Poultry-Related Price Transmissions and Structural Change Since the 1950's

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Abstract *We use a vector autoregression analysis of corn price, farm poultry price, and consumer poultry (meat) price for two periods, a mid-1950's to late 1960's period and an early 1970's to mid-1980's period We explored the dynamic aspects of the estimated price transmission models of these two periods Statistically significant evidence suggests a change in the dynamics of these price transmissions between the two periods Price-increasing shocks to corn production are now more likely to be passed on to consumers more quickly as prices increase Evidence also suggests that, since the early period, corn has become an increasingly important factor in explaining poultry prices, and substantial market change has occurred in the poultry industry at the retail level*

Keywords. *Corn/poultry price dynamics, vector autoregression, Tiao-Box likelihood ratio tests, Kloek-Van Dijk Monte Carlo methods, industry structural change*

When a policymaker considers alternative policies for a sector, the economic dynamics of the sector under consideration may influence the final decision Understanding the nature of farm/nonfarm price transmissions is vital to competent policy formulation For certain farm sector shocks, the time required for the farm price to affect the prices in the economy's other sectors (reaction times), as well as the directions, patterns, and durations of subsequent price responses, may influence the nature of the policy chosen For instance, suppose the shock were a drought and the feed-livestock-meat agents were organized into a perfectly competitive market system of price-taking producers and consumers Some livestock producers, faced with higher feed costs, may liquidate herds In the short term, one would expect lower livestock and meat prices from increased slaughter but higher prices in the longer term after the short-term glut passes An appropriate policy response to such conditions could be feed subsidies or transportation aid for moving feed into drought areas

Some agents in the system, however, may hold sufficient market power such that distressed selling does not occur and cost increases get passed to the consumers The appropriate policy response now differs from the first case The policy response may instead focus on protection from abuse of market power through investigation and prohibition of price gouging Thus, research that identifies the nature of the price transmission mechanisms provides useful economic intelligence for choosing the appropriate policy instrument

We focus on the price transmission mechanisms linking farm corn price (PC), livestock or farm poultry price (PL), and consumer or meat price for poultry products (PM)[1] (the "corn/poultry," or PC-PL-PM, price transmission mechanism) We address characteristics of the corn/poultry price transmission (1) the time required for a farm-level corn price shock to influence farm poultry and consumer meat prices (reaction time), (2) the direction and patterns in these responses of farm poultry and meat prices, (3) the statistically significant durations of responses in farm poultry and consumer prices to a farmgate shock in corn prices, (4) similarities and differences in price response patterns across the farm poultry and consumer poultry sectors, and (5) any evidence on whether the PC-PL-PM transmission mechanism has changed over time

While our approach identifies the nature of these price transmissions, explaining the reasons for the nature of the identified transmissions remains for further research using models with more economic structure We provide an initial phase for such inquiry To facilitate such further research with more structural econometric methods, we discuss our dynamic results in relation to observed post-1950 changes in the poultry industry

We apply vector autoregression, or VAR, econometrics throughout our study We found that this method is appropriate because the data-oriented technique provides evidence on the dynamic properties of relationships Static theory and more structurally oriented econometrics ignore these dynamic properties of relationships or, at best, treat them in an *ad hoc* manner

VAR Econometrics

Under rather general conditions, an m-component vector, indexed by time t, admits an autoregressive

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[1] Unless otherwise stated "farm poultry" and "consumer" (or "meat") prices are those of poultry products

representation generally expressed as equation 1 (*3*) [2] (Note underlined characters represent matrices or vectors)

$$\underline{x}(t) = SUM(s=1,inf)[\underline{b}(s)*\underline{x}(t-s)] + \underline{e}(t), \quad (1)$$

where, SUM(s=1, inf) is the summation operator for variable "s" over the range of 1 0 through infinity (inf) The b(s) are m*m matrices of autoregressive (AR) regression coefficients, and e(t) is an m-element vector of white noise residuals or innovations [3] The white noise nature of e(t) satisfies equations 2 and 3 *(2,3.4)*

$$E(\underline{e}(t)) = \underline{0} \text{ for all t, and} \quad (2)$$

$$E(\underline{e}(t)\underline{e}(s)') = \underline{0} \text{ if t does not equal s,}$$
$$= \underline{S}, \text{ a positive-definite, m*m covariance matrix when t=s} \quad (3)$$

