30.463 | 30.463 | 0.000 |
| GRSCOST | 551.027 | 1233.374 | 1031.260 | 30425.343 |
| NSCOST | 203.690 | 455.923 | 381.210 | 4157.466 |
| NSCOSTT | 11.261 | 11.261 | 11.261 | 0.000 |

## SCENARIO 4 - DESCRIPTIVE STATISTICS

| VARIABLE | MINIMUM VALUE | MAXIMUM VALUE | MEAN | VARIANCE |
|---|---|---|---|---|
| ------------ | ------------ | CROPYR=8788 | ------------ | ------------ |
| PREDSHIP | 34.099 | 34.099 | 34.099 | 0.000 |
| SHIP | 21.260 | 40.982 | 34.371 | 31.620 |
| CGSCC | 69.374 | 69.374 | 69.374 | 0.000 |
| GCOM | 727.974 | 727.974 | 727.974 | 0.000 |
| USPRICE | 112.812 | 132.970 | 123.904 | 34.989 |
| CANUS | 1.189 | 1.430 | 1.324 | 0.003 |
| WTP | 129.876 | 174.751 | 153.879 | 76.530 |
| FPRATIO | 16.846 | 22.666 | 19.193 | 1.223 |
| SSLADJ | 0.000 | 103.367 | 7.510 | 352.267 |
| GTR | 717.974 | 821.341 | 725.484 | 352.267 |
| GTRT | 21.056 | 24.087 | 21.276 | 0.303 |
| SSHT | 31.346 | 31.346 | 31.346 | 0.000 |
| GRSCOST | 666.413 | 1284.626 | 1077.387 | 31068.574 |
| NSCOST | 261.782 | 507.527 | 418.936 | 4789.637 |
| NSCOSTT | 9.668 | 12.396 | 12.198 | 0.245 |
| ------------ | ------------ | CROPYR=8889 | ------------ | ------------ |
| PREDSHIP | 34.615 | 34.615 | 34.615 | 0.000 |
| SHIP | 20.186 | 41.956 | 34.617 | 27.827 |
| CGSCC | 70.423 | 70.423 | 70.423 | 0.000 |
| GCOM | 729.023 | 729.023 | 729.023 | 0.000 |
| USPRICE | 110.209 | 138.213 | 125.982 | 61.082 |
| CANUS | 1.181 | 1.438 | 1.328 | 0.004 |
| WTP | 133.233 | 180.447 | 156.553 | 107.463 |
| FPRATIO | 17.158 | 23.238 | 19.864 | 1.754 |
| SSLADJ | 0.000 | 167.928 | 23.322 | 1201.341 |
| GTR | 719.023 | 886.951 | 742.345 | 1201.341 |
| GTRT | 20.772 | 25.624 | 21.446 | 1.003 |
| SSHT | 32.269 | 32.269 | 32.269 | 0.000 |
| GRSCOST | 651.390 | 1353.898 | 1117.065 | 28976.445 |
| NSCOST | 246.793 | 565.512 | 448.169 | 5146.760 |
| NSCOSTT | 9.208 | 13.574 | 12.968 | 0.812 |
| ------------ | ------------ | CROPYR=8990 | ------------ | ------------ |
| PREDSHIP | 35.131 | 35.131 | 35.131 | 0.000 |
| SHIP | 20.111 | 42.353 | 34.909 | 28.851 |
| CGSCC | 71.473 | 71.473 | 71.473 | 0.000 |
| GCOM | 730.073 | 730.073 | 730.073 | 0.000 |
| USPRICE | 107.454 | 165.106 | 128.838 | 97.782 |
| CANUS | 1.180 | 1.438 | 1.329 | 0.003 |
| WTP | 129.778 | 191.025 | 159.260 | 149.849 |
| FPRATIO | 16.682 | 24.555 | 20.127 | 2.402 |
| SSLADJ | 0.000 | 187.146 | 33.972 | 2240.207 |
| GTR | 720.073 | 907.219 | 754.045 | 2240.207 |
| GTRT | 20.497 | 25.824 | 21.464 | 1.815 |
| SSHT | 33.252 | 33.252 | 33.252 | 0.000 |
| GRSCOST | 668.750 | 1408.335 | 1160.803 | 31900.840 |
| NSCOST | 230.404 | 627.037 | 485.917 | 6987.532 |
| NSCOSTT | 10.011 | 14.805 | 13.935 | 1.470 |

