The Federal Hop Marketing Order and Volume-Control Behavior

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Abstract

The Hop Administrative Committee of the hop marketing order has been reasonably accurate in projecting quantities supplied and demanded and in formulating their recommended salable percentage to the Secretary of Agriculture The Federal Hop Marketing Order has helped stabilize hop acreages and nominal hop prices and has reduced cyclical variation in production Acreage and production stabilization may indicate a more stable decision environment leading to a more efficient resource allocation

Keywords

Marketing order, volume control, spectral analysis, bootstrapping, hops

Introduction

The Agricultural Marketing Agreement Act of 1937 as amended allows agricultural producers to collectively pursue orderly marketing programs[1] to stabilize producer prices and income, with the goal of improving producer welfare Orderly marketing programs are to be used for raising farm prices toward parity, according to the act The legislation also requires that consumer interests be protected

Marketing orders provide producers with a variety of methods for achieving orderly marketing, including quality and quantity (volume) regulations, container standardization, promotion, research and development, regulation of unfair trade practices, and provision of price and other market information. The volume-control regulations have been among the most controversial aspects of marketing orders and have recently come under intense scrutiny by consumer advocates, the Federal Trade Commission, the Department of Justice, and political groups who have become increasingly concerned with the possibility that producers are exercising monopoly power by restricting quantities to the extent of unduly increasing commodity and consumer prices.

This article analyzes the behavior of the Hop Administrative Committee (HAC) in executing the volume-control provision of the U S Hop Marketing Order [2] Specifically, the article analyzes the following:

(1) The U.S Hop Marketing Order, emphasizing the method by which volume-control decisions are made,

(2) The accuracy of market projections made by the HAC and used in the volume-control decisionmaking process, and

(3) The stabilization effects of HAC policies on acreage, prices, production, and sales.

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[1]"Orderly marketing" is defined as the coordination of the total supply of a commodity over time, form, and spatial markets in such a way as to achieve the market objectives of sellers (*8*) Note Italicized numbers in parentheses refer to items in the References at the end of this article

[2]The responsibility and authority to issue regulations lies with the Secretary of Agriculture under the Agricultural Marketing Agreement Act However, industry participants normally initiate actions to be taken under an order's provisions Such industry initiatives arise out of administrative committees which work with the U S Department of Agriculture (USDA) and carry out the programs The members of such committees usually are growers and handlers who are nominated and elected by the industry and appointed by the Secretary of Agriculture

The U.S. Hop Industry and Marketing Orders

The characteristics of the U S hop industry make it unique compared with other sectors of American agriculture Hops are a perennial crop produced by fewer than 240 farmers concentrated in the States of Washington, Idaho, Oregon, and California The investment cost of establishing an acre of hops is high relative to other agricultural crops The cost was estimated at between $3,500 and $4,000 in 1982, not including the cost of harvesting, picking, drying, and packaging equipment (*7*) Most hops are sold under long-term forward contracts that specify annual prices and are made as much as 7 years in advance of delivery

The market for hops is oligopolistic, only eight major buyers currently operate in the U S market The largest two buyers account for approximately two-thirds of all hops sold

The only major use of hops is to produce malted beverages, with only a commercially insignificant amount used to produce pharmaceutical products In 1984, five brewers accounted for 88 percent of beer sales. Because there is no substitute for hops in the production of malted beverages, the demand for and indirectly the supply of hops tend to be inelastic The high degree of inelasticity contributes to the potential for large price variability in hop markets (*6*).

On July 7, 1966, Federal Marketing Order No 991 was approved by more than two-thirds of the U S hop producers (*10*) The intent of the order was to establish a more orderly marketing process that would induce price stability so as to improve the gross returns of producers The order became effective in the 1966-67 marketing year, defined here as spanning September 1 through August 31 [3]

The order divided the U S hop-producing region (Washington, Idaho, Oregon, and California) into four districts, each composed of one producing State Thirteen growers from these districts make up the Hop Administrative Committee (HAC) Seven growers are from Washington State, while two growers from each of the remaining three States make up the remainder of the committee The main responsibilities of the HAC are to recommend to the U.S Secretary of Agriculture the policies to be administered under the provisions of the marketing order, to report any violators thereof to the Secretary, and to recommend amendments to the order as needed

Volume-Control Provision

Prior to March 1 of each year, the HAC and a Handler Advisory Board (HAB) meet to adopt a marketing policy for the ensuing marketing year.[4] The HAC decides the quantity of hops that can be marketed during the marketing year from the upcoming hop harvest The volume decision is based on the HAC's perception of the quantity of hops required to establish orderly marketing conditions As required by Federal Marketing Order No 991, the HAC must consider these factors in establishing the salable quantity of hops

(1) Prospective stock carry-in,

(2) Desirable stock carryout,

(3) Prospective imports and exports,

(4) Anticipated consumption, and

(5) Any other relevant factors that affect marketing conditions (*10*).

The HAC presents its volume recommendation to the Secretary of Agriculture for final approval and implementation

The most important factor to individual hop growers is the allotment percentage, which is the share of an individual producer's hop base allotment that can be marketed in the marketing year One can calculate the allotment percentage by taking the salable quantity recommended by the HAC and approved by the Secretary of Agriculture and

[3]The official marketing year, as noted in the *Federal Register*, runs from August 1 through July 31 However, all published hop statistics refer to September 1 through August 31 In this article, the latter period will be maintained as the marketing year because of the availability of September 1 stock data and other data from the Crop Reporting Board of USDA's Statistical Reporting Service

[4]The HAB consists of five hop handlers (dealers) who are elected by a vote of all hop handlers to act in an advisory capacity to the HAC

dividing it by the total of all producer base allotments established in 1966 (59 27 million pounds) The HAC must review its marketing policy prior to August 1 and recommend any increase in the salable quantity it feels that marketing conditions warrant (*10*) The Secretary of Agriculture may issue a salable quantity and allotment percentage based on the HAC's recommendation or other available information Producers may transfer their base allotment from one location to another Producers may also transfer all or part of an allotment base from themselves to another producer on a temporary or permanent basis Hops exceeding the level of allotment controlled by a producer are reserve hops and can only be sold through a reserve pool market controlled by the HAC

HAC/HAB Joint Marketing Policy Meetings

A joint HAC/HAB marketing policy meeting is held each January to recommend both the salable quantity and other marketing policy guidelines pertaining to quality control, research and development, and reserve pools, all of which go into effect in the marketing year