"E" signifies the expected value operator For applied work, equation 1's infinite lag sequence must be truncated to a number small enough to be operational but large enough for the residuals to approximate white noise *(2,* p 112) A universally accepted method of VAR lag selection, however, does not exist *(3)* One choice used with some success is the Tiao-Box likelihood ratio test Bessler (*3*) discusses the test's properties and suggests its use in applied problems

Compared with more conventional, structural econometric analyses, VAR econometrics is a relatively new approach that reveals empirical regularities from time-ordered data The approach imposes few or no *a priori* (theoretical) restrictions on data interrelationships Rather, VAR models loosely utilize theory to suggest which variables constitute a dynamic system in equation 1 All variables in the system are initially considered endogenous, that is, each variable influences itself and all others in the system, with lags

Estimated VAR Model, Data Sources, and Scenario Design

Equations 4, 5, and 6 provide a three-variable VAR of corn price (PC), farm poultry price (PL), and consumer or poultry meat price (PM) To allow us to investigate potential changes in price transmission, we formulate the monthly VAR model for two periods, an "early" period and a "recent" period defined below

$$PC_t = a_{c,0} + a_{c\,T}*TRD + a_{c,1}*PC_{t-1} + \ldots + a_{c,k}*PC_{t-k} + a_{c\,k+1}*PL_{t-1} + \ldots + a_{c\,2k}*PL_{t-k} + a_{c,2k+1}*PM_{t-1} + \ldots + a_{c\,3k}*PM_{t-k} + c_t \quad (4)$$

$$PL_t = a_{L\,0} + a_{L\,T}*TRD + a_{L,1}*PC_{t-1} + \ldots + a_{L,k}*PC_{t-k} + a_{L,k+1}*PL_{t-1} + \ldots + a_{L,2k}*PL_{t-k} + a_{L,2k+1}*PM_{t-1} + \ldots + a_{L,3k}*PM_{t\,k} + L_t \quad (5)$$

$$PM_t = a_{m,0} + a_{m,T}*TRD + a_{m,1}*PC_{t-1} + \ldots + a_{m\,k}*PC_{t-k} + a_{m\,k+1}*PL_{t-1} + \ldots + a_{m,2k}*PL_{t-k} + a_{m\,2k+1}*PM_{t\,1} + \ldots + a_{m\,3k}*PM_{t\,k} + m_t \quad (6)$$

The variables PC, PL, and PM are defined above All a-coefficients are regression coefficients, the c, L, and m subscripts on the a-coefficients refer to the PC, PL, and PM variables, respectively TRD is a time trend capturing time-dependent influences not of direct concern to this study The coefficients with a nought subscript are intercepts The c_t, L_t, and m_t are the innovations for the PC, PL, and PM equations, respectively We accounted for seasonal effects with 11 monthly indicator variables Data are in natural logarithms The k is the chosen lag number

For this paper, we used more than 30 years of monthly price data We used these data in natural logarithm (logged) form because the percent changes of the series are more apt to be stationary processes than the actual levels of the data

For the corn price at or near the farmgate (PC), we use the Bureau of Labor Statistics (BLS) producer price index (PPI) (farm products index, corn no 2 at Chicago category ("farmgate" corn price)) The PPI (farm products index, live poultry category) serves as the livestock or farm poultry price (PL) The consumer price index (CPI) (all urban consumers index, poultry category) is the consumer or meat price for poultry Doan and Litterman's package, Regression Analysis of Time Series (RATS) generated all VAR econometric results (*7*)