## SCENARIO 4 - DESCRIPTIVE STATISTICS

| VARIABLE | MINIMUM VALUE | MAXIMUM VALUE | MEAN | VARIANCE |
|---|---|---|---|---|
| ------------ | ------------ | CROPYR=9091 | ------------ | ------------ |
| PREDSHIP | 35.646 | 35.646 | 35.646 | 0.000 |
| SHIP | 21.373 | 43.151 | 35.688 | 28.384 |
| CGSCC | 72.523 | 72.523 | 72.523 | 0.000 |
| GCOM | 731.123 | 731.123 | 731.123 | 0.000 |
| USPRICE | 109.228 | 226.574 | 133.145 | 219.131 |
| CANUS | 1.180 | 1.445 | 1.323 | 0.004 |
| WTP | 132.643 | 210.353 | 162.747 | 232.375 |
| FPRATIO | 15.604 | 24.746 | 20.344 | 3.602 |
| SSLADJ | 0.000 | 238.621 | 47.695 | 4045.800 |
| GTR | 721.123 | 959.744 | 768.817 | 4045.800 |
| GTRT | 20.230 | 26.924 | 21.568 | 3.184 |
| SSHT | 34.320 | 34.320 | 34.320 | 0.000 |
| GRSCOST | 733.535 | 1460.934 | 1224.803 | 33432.125 |
| NSCOST | 306.400 | 673.273 | 530.571 | 8378.512 |
| NSCOSTT | 10.089 | 16.113 | 14.909 | 2.579 |
| ------------ | ------------ | CROPYR=9192 | ------------ | ------------ |
| PREDSHIP | 36.162 | 36.162 | 36.162 | 0.000 |
| SHIP | 22.056 | 42.330 | 35.912 | 28.689 |
| CGSCC | 73.572 | 73.572 | 73.572 | 0.000 |
| GCOM | 732.172 | 732.172 | 732.172 | 0.000 |
| USPRICE | 110.964 | 217.058 | 140.515 | 290.823 |
| CANUS | 1.179 | 1.444 | 1.328 | 0.003 |
| WTP | 129.569 | 315.052 | 167.559 | 456.010 |
| FPRATIO | 10.746 | 26.128 | 20.502 | 5.871 |
| SSLADJ | 0.000 | 311.487 | 63.859 | 6733.742 |
| GTR | 722.172 | 1033.659 | 786.031 | 6733.742 |
| GTRT | 19.970 | 28.584 | 21.736 | 5.149 |
| SSHT | 35.470 | 35.470 | 35.470 | 0.000 |
| GRSCOST | 782.318 | 1501.442 | 1273.810 | 36093.980 |
| NSCOST | 251.395 | 740.633 | 570.716 | 12327.498 |
| NSCOSTT | 9.744 | 17.497 | 15.907 | 4.171 |
| ------------ | ------------ | CROPYR=9293 | ------------ | ------------ |
| PREDSHIP | 36.678 | 36.678 | 36.678 | 0.000 |
| SHIP | 21.976 | 43.887 | 36.380 | 28.179 |
| CGSCC | 74.622 | 74.622 | 74.622 | 0.000 |
| GCOM | 733.222 | 733.222 | 733.222 | 0.000 |
| USPRICE | 112.957 | 238.655 | 148.374 | 511.925 |
| CANUS | 1.196 | 1.432 | 1.322 | 0.003 |
| WTP | 131.594 | 294.780 | 177.583 | 588.393 |
| FPRATIO | 11.862 | 26.573 | 20.032 | 6.601 |
| SSLADJ | 0.000 | 275.973 | 55.724 | 6204.569 |
| GTR | 723.222 | 999.195 | 778.946 | 6204.569 |
| GTRT | 19.718 | 27.242 | 21.237 | 4.612 |
| SSHT | 36.700 | 36.700 | 36.700 | 0.000 |
| GRSCOST | 806.515 | 1610.641 | 1335.147 | 37953.621 |
| NSCOST | 354.713 | 813.119 | 637.525 | 11397.299 |
| NSCOSTT | 12.182 | 18.954 | 17.586 | 3.736 |