The HAC uses a balance sheet approach, or equivalently, a quantity-supplied, quantity-demanded approach, to determine salable quantity Essentially, the HAC makes two projections for the upcoming marketing year (1) total hop quantity demanded of U S hops and (2) total quantity supplied to the U S market from sources other than upcoming domestic production Subtracting the latter from the former projection defines the projected domestic production required for an equilibrium of quantities supplied and demanded The HAC then adjusts the projected production requirement upward by an amount considered sufficient to compensate for production falling short of announced salable quantity Finally, the HAC adjusts the production requirement to reflect "any other relevant factors that affect marketing conditions" to arrive at the final production recommendation (*10*)

The following discussion explains the projection process in more detail, identifying the various components of the demand and supply projections and describing how they enter into the balance sheet calculation of the salable quantity recommendation We frequently refer to various time periods relevant to the recommendation process (table 1), where "t + 1" refers to the hop marketing year (September 1 to August 31) following the January policy meeting

The balance sheet used at the policy meeting in determining the salable quantity for marketing year t + 1 is illustrated in table 2 Prior to the policy meeting, the HAC manager and staff with a statistical subcommittee of HAC members assemble all known market information All supply and demand information is known for the previous marketing year, t − 1 Only carry-in stocks (CI_t) and salable production (SPR_t) are completely known for marketing year t, where salable production is the quantity of hops arising from the previous August-September harvest that is eligible for sale Other supply and demand components, both for years t and t + 1, are unknown and must be estimated by the HAC at the January meeting

Neither the HAC statistics subcommittee nor the HAC staff members use a formal statistical model for forecasting unknown market variables Rather, HAC forecasts have been based on subjective evaluation of market trend information and represent consensus forecasts of the HAC members [5]

The subjective forecasts are interrelated and are made in sequence First, the HAC forecasts imports ($\hat{IM}_t$), brewery consumption ($\hat{BC}_t$), exports ($\hat{EX}_t$), and a balancing item ($\hat{BI}_t$)[6] for marketing year t Then total supply of hops in t (TS_t) is forecast as·

$$\hat{TS}_t = CI_t + SPR_t + \hat{IM}_t \quad (1)$$

and total demand for hops in t (TD_t) is forecast as

$$\hat{TD}_t = \hat{BC}_t + \hat{EX}_t + \hat{BI}_t \quad (2)$$

The level of carry-in stocks for the subsequent marketing year, t + 1, is then forecast as

$$\hat{CI}_{t+1} = \hat{TS}_t - \hat{TD}_t \quad (3)$$

[5]The HAC has contracted for the construction of an econometric structural model of the industry both to generate a better understanding of market forces and to provide supplementary information for forecasting market outcomes

[6]The main components of the balancing item include minor uses of hops in pharmaceuticals and as perfume bases, plus a year end statistical adjustment

Table 1—Time framework in U S. hop industry

Occurrences	Marketing year t-1				Marketing year t												Marketing year t + 1	
	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct
HAC/HAB quarterly meetings			X			X			X[1]			X			X			X
Harvest				X	X											X	X	
Market information known at the January, t, market policy meeting	All information for marketing year t-1				9/1 stocks; 9/1-11/1 imports, exports, and brewery consumption		11/1 stocks											
Projections made by HAC/HAB					Updated projections for t; Projections for t + 1													

[1]Joint HAC/HAB marketing policy meeting

Table 2—Marketing policy balance sheet

Supply and demand component	Year t-1	Year t
Supply		
Carry-in 9/1	CI_{t-1}	CI_t
Salable production[1]	SPR_{t-1}	SPR_t
Imports	IM_{t-1}	$\hat{IM}_t$[2]
Total supply	TS_{t-1}	$\hat{TS}_t$
Demand		
Brewery consumption[3]	BC_{t-1}	$\hat{BC}_t$
Exports[3]	EX_{t-1}	$\hat{EX}_t$
Balancing item[4]	BI_{t-1}	$\hat{BI}_t$
Total demand	TD_{t-1}	$\hat{TD}_t$
	Year t	**Year t + 1**
Supply		
Carry-in 9/1	CI_t	$\hat{CI}_{t+1}$
Imports		$\hat{IM}_{t+1}$
Total net supply		$\hat{TNS}_{t+1}$
Demand		
Brewery consumption		$\hat{BC}_{t+1}$
Exports		$\hat{EX}_{t+1}$
Balancing item		$\hat{BI}_{t+1}$
Desirable carryout[5]		$\hat{CO}_{t+1}$
Total demand		$\hat{TD}_{t+1}$
Salable quantity		
Gross trade requirement		$\hat{GTR}_{t+1}$
Special allotment for Fuggle hops		SFA_{t+1}
Balance		$\hat{GTR}_{t+1}-SFA_{t+1}$
Potential available not produced		$\hat{PANP}_{t+1}$
Salable quantity		$\hat{SQ}_{t+1}$
Salable percentage computed		$\hat{SPC}_{t+1}$
Salable percentage recommended		$\hat{SPRC}_{t+1}$

[1]Quantity of hops produced that is available to the market under that year's salable percentage

[2]All projections are indicated as such by a hat (^) above them

[3]Demand component estimates are for both fresh hops and hop extract Extract is based on the ratio of pounds of fresh hops to 1 pound of hop extract In this research, the authors used total demand components (fresh plus extract)

[4]Includes other minor uses and year end statistical adjustments

[5]Pounds of hops the HAC/HAB deems necessary to maintain orderly marketing conditions in future years

The purpose of the projection procedure (1) – (3) is to generate the carry-in forecast, $\hat{CI}_{t+1}$. Forecasts of imports, brewery consumption, exports, and a balancing item are then made for marketing year t + 1, together with a determination of a desired carryout level, $\hat{CO}_{t+1}$, which represents the pounds of hops in stock the HAC deemed necessary to maintain orderly marketing conditions in future years. Then, the total net supply ($\hat{TNS}_{t+1}$) of hops in marketing year t + 1 is defined as

$$\hat{TNS}_{t+1} = \hat{CI}_{t+1} + \hat{IM}_{t+1} \tag{4}$$

Note that $\hat{TNS}_{t+1}$ is the projected total supply of hops in marketing year t + 1, not including net domestic hop production Total demand for hops in year t + 1 is defined as:

$$\hat{TD}_{t+1} = \hat{BC}_{t+1} + \hat{EX}_{t+1} + \hat{BI}_{t+1} + \hat{CO}_{t+1} \tag{5}$$