We used a several-phased procedure to obtain evidence related to answering the questions about the corn/poultry price transmission First, we estimated a monthly corn/poultry price VAR (equations 4, 5, and 6) for two periods an "early" period from the start of 1956 to the end of 1968 (1956 1-68 12) and a "recent"

[2] Italicized numbers in parentheses cite sources listed in the References at the end of this article

[3] Innovations in a VAR context differ from the usual economic meaning of innovation Rather than meaning the deliberate introduction of a new economic process expected to continue for some indefinite future in the economic system, innovation in the VAR context refers to an unexpected "surprise" or shock, perhaps random, to the economic system VAR econometrics then models the adjustment path as this shock reverberates throughout the economic system and eventually decays

period (1973 1-85 11) (the early and recent models, respectively) [4] Choosing these periods allowed about half our sample of overall data for each period and provided the maximum numbers of observations for both VAR models Also, the cutoff between the two periods roughly coincided with the early-1970's start of intensive poultry marketing efforts by restaurant and fast-food outlets (*12*, p 14) Tiao and Box's (*14*) likelihood ratio tests, conducted at Lutkepohl's (*11*) suggested 1-percent significance level, suggest a one-order lag for the early model and a six-order lag for the recent model So in equations 4 through 6, k or the lag number for each variable, is one for the early model and six for the recent model

Second, we shocked the early and recent VAR's with a one-time increase in corn price We analyzed the resulting impulse responses across prices within each of the two models, and then across the two models This comparison provided reaction times, durations, and patterns in responses of farm and consumer poultry prices to corn price changes, as well as changes in these response patterns between the two periods

Third, we used Sims' (*13*, p 17) test of "structural change" to determine whether or not VAR coefficients have changed since the 1950's Results not only suggest whether price structure has changed but where such change has occurred (in crop, farm poultry, and/or retail sectors)

Fourth, we analyzed forecast error variance (FEV) decompositions both across each VAR's component series and then comparatively across the early and recent models These results suggest the strength of interrelationships among prices and how the nature of these price interrelationships have changed between the early and recent periods

Influences of a Shock in Corn Price

The impulse response function simulates, over time, the effect of a one-time shock in one of a VAR's series on itself and on other series in the system (*3*) We shocked each VAR by a standard error (increase) of the historical innovation of farmgate corn price We normalized the impulse responses of each variable by the standard deviation of each variable's historical innovation (hereinafter, the variable's standard error) The non-normalized impulse responses are percent changes in nonlogged indices When normalized, these impulse responses become approximate percent changes in the standard error Hence, if the normalized impulse of one price is larger (smaller) than another price's normalized impulse, then the second price has been more (less) "traumatized" or influenced by the initial corn price shock

We imposed a Choleski decomposition on each VAR to orthogonalize the current innovation matrix, such that the variance/covariance matrix of the transformed current innovations is identity We ordered the series as follows corn price, farm poultry price, and consumer price in each VAR model This ordering assumes that, in contemporaneous time, if a casual pattern does exist, it flows from corn price to farm poultry price to consumer price Monte Carlo methods developed by Kloek and Van Dijk (*8*), and programmed by Doan and Litterman (*7*), generated a t-statistic for each impulse response

Figures 1 and 2 provide responses in poultry prices from a standard error rise in corn price Circled impulse responses are statistically different from zero at the 10-percent level of significance We emphasize these statistically significant portions of the impulse response patterns in our analyses Panels 1a and 1b provide the farm poultry price impulses of the early and recent models Panels 2a and 2b provide the impulses in consumer poultry price for the early and recent models Note that both figures present changes in, and not levels of, price indices

Impulse Responses in Farm Poultry Price

During the early period, panel 1a suggests that a positive shock to corn price generated 6 months of declines in farm poultry price Eventually, the early model's price declines approached zero, and then prices began to increase Early model impulses in PL, however, were not statistically significant from zero

This earlier period's patterns of impulse responses parallel those expected where producers are price-takers in a perfectly competitive industry Poultry producers, having faced higher feed costs, marketed birds early These earlier than expected marketings led to price-depressing higher slaughter ("expense-induced" slaughter) This expense-induced slaughter would give a pricing pattern similar to that observed