SCENARIO 4 - DESCRIPTIVE STATISTICS

| VARIABLE | MINIMUM VALUE | MAXIMUM VALUE | MEAN | VARIANCE |
|---|---|---|---|---|
| ------------ CROPYR=9394 ------------ | | | | |
| PREDSHIP | 37.194 | 37.194 | 37.194 | 0.000 |
| SHIP | 22.676 | 43.534 | 36.888 | 25.813 |
| CGSCC | 75.672 | 75.672 | 75.672 | 0.000 |
| GCOM | 734.272 | 734.272 | 734.272 | 0.000 |
| USPRICE | 113.441 | 253.678 | 158.484 | 1004.371 |
| CANUS | 1.188 | 1.440 | 1.328 | 0.004 |
| WTP | 136.221 | 297.985 | 186.087 | 874.861 |
| FPRATIO | 12.136 | 26.547 | 19.890 | 8.679 |
| SSLADJ | 0.000 | 316.050 | 64.979 | 8207.745 |
| GTR | 724.272 | 1040.321 | 789.251 | 8207.745 |
| GTRT | 19.473 | 27.970 | 21.220 | 5.933 |
| SSHT | 38.009 | 38.009 | 38.009 | 0.000 |
| GRSCOST | 861.869 | 1654.658 | 1402.075 | 37291.494 |
| NSCOST | 390.560 | 891.709 | 696.310 | 14477.732 |
| NSCOSTT | 12.836 | 20.483 | 18.911 | 4.806 |
| ------------ CROPYR=9495 ------------ | | | | |
| PREDSHIP | 37.710 | 37.710 | 37.710 | 0.000 |
| SHIP | 21.107 | 43.988 | 37.659 | 22.917 |
| CGSCC | 76.721 | 76.721 | 76.721 | 0.000 |
| GCOM | 735.321 | 735.321 | 735.321 | 0.000 |
| USPRICE | 114.805 | 263.872 | 170.689 | 1158.244 |
| CANUS | 1.181 | 1.446 | 1.315 | 0.004 |
| WTP | 138.181 | 323.226 | 199.252 | 1762.047 |
| FPRATIO | 11.582 | 27.093 | 19.522 | 12.848 |
| SSLADJ | 0.000 | 343.133 | 72.187 | 9511.739 |
| GTR | 725.321 | 1068.454 | 797.509 | 9511.739 |
| GTRT | 19.234 | 28.333 | 21.148 | 6.689 |
| SSHT | 39.396 | 39.396 | 39.396 | 0.000 |
| GRSCOST | 831.521 | 1732.921 | 1483.592 | 35567.761 |
| NSCOST | 436.807 | 967.153 | 766.277 | 16664.806 |
| NSCOSTT | 13.895 | 22.085 | 20.362 | 5.418 |
| ------------ CROPYR=9596 ------------ | | | | |
| PREDSHIP | 38.226 | 38.226 | 38.226 | 0.000 |
| SHIP | 24.291 | 44.444 | 37.865 | 24.206 |
| CGSCC | 77.771 | 77.771 | 77.771 | 0.000 |
| GCOM | 736.371 | 736.371 | 736.371 | 0.000 |
| USPRICE | 120.477 | 275.632 | 185.564 | 1847.868 |
| CANUS | 1.189 | 1.442 | 1.326 | 0.003 |
| WTP | 135.672 | 338.867 | 211.619 | 1761.087 |
| FPRATIO | 11.447 | 28.591 | 18.986 | 11.599 |
| SSLADJ | 0.000 | 481.683 | 54.971 | 8343.331 |
| GTR | 726.371 | 1208.053 | 781.341 | 8343.331 |
| GTRT | 19.002 | 31.603 | 20.440 | 5.710 |
| SSHT | 40.860 | 40.860 | 40.860 | 0.000 |
| GRSCOST | 992.526 | 1815.990 | 1547.185 | 40413.382 |
| NSCOST | 428.040 | 1055.919 | 850.736 | 19174.164 |
| NSCOSTT | 12.418 | 23.758 | 22.464 | 4.625 |