Then, the gross trade requirement for marketing year t + 1, $\hat{GTR}_{t+1}$, representing the HAC's forecast of the pounds of hops needed from domestic producers to produce an equilibrium of supply and demand, is defined as:

$$\hat{GTR}_{t+1} = \hat{TD}_{t+1} - \hat{TNS}_{t+1} \tag{6}$$

Adjustments are made to the $\hat{GTR}_{t+1}$ to arrive at the final salable quantity to be recommended to the Secretary of Agriculture for the marketing year t + 1. First, $\hat{GTR}_{t+1}$ is adjusted downward by 1 million pounds, reflecting a special allotment (SFA_{t+1}) granted to growers, primarily in Oregon, in 1972 for the production of Fuggle hops, a low alpha acid-type hop The allotment has remained unchanged since 1972. The $\hat{GTR}_{t+1}$ is also adjusted upward by potential available not produced, $\hat{PANP}_{t+1}$ This is an adjustment the HAC makes to account for factors such as disease, winter kill, or drought or for growers not producing up to their allotted salable production which would otherwise drop realized domestic hop production below those levels required to balance supply and demand The recommended salable quantity is then defined as

$$\hat{SQ}_{t+1} = \hat{GTR}_{t+1} - SFA_{t+1} + \hat{PANP}_{t+1} \tag{7}$$

To distribute the salable quantity among individual producers, we can specify the salable percentage (SPC_{t+1}) as

$$\hat{SPC}_{t+1} = (\hat{SQ}_{t+1}/59{,}270{,}000 \text{ pounds of hops}) \times 100 \quad (8)$$

which represents the percentage of individual base allotments that determine the quantity of hops salable by individual producers Finally, $\hat{SPC}_{t+1}$ may be adjusted to reflect other factors that affect hop marketing conditions, if the HAC determines such an adjustment is necessary [7] Either $\hat{SPC}_{t+1}$ or its adjusted value then becomes the salable percentage recommended ($\hat{SPRC}_{t+1}$) to the Secretary of Agriculture. Upward adjustments to the ($\hat{SPRC}_{t+1}$) due to changing marketing conditions can be made prior to August 1 Decisions made at the HAC policy meetings have historically not been altered

Information Set for Projections

The HAC projects expected imports by taking into account past levels of imports, quantities of previously contracted imports, currency exchange rates, domestic and foreign hop stocks, expected foreign hop crops, and breweries' philosophies [8] We projected brewery consumption by examining past levels of brewery consumption, breweries' philosophies, brewery stocks, and total U S beer production The HAC projects exports in light of past levels of exports, quantities of previously contracted exports, currency exchange rates, domestic and foreign stocks, brewing philosophies, and expected foreign hop crops The balancing item is based primarily on its previous level and accounts for a small percentage of all hops We projected the desirable carryout by considering previous carryout levels, brewery inventories and brewers' stockholding intentions, and the estimated quantity of hops necessary to counteract a crop failure in t + 2 should it arise [9]

The process used to calculate the recommended salable quantity is, at least officially, void of any price considerations The hop marketing order does not contain authority for price setting even though the volume-control provisions, aimed at establishing orderly marketing, can influence prices and farmer incomes However, the choice of a desirable carryout level is a subjective decision by the HAC aimed at achieving the somewhat intangible goal of "orderly marketing" Carryouts that are too large relative to inventory demand can depress prices, and too small a carryout can increase prices Because an objective of the hop order is market stabilization, the HAC carryout decision must implicitly consider the effects of potential carryout levels on price changes [10]

Accuracy of HAC Projections

The HAC uses a balance sheet approach (table 2) to record and calculate the projections of the various supply and demand components used to determine the salable quantity recommended to the Secretary of Agriculture Because of this procedure for calculating salable quantity, the accuracy of the projections of market variables is important for two major reasons First, the salable quantity the HAC recommends depends largely on the projections of the variables on the HAC balance sheet In the *ex ante* sense, the salable quantity represents a quantity level that the HAC has decided is sufficient to create an equilibrium of total hop quantities demanded and supplied in the U S market However, for the salable quantity to closely approximate equilibrium domestic quantity supplied *ex post facto*, the projections of total quantity demanded and total quantity supplied net of domestic production must closely approximate their true values realized in the upcoming marketing year Second, in projecting values of the market variables, the HAC provides growers with an outlook of the market

[7]As an example of "other factors," the HAC felt that in the midseventies the European Economic Community was subsidizing hop growers To counteract a potential erosion of U S market share, the HAC elected to increase the $\hat{SPC}_t$ (personal communication with Mr Robert H Eaton, Manager U S HAC)

[8]"Breweries' philosophies" refers primarily to the quantity and type of hops various brewers use to flavor a barrel of beer

[9]The HAC perceived the level of desirable carryout during the period covered in this analysis as being that level of hops in inventories together with the quantity of harvested hops in the new marketing year which would allow brewers about a 2 year supply in relation to beer production In the recent past, this inventory level has been reduced because of higher interest rates and the cost of holding inventories

[10]Until recently, the HAC has relied heavily on the rule of thumb of maintaining approximately a year's supply of hops as carryouts to ensure a reliable supply of domestic hops for brewing purposes With increasing interest rates and accompanying increased cost of carrying inventory, the HAC has been compelled by industry participants to lower the carryout levels in recent years

situation for the coming marketing year The more accurate the projections, the more valuable is the market information function performed under the U S Hop Order

Table 3 shows various goodness-of-fit measures comparing HAC projections with actual industry outcomes The data available allowed an analysis of marketing year t projections for 1969-78 and marketing year t+1 projections for 1969-79 The analysis does not include the special Fuggle allotment (SFA) because it is a constant The balancing item, BI, was not individually analyzed because of its extremely minor role in overall demand

HAC projections of variables in t are characterized by smaller mean absolute percentage errors (MAPE's), higher correlations with actual market outcomes, lower mean squared prediction errors (MSPE's) measuring the accuracy of percentage change predictions, and lower U-statistics measuring the ability to predict turning points, than corresponding projections for variables in t+1 Except for carryout projections, a lesser proportion of the MSPE's is attributable to systematic errors in projection ($U^M + U^R$) than to random disturbances (U^D),[11] and the average percentage bias in projections, as measured by the mean percentage error (MPE), is smaller in magnitude for marketing year t projections. Thus, forecasts for marketing year t generally appear superior to corresponding forecasts for marketing year t+1 This superiority probably reflects the additional uncertainties involved in predicting market outcomes further into the future and the fact that market conditions in the first third of marketing year t have already been observed at the time of the January HAC policy meeting In terms of providing market outlook information, the HAC has been more adept at projecting the near term, where the average absolute percentage errors range from a low of 3 56 percent for brewery consumption projections for t to a high of 11 49 percent for export projections for t