[4] Throughout the number following a postyear colon refers to the month with "1" representing January and "12" representing December The following observations were saved as validation periods to ascertain the models' out-of-sample predictability relative to naive forecasts 1969 1 1971 9 for the early model and 1985 12-1988 9 for the recent model Forecasts were evaluated for both VAR's at the 1- 2-, 6- 12- and 18-month horizons Each equation (except the early PM) generated Theil-U statistics which about equaled or were less than, unity at most of these horizons Generally the equations predicted well out-of sample relative to the naive model

Figure 1
Changes (impulse responses) in livestock poultry price

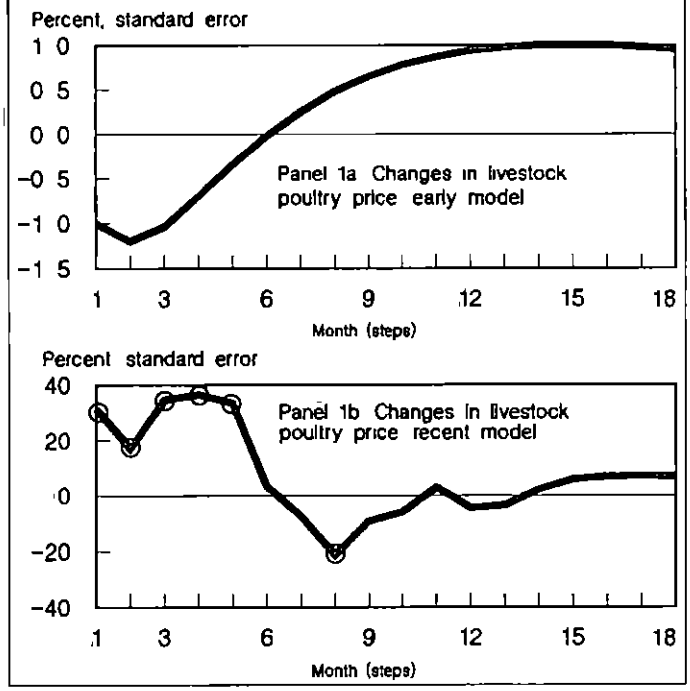
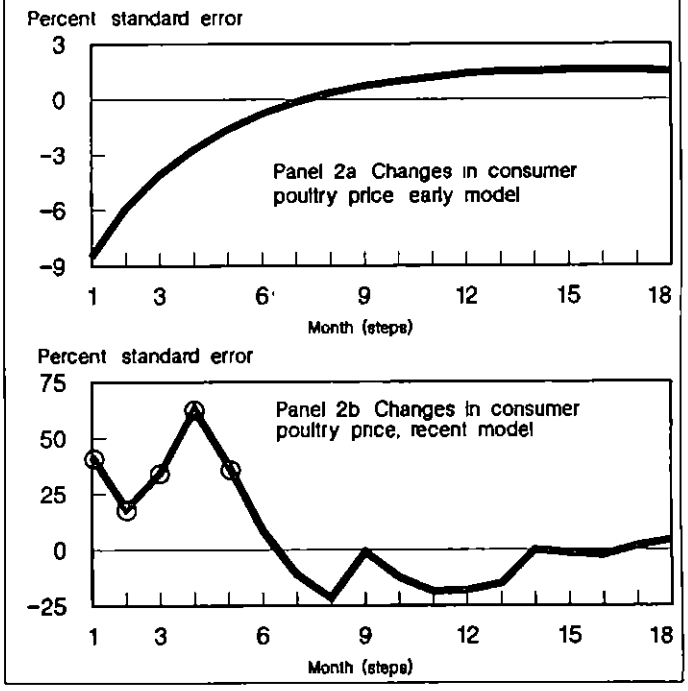