SCENARIO 4 - DESCRIPTIVE STATISTICS

| VARIABLE | MINIMUM VALUE | MAXIMUM VALUE | MEAN | VARIANCE |
|---|---|---|---|---|
| ------------ CROPYR=9697 ------------ | | | | |
| PREDSHIP | 38.742 | 38.742 | 38.742 | 0.000 |
| SHIP | 23.879 | 45.090 | 38.796 | 23.327 |
| CGSCC | 78.820 | 78.820 | 78.820 | 0.000 |
| GCOM | 737.420 | 737.420 | 737.420 | 0.000 |
| USPRICE | 117.531 | 286.723 | 202.412 | 2258.644 |
| CANUS | 1.189 | 1.438 | 1.322 | 0.003 |
| WTP | 135.570 | 364.374 | 232.095 | 2998.223 |
| FPRATIO | 11.038 | 29.668 | 18.268 | 16.874 |
| SSLADJ | 0.000 | 466.280 | 64.123 | 11467.155 |
| GTR | 727.420 | 1193.700 | 791.544 | 11467.155 |
| GTRT | 18.776 | 30.812 | 20.431 | 7.640 |
| SSHT | 42.403 | 42.403 | 42.403 | 0.000 |
| GRSCOST | 1012.539 | 1911.961 | 1645.062 | 41943.062 |
| NSCOST | 542.267 | 1150.007 | 929.469 | 19730.161 |
| NSCOSTT | 14.673 | 25.505 | 24.015 | 6.188 |
| ------------ CROPYR=9798 ------------ | | | | |
| PREDSHIP | 39.258 | 39.258 | 39.258 | 0.000 |
| SHIP | 24.047 | 45.914 | 39.506 | 19.427 |
| CGSCC | 79.870 | 79.870 | 79.870 | 0.000 |
| GCOM | 738.470 | 738.470 | 738.470 | 0.000 |
| USPRICE | 124.552 | 299.335 | 214.863 | 2300.636 |
| CANUS | 1.187 | 1.443 | 1.327 | 0.003 |
| WTP | 143.699 | 379.921 | 252.221 | 3751.248 |
| FPRATIO | 10.984 | 29.039 | 17.583 | 19.631 |
| SSLADJ | 0.000 | 539.149 | 63.201 | 15302.050 |
| GTR | 728.470 | 1267.619 | 791.671 | 15302.050 |
| GTRT | 18.556 | 32.290 | 20.166 | 9.929 |
| SSHT | 44.024 | 44.024 | 44.024 | 0.000 |
| GRSCOST | 1058.666 | 2021.324 | 1739.218 | 37652.683 |
| NSCOST | 462.509 | 1242.722 | 1021.920 | 24471.978 |
| NSCOSTT | 14.964 | 27.324 | 25.875 | 8.042 |
| ------------ CROPYR=9899 ------------ | | | | |
| PREDSHIP | 39.774 | 39.774 | 39.774 | 0.000 |
| SHIP | 23.443 | 46.395 | 39.569 | 23.365 |
| CGSCC | 80.920 | 80.920 | 80.920 | 0.000 |
| GCOM | 739.520 | 739.520 | 739.520 | 0.000 |
| USPRICE | 128.143 | 310.467 | 226.891 | 2270.209 |
| CANUS | 1.186 | 1.444 | 1.316 | 0.004 |
| WTP | 152.683 | 399.053 | 268.204 | 3783.599 |
| FPRATIO | 10.855 | 28.370 | 17.061 | 16.925 |
| SSLADJ | 0.000 | 536.323 | 46.888 | 12400.744 |
| GTR | 729.520 | 1265.842 | 776.407 | 12400.744 |
| GTRT | 18.342 | 31.826 | 19.521 | 7.839 |
| SSHT | 45.725 | 45.725 | 45.725 | 0.000 |
| GRSCOST | 1071.923 | 2121.410 | 1809.291 | 48851.095 |
| NSCOST | 473.808 | 1355.545 | 1114.396 | 28945.361 |
| NSCOSTT | 17.082 | 29.218 | 28.157 | 6.350 |