The projection of total net supply ($\widehat{TNS}$) has an average downward bias of 1 71 percent Of the components of $\widehat{TNS}_{t+1}$, imports in t+1 have been underestimated, whereas carryouts in t (carryouts in t = carry-ins in t+1) have been slightly overestimated The average absolute magnitude of the percentage error made by the HAC in projecting $\widehat{TNS}$, as indicated by the MSPE, is 4 82 percent A large proportion ($U^M + U^R = 0.75$) of the 47 9 MSPE in projecting percentage changes is attributable to systematic errors so that an optimal linear correction applied to the projection would reduce the MSPE by 75 percent (9) the MSPE of the HAC projections was 87 percent ($U = 0.87$) of what it would have been had the HAC used a no-change extrapolation method of projection[12]

Overall, the HAC seems to provide reasonably accurate projections of the general magnitude of $\widehat{TNS}_{t+1}$, and it has some success in projecting turning points in market outcomes However, it does make systematic errors in predicting percentage changes that, if eliminated, could improve the accuracy of the projections Underestimation of $\widehat{TNS}_{t+1}$ contributes to an overestimation of the domestic production required to equilibrate quantities supplied and demanded, as $\widehat{TNS}_{t+1}$ is the measure of supplies available from sources other than upcoming domestic production

The projection of total demand ($\widehat{TD}_{t+1}$) has a slight average downward bias of 0 29 percent The export component of $\widehat{TD}_{t+1}$ was underestimated, whereas brewery consumption was overestimated[13] The average absolute magnitude of the percentage error made by the HAC in projecting $\widehat{TD}_{t+1}$ was 4 24 percent Only 19 percent ($U^M + U^R = 0.19$) of the 27 9

[11] U^M, U^R, and U^D can be interpreted in the context of optimal linear correction of forecast changes in the variables Optimal linear correction of the forecast changes means choosing a and b values that minimize the sum of squared errors in predicting actual changes, ΔA_t, with the linear (correction) function of predicted changes $\Delta P_t^c = a + b\Delta P_t$ Uncorrected forecasts correspond to a = 0 and b = 1 The proportional reduction in MSPE that would result from using the optimally linearly corrected predicted changes equals $U^M + U^R$, where U^M refers to the proportional reduction due to equalizing the mean of predicted and actual changes (which necessarily follows from the least squares fitting of a and b), and U^R refers to the proportional reduction due to adjusting the b coefficient from unity to its optimal value The proportion of MSPE's attributed to random disturbances, U^D, is left unaffected by the optimal linear correction (see (9))

[12] A "no-change extrapolation" means using $P_{t+1} = A_t$, that is, the value of a variable in period t+1 is predicted to be equal to its value in period t

[13] Desired carryouts in t have no projection errors, by definition, as that figure represents the level of carryouts demanded by the HAC for market stabilization The actual carryouts can deviate from desired levels, this difference is portrayed in table 3

Table 3—Statistical comparison of actual U.S hop industry market statistics and HAC projections[1]

Variable	Actual		Projected		Actual vs projected values[2]			Actual vs projected percentage changes[3]				
	Mean	Coefficient of variation	Mean	Coefficient of variation	Correlation	Mean percentage error	Mean absolute percentage error	Mean squared prediction error	U^M	U^R	U^D	U
	1,000 lbs	*Measure*	*1,000 lbs*	*Measure*	*Measure*	*Percent*	*Percent*	*Measure*	*Measure*	*Measure*	*Measure*	*Measure*
$Imports_t$	12 315	11 88	12 104	7 89	0 72	1 08	6 00	72 0	0 064	0 001	0 935	0 74
$Imports_{t+1}$	12,721	15 19	11,632	11 10	39	7 33	10 52	310 3	261	033	706	92
$Exports_t$	26,800	15 31	27,100	14 10	64	– 2 04	11 49	194 3	010	110	880	71
$Exports_{t+1}$	28,158	21 14	26,591	14 73	15	2 50	17 14	592 7	105	347	548	1 18
Brewery $consumption_t$	35,271	6 35	35,546	5 03	68	– 94	3 56	37 5	100	236	664	1 13
Brewery $consumption_{t+1}$	35,757	8 52	36,341	5 57	26	– 2 15	6 88	84 1	051	686	263	1 66
$Carryouts_t$	36,920	25 94	37,301	26 72	97	– 94	5 03	52 2	095	778	126	61
$Carryouts_{t+1}$	37,504	23 36	33,409	31 50	46	9 72	22 90	677 3	170	645	185	1 91
Total net $supply_{t+1}$	48,717	19 46	47,874	20 16	93	1 71	4 82	47 9	037	712	251	87
Total $demand_{t+1}$	97,976	17 24	97,250	14 79	95	29	4 24	27 9	030	158	812	59

[1]Projection for marketing year t based on 1969 78 data, and projections for marketing year t+1 based on 1969 79 data Projections are made in January of marketing year t (Sept 1 to Aug 31)

[2]Mean percentage error = $(1/n)\,\Sigma\,(Y_t - \hat{Y}_t) \times 100/Y_t$, mean absolute percentage error = $(1/n)\,\Sigma\,|Y_t - \hat{Y}_t| \times 100/Y_t$

[3]U^M, U^R, U^D are the mean bias, regression and disturbance proportion of mean squared prediction error, and U is Theil's inequality coefficient (9)

MSPE was attributable to systematic errors The MSPE of the HAC projections was 59 percent (U = 0 59) of what it would have been had the HAC used a no-change extrapolation projection method

Overall, the HAC has provided fairly accurate projections of the general magnitude of $\hat{TD}_{t+1}$ and has anticipated turning points with some success However, in the case of $\hat{TD}_{t+1}$ projections, a component of $\hat{TD}_{t+1}$ is the HAC's desired carryout variable, the level of which is determined at the discretion of the HAC, and is thus "projected" without error Because decreasing desired carryout contributes to a decrease in both projected and actual $\hat{TD}_{t+1}$, $\hat{TD}_{t+1}$ may be projected with enhanced accuracy

When examining the issue of equilibrating quantities supplied and demanded, note that the average projected gross trade requirement (average projected TD_{t+1} − average projected $\hat{TNS}_{t+1}$ = 49,376, from equation (6) is greater than the actual gross trade requirement (average $\hat{TD}_{t+1}$ − average $\hat{TNS}_{t+1}$ = 49,259) by only 117,000 pounds, or by 0 2 percent of the average production requirement However, table 3 reveals that realized carryouts exceed projected carryouts by an average 9 72 percent The carryout projections for marketing year t + 1 are also characterized by the highest mean absolute percentage error and mean square prediction error of all the projections They represent the poorest set of projections in terms of anticipating turning points and, next to carryout projections for t, they have the highest systematic error (U^M + U^R = 0.82) Thus, the HAC's desired level of carryouts has not been achieved on the average, nor do desired carryouts represent accurate estimates of actual carryouts in marketing year t + 1 Given the method for establishing the salable quantity of hop production, the discrepancy between desired and actual carryouts may be mostly the result of adjustments to the $\hat{GTR}_t$ (recall equation (6)) In particular, the $\hat{PANP}_t$ adjustment to account for shortfalls in production on allotments, coupled with hop growers supplying the full amount of hops specified by the final salable quantity level, may be a major factor in explaining why hop production exceeded noninventory demand and added to carryout stocks, thereby raising them above desired levels

Analysis of HAC Market Stabilization

Has the control provision of the Federal Hop Order contributed to stabilizing the hop market, a principal objective of the order?