Figure 2
Changes (impulse responses) in consumer poultry price



in the early VAR's initial half-year of farm poultry price reductions

During the recent period, increased corn price generated farm poultry price impulses that differed from early VAR impulses They differed in direction (increases instead of decreases) and the impulses were statistically significant The recent VAR's farm poultry price rose in a significant manner for 5 months (Six of the first eight impulses in the recent model's PL were significant)

A comparison of panels 1a and 1b suggests that, in terms of PL's innovation standard error for a period, the corn price shock influenced the farm poultry price to a greater degree in the recent VAR than in the early VAR

Two points summarize this section's results about farm poultry price impulses to a positive shock in corn price First, the effects of corn prices on farm poultry prices drastically changed between the early and recent periods These responses in farm poultry price changed from 6 months of statistically insignificant declines to about a half year of mostly significant increases, a change in response patterns consistent with a change from an industry of many small, price-taking producers to an industry where producers had the market power to pass on cost increases And second, corn price shocks had far less influence on PL in the early period than in the recent period [5]

Consumer Meat Price Responses

Consumer price impulses from the initial rise in PC closely mirrored farm poultry price response in each of the two models (figs 1 and 2) As with farm poultry prices, consumer poultry prices took directionally opposite response patterns in the early and recent VAR's The early model's consumer price fell in an insignificant manner for 7 months after the initial increase in farmgate corn price Presumably, expense-induced slaughter's effects on PL filtered through to prices of retail poultry products Yet response patterns reversed in the recent period, with consumer price having increased for about 5 months in a largely significant manner Corn price increases influenced the recent period's consumer poultry price to a far greater extent than the early period's consumer poultry prices

[5] A price's impulse responses are normalized by the standard error of that price's historical innovation for the model's sample period, and such innovation standard errors in the recent model exceed those of the early model for all modeled prices Comparisons of absolute values of non-normalized impulses also suggest that recent model impulses in PL and PM exceed those of the early model

Formal Evidence of Structural Changes

We tested coefficient constancy or "structural change" since the 1950's with the procedure of Sims (*13*, p 17) We specified a "reduced" model for PC, PL, and PM, and estimated it over the 1954 1-1985·11 period with ordinary least squares This "reduced" model differs from a "full model," since the full model includes test variables which were not in the reduced model These variables are IND, IND*PC(1), ,IND*PC(6), IND*PL(1), , IND*PL(6), IND*PM(1), , IND*PM(6) IND is an indicator variable valued at unity after December 1970 and at zero otherwise The asterisk denotes the multiplication operator The parenthetical number denotes lags A "full-vs -reduced model" F-test was then implemented for the test variables The null hypothesis is that the test variable coefficients are, as a group, zero, thereby implying no structural change One rejects the null of no structural change for F-values greater than the tabular F(19,333) of 1 58 for the chosen 5-percent significance level

Evidence was insufficient to suggest that coefficients changed in the corn price and the farm poultry price relations The F-values (1 09 for PC and 1 25 for PL) were less than 1 58 With a 2 79 F-value, evidence was sufficient to suggest structural change at the retail (PM) level These results indicate that at least part of the cause for the directionally opposite patterns in the two model's price responses may have risen from retail-level changes

Decompositions of FEV

Analysis of decompositions of FEV identifies the interrelationships within a modeled system's time series (*13*) Error decompositions attribute within-sample error variance to alternative series, giving a measure useful in applied work We calculated FEV decompositions for k-step-ahead forecasts for the early and recent models (table 1)

Corn price was largely exogenous in both VAR's The percentage of PC's FEV attributed to its own error exceeded 73 percent at all reported horizons

One difference among the past and recent patterns of FEV decompositions was particularly evident. Farm poultry and meat prices had negligible FEV proportions attributed to farmgate corn price in the early period but much larger proportions so attributed in the recent period The influence of corn price on poultry prices has increased between the two periods This evidence underscores the greater statistical

Table 1—Proportions of FEV k months ahead allocated to innovations in respective series, early and recent composite model estimations