SCENARIO 4 - DESCRIPTIVE STATISTICS

| VARIABLE | MINIMUM VALUE | MAXIMUM VALUE | MEAN | VARIANCE |
|---|---|---|---|---|
| CROPYR=9900 | | | | |
| PREDSHIP | 40.280 | 40.280 | 40.280 | 0.000 |
| SHIP | 26.005 | 46.872 | 40.561 | 21.484 |
| CGSCC | 81.969 | 81.969 | 81.969 | 0.000 |
| GCOM | 740.569 | 740.569 | 740.569 | 0.000 |
| USPRICE | 132.767 | 323.367 | 251.985 | 2022.078 |
| CANUS | 1.187 | 1.422 | 1.320 | 0.004 |
| WTP | 153.798 | 410.045 | 280.822 | 3696.075 |
| FPRATIO | 10.970 | 29.248 | 16.852 | 16.061 |
| SSLADJ | 0.000 | 582.324 | 42.226 | 13695.426 |
| GTR | 730.569 | 1312.893 | 772.796 | 13695.426 |
| GTRT | 18.133 | 32.586 | 19.181 | 8.437 |
| SSHT | 47.507 | 47.507 | 47.507 | 0.000 |
| GRSCOST | 1235.421 | 2231.509 | 1926.920 | 48487.607 |
| NSCOST | 763.747 | 1464.935 | 1225.454 | 29091.993 |
| NSCOSTT | 18.179 | 31.187 | 30.244 | 6.834 |
| CROPYR=200001 | | | | |
| PREDSHIP | 40.806 | 40.806 | 40.806 | 0.000 |
| SHIP | 28.599 | 46.814 | 41.043 | 17.732 |
| CGSCC | 83.019 | 83.019 | 83.019 | 0.000 |
| GCOM | 741.619 | 741.619 | 741.619 | 0.000 |
| USPRICE | 148.401 | 336.572 | 260.431 | 2097.87A |
| CANUS | 1.191 | 1.444 | 1.318 | 0.003 |
| WTP | 166.333 | 427.549 | 312.525 | 3494.817 |
| FPRATIO | 10.929 | 28.093 | 15.549 | 10.602 |
| SSLADJ | 0.000 | 492.283 | 15.363 | 3941.268 |
| GTR | 731.619 | 1223.912 | 746.982 | 3941.268 |
| GTRT | 17.929 | 29.994 | 18.306 | 2.367 |
| SSHT | 49.371 | 49.371 | 49.371 | 0.000 |
| GRSCOST | 1411.939 | 2311.247 | 2026.317 | 43221.771 |
| NSCOST | 940.461 | 1555.830 | 1349.635 | 21527.629 |
| NSCOSTT | 22.376 | 33.234 | 32.895 | 1.917 |