An empirical investigation of the stability question is complicated by data limitations In particular, although basic hop statistics are available back to 1915, two World Wars, the Great Depression, Prohibition, and a previous Federal Hop Order all happened in the years prior to 1953 When one tries to analyze the effect of the hop order on the stability of the hop market, 1953-65 represents the only period with which the period of operation of Federal Order No 991 can be relatively noncontroversially compared Furthermore, a substantial crop failure for German hops in 1980 (resulting in unprecedented levels of spot prices and futures contract prices negotiated in 1980) together with a breakdown of futures contract markets in 1981 and 1982 for near-term delivery, were exogenous shocks that appear to disqualify all but the 1966-79 period as the Federal Order reference period for purposes of stabilization analysis

We used two techniques to provide information on the effects of the HAC's implementation of the volume-control provision on stability in the U S hop market First, we calculated variances of acreage harvested, production (in 1,000 pounds), real and nominal prices (season-average hop price in dollars per pound, deflated by an index of prices received by farmers, 1910-14 = 1 00), and real and nominal sales (hop sales in thousands of dollars, deflated by an index of prices received by farmers, 1910-14 = 1 00) after we applied a linear regression to each variable [14] We then tested the null hypothesis of variance equality versus the alternative hypothesis of variance reduction from preorder to the Federal Order period using the standard F-statistic Table 4 shows the results of the calculations and gives variances, F-ratios, and marginal significance levels (also called "probability values") of the hypothesis tests (see (*1*), p 171, for the use of probability values as strength of evidence against the null hypothesis) We examined both nominal and real

[14] We removed trend by a linear regression of each variable on time for 1953-65 and for 1966-79 The residuals of these regressions represented the data series we examined

prices and sales to provide two different perspectives on the stabilization issue. The analysis involving nominal prices and sales provides information on the variability of actual hop prices received and sales levels achieved by hop growers The analysis of prices and sales deflated by the index of prices received by farmers provides information on variability relative to the general price level of agricultural commodities

The variance analysis in table 4 provides strong statistical evidence that the variance in acreage harvested was reduced during the period in which the Federal Order was in operation, where the hypothesis of variance equality would be rejected in favor of variance reduction at as low a level of significance as 0 008. The allotment system does affect the decisions of hop growers regarding utilization of, and investment in, hop-growing capacity to the extent that capacity is reflected by land use There is also evidence, albeit weaker than in the case of acreage, that production varied less in the Federal Order reference period, where the minimum significance level possible for rejection of the null hypothesis (0 168) results in only a one-in-six chance of rejection due to a type I error Because production is also influenced by weather, disease, and pest effects that are not under the direct control of hop growers, the potential for stabilizing production by influencing growers' decisions on the environment may not be so directly effective as in the case of decisions about acreage harvested.

A rejection of variance equality and acceptance of variance reduction in the case of real sales is tenuous where acceptance of variance reduction is a decision involving slightly more than a one-in-four chance of committing a type I error, given the calculated F-ratio Thus, there is only weak statistical support for the contention that Federal Order operations have contributed to increased stability of real sales of hops There is essentially no statistical support for the hypothesis that nominal sales variation has been reduced in the Federal Order period

Regarding variation in hop prices, there is no statistical evidence to support the contention that real price variation has been reduced in the Federal Order period In fact, the calculated F-statistic might be used as weak statistical evidence in favor of an alternative hypothesis of a real-price variance increase in the Federal Order period However,

Table 4—Tests of variance reduction between the pre- and post-Federal order reference periods

Variable	Unit	1953 65 variance[1]	1966-79 variance[1]	F-ratio	Marginal level[2]
Harvested acreage	Acres	$1\ 1405 \times 10^{7}$	$2\ 5764 \times 10^{6}$	4 4267	0 008
Production	1,000 lbs	$3\ 1610 \times 10^{7}$	$1\ 7742 \times 10^{7}$	1 7816	168
Real sales	$1,000	$2\ 1192 \times 10^{6}$	$1\ 5088 \times 10^{6}$	1 4046	284
Real price	Dollars per lb	$3\ 4780 \times 10^{-4}$	$4\ 9177 \times 10^{-4}$	7072	713
Nominal sales	$1,000	$1\ 3955 \times 10^{7}$	$1\ 2694 \times 10^{7}$	1 0993	434
Nominal price	Dollars per lb	$2\ 0925 \times 10^{-3}$	$9\ 8401 \times 10^{-4}$	2 1265	105

[1]The reported variances are those of the residuals resulting from a linear regression where the dependent variable was one of the variables shown in the first column of this table and the independent variable was time (year)

[2]Marginal significance level represents the minimum significance level of the hypothesis test that would have resulted in the rejection of the null hypothesis of variance equality and acceptance of the alternative of variance reduction based on the observed value of the F statistic (1) The F-ratio is defined with the preorder period variance in the numerator, the postorder period variance in the denominator and the F statistic has 11 numerator and 12 denominator degrees of freedom

there is relatively strong statistical support for the hypothesis that nominal price variation has been reduced in the Federal Order period, where the conclusion of variance reduction involves only slightly more than a 1-in-10 chance of committing a type I error, given the calculated F-ratio

We conducted a spectral analysis of detrended acreage, production, real and nominal sales, and real and nominal prices for the preorder (1953-65) and Federal Order (1966-79) reference periods The spectral analysis technique provided estimates of the decomposition of variation in the variables across cyclical components of various frequency lengths, and thus allowed estimates of the degree to which variation was due to shortrun versus longrun variance components in each reference period Given the perennial crop/longrun investment characteristics of hop production and the extremely inelastic hop supplies and demands (*6*), shortrun variability might be more difficult for hop markets to adapt to and more disruptive than longrun variability Thus, the potential variance frequency decomposition information of spectral analysis appeared to be relevant