Variable name	k	Standard error	Percent explanation from PC	PL	PM
"Early" VAR estimated over 1956 1-68 12					
Corn price (PC)	1	0 0506	99 52	0	0 48
	6	0707	93 02	1 34	5 64
	12	0777	83 97	5 03	11 00
	18	0809	78 36	7 77	13 87
	24	0825	75 57	9 22	15 21
	35	0835	73 75	10 20	16 05
	36	0835	73 68	10 24	16 08
Farm poultry price (PL)	1	0576	02	97 99	1 99
	6	0750	02	85 55	14 44
	12	0820	03	80 09	19 88
	18	0848	04	78 23	21 73
	24	0860	05	77 49	22 46
	35	0867	06	77 06	22 88
	36	0867	06	77 04	22 90
Consumer meat price (PM)	1	0277	59	23 38	76 03
	6	0434	30	37 53	62 18
	12	0498	24	40 93	58 83
	18	0523	24	41 88	57 89
	24	0533	25	42 22	57 54
	35	0539	25	42 40	57 34
	36	0539	25	42 41	57 34
"Recent" VAR estimated over 1973 1-85 11					
Corn price (PC)	1	0834	99 54	34	13
	6	1392	97 97	90	1 14
	12	1536	92 57	1 17	6 27
	18	1591	87 33	1 54	11 13
	24	1607	85 65	1 53	12 81
	35	1612	85 10	1 54	13 36
	36	1612	85 09	1 54	13 37
Farm poultry price (PL)	1	0751	8 60	90 59	81
	6	1009	18 58	73 97	7 45
	12	1070	18 69	69 75	11 55
	18	1077	19 13	68 69	12 17
	24	1079	19 28	68 57	12 15
	35	1080	19 28	68 57	12 15
	36	1080	19 28	68 57	12 15
Consumer meat price (PM)	1	0386	12 61	46 01	41 38
	6	0579	23 76	54 31	21 92
	12	0602	25 69	53 05	21 27
	18	0607	25 54	53 18	21 28
	24	0608	25 66	53 10	21 24
	35	0608	25 66	53 09	21 25
	36	0608	25 66	53 09	21 25

significance of the recent model's PL- and PM-impulse responses

Both the early and recent VAR's suggest a minor feedback relationship from consumer price to farm poultry price The proportion of the farm poultry price's FEV attributed to consumer meat price reached 23 percent in the early model and 12 percent in the recent model

Consumer poultry price became more endogenous between the early and recent periods In the early model, meat price was largely exogenous, with more than 57 percent of FEV having been self-attributed at all reported horizons In the recent VAR, the meat price was largely endogenous with no more than about 22 percent of its FEV being self-attributed at horizons beyond 1 month

A Collation of Results With Post-1950 Trends in the Poultry Industry

Our results concerning impulse responses, change in structure, and FEV decompositions strongly suggest that something substantial has changed in how a corn price shock pulsates through the poultry-related noncrop economy Beginning with an increase in corn price, farm and retail poultry prices declined in a statistically insignificant manner for about 6 months in the early model In the recent model, under the same conditions, both poultry prices not only rose for roughly 6 months, but most of these increases were statistically significant Since the early period, perhaps producers have developed an ability to pass on corn-based feed cost increases to consumers, an ability whose existence was not evident in the early period's data The change-of-structure test results suggest changes at the consumer or retail demand level. Patterns of FEV decompositions suggest that a more direct link has developed (since the early period) between corn price and the farm and retail poultry prices This result underscores the higher levels of statistical significance in the impulses of both poultry prices to a corn price shock with the recent model than with the early model The FEV decompositions suggest that retail price is more endogenous to the modeled system in the recent rather than in the early period

Our data-oriented model has revealed that substantial and statistically significant changes have occurred, but the nontheoretical VAR models do not determine why such changes evolved. We can offer some potential reasons based on several patterns observed since the 1950's and concerning change in market structure on both the demand and supply sides of the U S poultry industry Most of the patterns we discuss are for broiler and turkey prices These two are the primary elements comprising the composite poultry prices at the producer and retail levels [6]