The power spectrum estimator used four lags for the autocovariance function We used the Parzen lag window generator to smooth the estimated spectrum (see (*2*), chapter 9, and p 504). Estimates of power spectra from samples as small as in each of the reference periods can be subject to relatively high variation Tractable variance estimates and hypothesis testing procedures are only asymptotically appropriate and would be highly suspect in this analysis To provide finite sample variability estimates and to test hypotheses of power spectrum ordinate equality, we used the statistical technique of bootstrapping originated by Efron (*3*) to generate bootstrap distributions of spectrum ordinates. In particular, we generated 200 bootstrap samples of detrended acreage, production, real and nominal sales, and real and nominal prices for each reference period from a four-lag autoregressive structure (consistent with the four-lag autocovariance function used in the spectrum estimation) Then, we used these samples to generate a bootstrap distribution of 200 power spectra for each variable and for each reference period (*3*, *5*) Table 5 presents the natural logarithms of the means of the bootstrap power spectra distributions,[15] and figures 1-6 plot them Table 5 also presents 90 percent confidence intervals for each power spectrum ordinate based on truncation of the upper and lower 5 percent of the observed bootstrap distribution of ordinates for each variable and for each reference period (*4*)

The horizontal axis in figures 1-6 measures frequency of cyclical components of the series, for example, a frequency of 0 25 refers to a cycle that is 1/4 completed in a year or to a cycle that has a duration of 4 years The area beneath the antilog of the power spectrum curve in figures 1-6 and between two frequency points $f_1 < f_2$ (the integral of the density from f_1 to f_2) is an estimate of the variance contribution of cyclical components in the frequency interval (f_1, f_2) to the total variance of the respective series The area under the entire antilogged power spectrum graph is the total variance of the series When the power spectrum is expressed in logarithms, the power (the height of the power spectrum) associated with a data series A relative to the power associated with a data series B at a given frequency point f is a monotonically increasing function of the difference between the ordinates of the natural logarithms of the power spectra for A and B at frequency f Thus, the gap between the graphs of the two logged power spectra in each figure is a measure of power reduction or increase across frequencies $(\exp(\ell n\ a - \ell n\ b) = a/b)$

The point estimates of the power spectra in figures 1 and 2 indicate that, in the case of production and acreage, all frequencies had reduced power in the Federal Order reference period The shapes of the power spectra suggest that much of the variability in both acreage and production was attributable to longrun cyclical variation in both reference periods Examining the confidence intervals for the power spectrum ordinates presented in table 5, one can see that the difference in power at each frequency is significant in the case of acreage, because none of the spectrum ordinate confidence intervals overlaps [16] For production, reduced variance contributed

[15]We transformed the power spectra into a logarithmic scale to facilitate graphing and interpreting the spectra

[16]Using the Bonferroni probability inequality, one can make the statement of unequal ordinates at frequency f_i with a minimum of 80-percent confidence, given the use of a 90-percent confidence interval for each ordinate

Table 5—Power spectrum ordinates and 90-percent confidence intervals, natural logarithmic scale[1]

Variable	Unit	Frequency	1966-79 Ordinate	1966-79 90 percent interval	1953-65 Ordinate	1953-65 90-percent interval
Acres harvested	Acres	0 0000[2]	15 96	(15 75, 16 14)	17 26	(16 60, 17 74)
		0625[2]	15 94	(15 74, 16 11)	17 30	(16 67, 17 76)
		1250[2]	15 86	(15 69, 16 02)	17 35	(16 78, 17 79)
		1875[2]	15 72	(15 57, 15 87)	17 34	(16 81, 17 75)
		2500[2]	15 47	(15 34, 15 61)	17 22	(16 70, 17 61)
		3125[2]	15 13	(15 00, 15 26)	16 97	(16 43, 17 32)
		3750[2]	14 75	(14 61, 14 89)	16 61	(16 06, 16 96)
		4375[2]	14 44	(14 27, 14 63)	16 24	(15 56, 16 74)
		5000[2]	14 32	(14 14, 14 53)	16 07	(15 28 16 64)
Production	1,000 lbs	0000	17 88	(17 68, 18 06)	18 12	(17 57, 18 49)
		0625	17 86	(17 67, 18 04)	18 15	(17 53, 18 50)
		1250	17 80	(17 63, 17 94)	18 21	(17 58, 18 56)
		1875	17 66	(17 53, 17 79)	18 21	(17 58, 18 56)
		2500[2]	17 42	(17 32, 17 53)	18 12	(17 54, 18 46)
		3125[2]	17 08	(17 00, 17 16)	17 91	(17 39, 18 25)
		3750[2]	16 67	(16 59, 16 76)	17 63	(17 05, 17 98)
		4375[2]	16 31	(16 17, 16 46)	17 37	(16 72, 17 85)
		5000[2]	16 16	(15 97, 16 33)	17 25	(16 51, 17 82)
Real sales	$1,000	0000	15 14	(14 61, 15 52)	15 42	(14 75, 15 86)
		0625	15 16	(14 61, 15 54)	15 45	(14 80, 15 88)
		1250	15 19	(14 70, 15 58)	15 50	(14 87, 15 92)
		1875	15 17	(14 68, 15 52)	15 51	(14 91, 15 89)
		2500	15 05	(14 51, 15 40)	15 41	(14 84, 15 79)
		3125	14 84	(14 31, 15 16)	15 20	(14 66, 15 59)
		3750	14 58	(14 02, 14 96)	14 93	(14 37, 15 40)
		4375	14 35	(13 63, 14 79)	14 69	(13 85, 15 24)
		5000	14 26	(13 46, 14 75)	14 58	(13 62, 15 17)
Real price	Dollars per lb	0000	-6 77	(-7 58, -6 21)	-6 80	(-7 23, -6 44)
		0625	-6 77	(-7 56, -6 22)	-6 82	(-7 24, -6 46)
		1250	-6 77	(-7 54, -6 25)	-6 87	(-7 28, -6 53)
		1875	-6 82	(-7 53, -6 33)	-7 00	(-7 41, -6 67)
		2500	-6 91	(-7 63, -6 46)	-7 23	(-7 63, -6 91)
		3125	-7 06	(-7 79, -6 55)	-7 55	(-7 97, -7 23)
		3750	-7 20	(-7 92, -6 65)	-7 93	(-8 46, -7 52)
		4375	-7 30	(-8 16, -6 63)	-8 26	(-8 99, -7 70)
		5000	-7 34	(-8 27, -6 64)	-8 39	(-9 27, -7 77)
Nominal sales	$1,000	0000	17 56	(17 50, 17 61)	17 31	(17 06, 17 52)
		0625	17 54	(17 49, 17 58)	17 35	(17 10, 17 54)
		1250	17 46	(17 42, 17 48)	17 41	(17 23, 17 56)
		1875	17 30	(17 28, 17 31)	17 41	(17 25, 17 50)
		2500[2]	17 05	(17 02, 17 07)	17 31	(17 22, 17 38)
		3125[2]	16 72	(16 66, 16 77)	17 09	(16 96, 17 21)
		3750	16 36	(16 27, 16 44)	16 78	(16 43, 17 06)
		4375	16 08	(15 96, 16 30)	16 49	(15 85, 17 02)
		5000	15 98	(15 85, 16 12)	16 37	(15 52, 17 01)

See footnotes at end of table

Continued—

Table 5—Power spectrum ordinates and 90-percent confidence intervals, natural logarithmic scale—Continued

Variable	Unit	Frequency	1966-79		1953-65	
			Ordinate	90-percent interval	Ordinate	90-percent interval
Nominal price	Dollars per lb	0000[2]	-5 72	(-5 83, -5 62)	-5 11	(-5 29, -4 97)
		0625[2]	-5 74	(-5 84, -5 64)	-5 11	(-5 25, -4 98)
		1250[2]	-5 82	(-5 89, -5 75)	-5 11	(-5 22, -5 03)
		1875[2]	-5 97	(-6 02, -5 94)	-5 18	(-5 26, -5 03)
		2500[2]	-6 24	(-6 28, -6 17)	-5 36	(-5 43, -5 30)
		3125[2]	-6 57	(-6 68, -6 46)	-5 67	(-5 79, -5 56)
		3750[2]	-6 95	(-7 18, -6 76)	-6 07	(-6 31, -5 82)
		4375[2]	-7 27	(-7 62, -6 94)	-6 44	(-6 91, -6 02)
		5000	-7 39	(-7 82, -6 98)	-6.61	(-7 21, -6 10)

[1]Power spectrum ordinates are the natural logarithms of the means of 200 bootstrap observations for each ordinate in each spectral estimation problem The 90-percent intervals are generated by truncating the lower and upper 5 percent of the bootstrap observations and by taking logarithms of the remaining lowest and highest ordinates

[2]Confidence intervals for the two reference periods did not overlap

Figure 1

Natural Logarithm Power Spectrum of Hop Acres

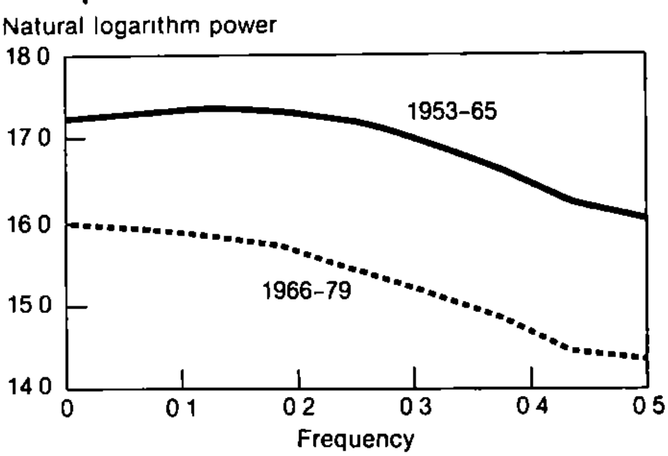
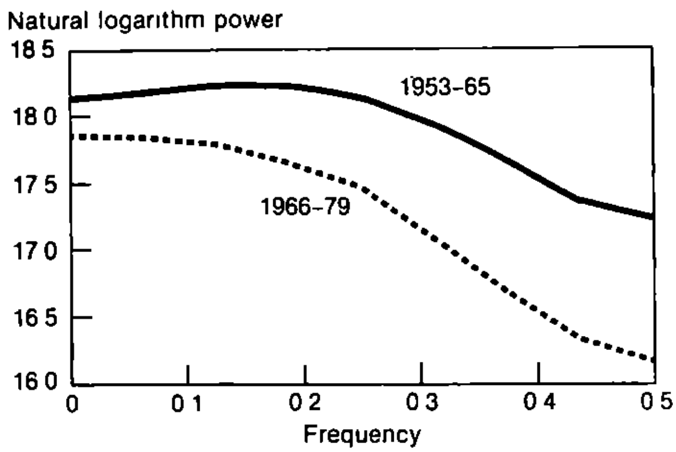


Figure 2

Natural Logarithm Power Spectrum of Hop Production



by shortrun cyclical variation (cycles of 4 years or less) is strongly supported, however, reduced variance contributed by longrun cyclical variation is not strongly supported.

The point estimates of the real sales power spectra indicate reduced power at each frequency level, where again most of the power is concentrated in longrun cycles However, all confidence intervals overlap in this case, thus, at the confidence level used here, the statistical evidence does not support reduced power at each frequency In the case of nominal sales, the point estimates of the power spectra indicate a power increase for longer run cyclical variation and a power decrease for shorter run cyclical variation However, only the ordinates associated with 3- and 4-year cyclical variation are significantly different at the confidence level used here, with all other confidence intervals overlapping.

The point estimates of the real-price power spectra actually indicate a power increase in the Federal Order reference period, especially for shortrun cyclical variation However, as in the case of real sales, all confidence intervals overlap, and, at the