Many demand- and supply-side changes have occurred in the poultry industry since the 1950's These demand- and supply-side events are potential reasons for the changes we found in poultry price response patterns, in the dynamic characteristics of corn/poultry price interrelationships, and in the changing structure of the retail price equation. On the supply side, observed technological advancements have shifted poultry supply rightward Demand-side changes have also occurred in the forms of both demand shifts and movements along these shifting relations Changing poultry demand and changing broiler supply curves have interacted to generate newer and different equilibria since the 1950's Our VAR models cannot discern the exact roles which such events have played in the data-embedded changes We leave this task to more conventional econometric efforts which specifically address theoretical market structure issues We have accomplished the first step in this overall inquiry by having uncovered evidence that points to sufficient changes to warrant such inquiry

Observed Supply-Oriented Events

Lasley (*9*), the National Broiler Council (*12*), and Coffin, Romain, and Douglas (*6*) mention several post-1950 changes in the supply side of the poultry industry These events are advancements in poultry production technology, increased flexibility of poultry supply through broiler product specialization, and more standardized poultry output quality from more vertically integrated poultry production

Lasley (*9*, pp 7-14) notes that over the last several decades, technologically induced production expansion has occurred so rapidly that producers responded swiftly enough to shortrun profits that prices, in the long run, have hovered very close to production costs

[6]The composite poultry price at the farm level is the BLS producer price index (PPI) (farm products index live poultry category) This series is comprised of (1) the PPI (farm products index broilers category) and (2) PPI (farm products index, turkeys category) The broiler price index has an 81 percent weight and the turkey price index has a 19-percent weight in the composite poultry price at the farmgate The CPI (all urban consumers index, poultry category) serves as the composite poultry price at the consumer or retail level This composite consumer price is composed of (1) the CPI (all urban consumers index fresh whole chickens category) (2) the CPI (all urban consumers index, fresh and frozen chickens category), and (3) CPI (all urban consumers index "other" poultry category) Weights for the composite consumer price are a combined 81 percent for items 1 and 2, and 19 percent for item 3

These technological advancements are evident from lower input requirements for poultry production A ton of feed now produces 37 percent more broilers and 54 percent more turkey than in 1955 (*9*, p 14) Labor input requirements per pound of broiler and turkey production are 2 6 percent and 3 8 percent, respectively, of 1945-49 requirements (*9*, p 14)

The second supply-side event is a more flexible supply through producer/processor specialization of poultry output (*9, 12*) This producer/processor specialization was motivated, in part, because of the various demand changes discussed below Responding to consumer preference changes, since the early period, poultry supply today is composed of less of the traditionally demanded whole-bird product, and of more of the specialized or fully processed broiler products (*5,9,12*) More fully processed products include prepackaged birds (whole, cut-up), packaged parts, and "further-processed" products (precooked, "microwavable," and "cold cut" products) (*5,9,12*) Since 1965, proportions of federally inspected slaughter slated for cut-up products rose from 19 3 to 42 0 percent for broilers, and from 7 3 to 27 0 percent for turkeys (*9*, p 17) Since 1960, proportions of federally inspected poultry slaughter for further processing rose from 2 7 to 10 5 percent for broilers and from 5 0 to 36 6 percent for turkeys (*9*, p 17) The proportions of processors' marketed broilers sold as prepackaged chilled parts rose from 3 4 to 16 9 percent during 1967-87 (*12*, p 14) These advancements have more than offset the demand-increasing events discussed below, such that by the early 1980's, deflated retail prices fell short of 1955 levels by 61 percent for broilers and by 56 percent for turkeys (*9*, p 4)

As the third supply event, poultry output has become more standardized because of the increased vertical integration of poultry production (*6,9 12*) Since the mid-1950's, proportions of production that were vertically integrated rose from 90 to 99 percent for broilers and from 36 to 90 percent for turkeys (*9*, p 8) The increasing concentration into fewer and larger poultry "producer/processor" firms may provide some explanation into why PL and PM responses to corn price movements are more statistically significant in the recent than in the early period The increasing concentration may also explain why corn price uncertainty's influence on poultry price FEV's has increased since the early period With larger diversified units came more standard blended rations With the needs for large volumes of energy feed for these rations and the wide availability of corn as a feed energy source, it is natural that large volumes of corn would be used in these large production units The more systematic use of purchased corn-based feed, where producers exercise more complete and more precise control over the poultry ration, may account for corn price's more direct influences on PL and PM in the recent rather than in the early model