Figure 3

Natural Logarithm Power Spectrum of Real Hop Sales

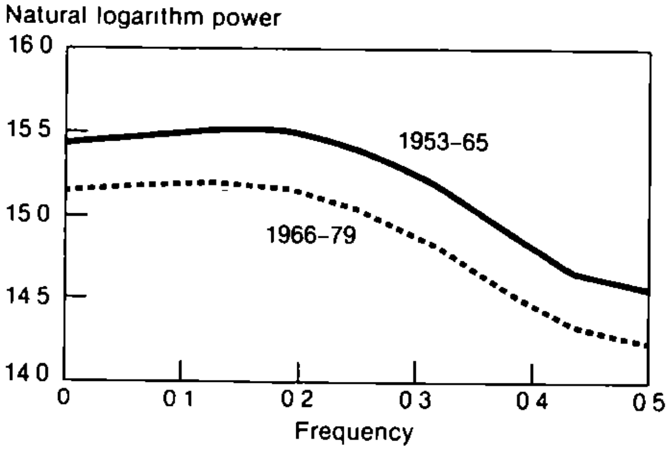


Figure 4

Natural Logarithm Power Spectrum of Real Hop Price

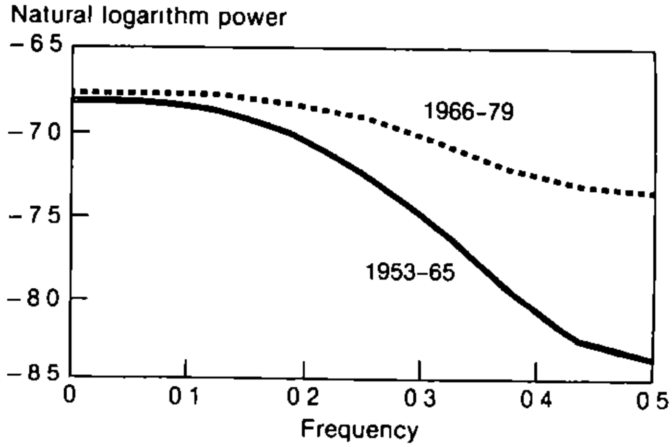


Figure 5

Natural Logarithm Power Spectrum of Nominal Hop Sales

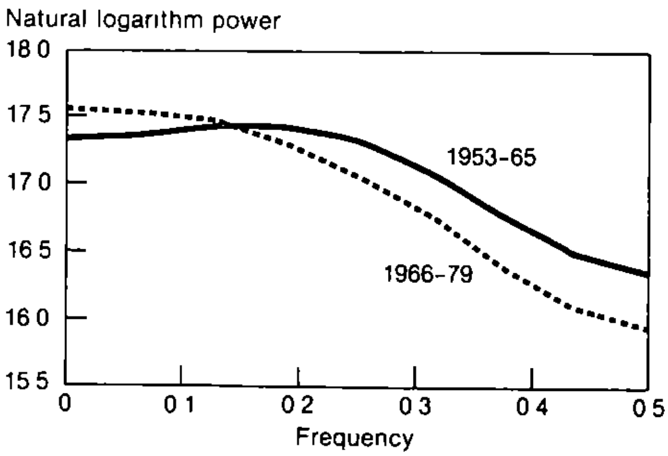
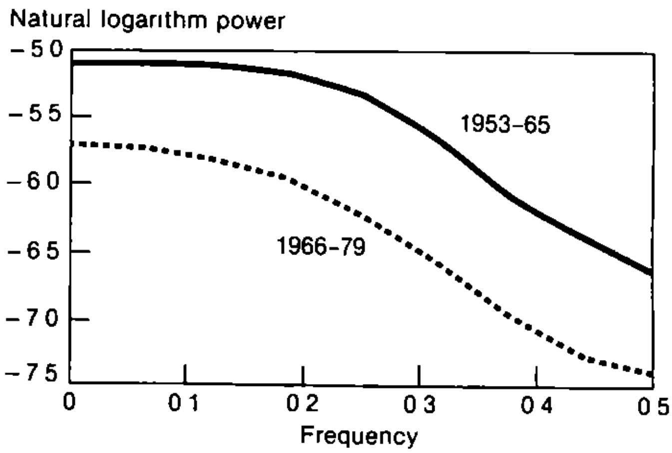


Figure 6

Natural Logarithm Spectrum of Nominal Hop Price



confidence level used here, statistical evidence does not support power increase at each frequency The estimated ordinates of the nominal-price power spectra indicate reduced power across all frequencies The confidence intervals suggest that the difference in power at each frequency, except the highest frequency, is significant

Overall, the variance analysis suggests that the marketing order has contributed to both longrun (cycles greater than 4 years in length) and shortrun stabilization of hop acreage, as well as shortrun stabilization of hop production. There is not sufficient evidence to conclude that real and nominal sales and real price were more stable in the Federal Order reference period However, there is notable support for the hypothesis that variation in nominal prices has been reduced overall, including both shortrun and longrun cyclical variation

The statistical procedures used here were based on a relatively small number of observations, thus, in the case of real and nominal sales as well as in the case of longrun cyclical stabilization of production, failure to amass statistical evidence supporting stabilization may be the result of small sample size The Federal Hop Order can only affect the supply response of U S hop producers and not the demand for, or the foreign supply of, hops Thus, the order might be viewed as successful from a domestic supply viewpoint, however, because of changes in demand or foreign supply, the potential reduction in price, sales, and income variability may not be as pronounced If the order had not been successful in modifying the domestic hop supply response, we cannot know whether the variation in price, sales, and income could have been of a greater magnitude than it was

Conclusions

Although some market variable projections were subject to notable errors, the HAC's overall projections of quantities supplied and demanded for forthcoming marketing years were reasonably accurate when they are judged by standard goodness-of-fit measures used to assess forecast accuracy However, the salable quantities the HAC ultimately recommended have caused larger carryout stocks than the projected carryout stocks that the HAC suggested as desirable levels Given the overstated salable quantity recommendations and the resultant larger than desirable carryouts, one might suspect that the HAC has explicitly attempted to expand the size and market share of the U S production base This philosophy has often been stated in the minutes of the HAC's marketing policy meeting

We used a variance analysis together with a spectral analysis to analyze the question of whether the hop marketing order has helped stabilize hop acreages, production, prices, and sales Contrasting two time periods before and after the inception of Federal Hop Order No 991 (1953-65 and 1966-79, respectively), we found that the latter period was characterized by significantly less variation in hop acreages and nominal hop prices and by less short-run cyclical variation in production There was insufficient statistical evidence to conclude that either real and nominal sales or real prices were more stable in the Federal Order period

Despite the lack of evidence supporting stabilization of real and nominal sales and real price, stabilized acreage, production, and nominal prices may signal significant benefits to hop growers and, indirectly, to society at large Given the long-term nature and the relativley large level of investment required in hop production capacity and the relatively long payback period required for amortization of such investment, large variability in acreage and production can be symptomatic of uncertainty and misallocation of hop production resources The fact that acreage and production have been stabilized by the Federal Order may indicate a more stable decision environment leading to a more efficient resource allocation The reduced variation in nominal prices may also facilitate more accurate predictions of future hop price levels and may improve the efficiency of resource allocation in hop production

The question of whether the benefits of hop market stabilization exceed their costs requires a full accounting of social benefits and costs, and most important, a definition of the social decision function ultimately used to gauge the performance of the program The study of volume-control behavior presented in this article suggests that, value judgments aside, the U S. hop order has at least partially met its principal challenge of stabilizing the hop market and has also served a reasonably accurate market information and outlook function

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In Earlier Issues

Exit and entry, if they occur, certainly affect the net changes in the number of farms and changes in total production The change in the number of farms has a major effect on the results from the application of two widely used concepts in agricultural supply analysis studies· the representative farm concept and the Markov process concept. Too often agricultural supply analysis studies have not taken sufficient account of the dynamic nature of changes in supply as caused by both exit and entry of firms

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