Observed Demand-Side Events and Interaction With a Changing Supply

Several demand-side events have together resulted in different (often augmented) consumption patterns for poultry products Some events have shifted demand curves rightward so that more poultry is demanded at each price, other events have generated actual changes in the nature of poultry demand Combinations in demand-supply interactions have triggered events which have caused movements along present (and previous) poultry demand curves Since the 1950's, these changes have coincided with strong rises in annual per capita consumption from 14 to 49 pounds of broilers and from 4 1 to 10 7 pounds of turkeys (*9*, p 1) Either increases or changes in retail broiler consumption or both coincided with the development of consumer allegiances to brand names, ever-increasing poultry volumes marketed by restaurant and fast-food outlets, and more serious health concerns about beef and pork products than about poultry products

Consumer allegiance to poultry brand names has been increasing, and processor marketing efforts under these poultry brands have increased consumer demand The National Broiler Council (*12*) provides data about trends in consumer allegiance since 1981 These data are for broilers and chicken which account for 81 percent of the PL and PM indices Today, 84 percent of poultry processors market broilers under a brand name, up from 71 percent in 1981 (*12*, p 13) In 1987, 52 percent of marketed broilers were sold under a brand name, a proportion which rose from 39 percent in 1983 (*12*, p 13)

Another source of enhanced consumer demand for poultry arose from heightened marketing efforts by restaurants and fast-food outlets The share of processors' broilers shipped to restaurants dramatically increased from 1 5 percent in 1960 to 13 8 percent in 1987 (*12*, p 14)

The net effect of growing consumer demand for poultry and the dominance of corn as an energy source in poultry rations has led to broiler rations accounting for a larger share of domestic corn usage For example, from the early 1950's until the mid-1980's, broilers'

percentage of total feed use of corn rose from 3 5 percent to over 11 5 percent (*15*)

Findings and Conclusions

Which of the two views of the underlying market mechanisms discussed in the introduction correctly describes the effects of a price-influencing crop sector shock on the rest of the economy? Our second view did for the PC-PL-PM price transmission mechanism and for the recent period

But we found that our first view would have been correct in an earlier time We found higher corn prices are passed on as higher farm poultry and consumer poultry meat prices Under these circumstances, a public policy of feed subsidies or feed transportation aid would benefit poultry producers without protecting consumers Thus, an understanding of the noncrop price ramifications of a crop sector shock aids policymakers attempting to formulate policy to alleviate detrimental effects of, or to cope with, a shock to a crop sector

Our results focused on how a corn price shock pulsates through the noncrop economy, in particular for poultry-related products We investigated how a corn price increase influences farm poultry and retail meat prices, and how such price dynamics have changed over time

We found that if trends observed since the early 1970's continue, one may expect a rise in corn price to generate about 6 months of farm poultry and retail poultry price increases Reaction times for PL and PM responses are immediate Retail poultry price impulses directionally mirror impulses at the farm poultry level Corn price appears highly exogenous, while retail meat price appears highly endogenous The farm poultry price greatly influences the retail price We obtained these current results about the PC-PL-PM price transmission from the recent model

Another set of results concern how the PC-PL-PM price transmissions for poultry and broilers have changed since the early 1950's This research reveals that marked and statistically significant changes have occurred among corn and poultry price relationships over the last 30 years Poultry price responses (at the farm and retail levels) to rises in corn price have completely reversed We observed about 6 months of insignificant decreases in the early period In the recent period, this has changed to about half a year of significant increases

Results may suggest that in the recent period the larger, more vertically integrated, and "factory-like" poultry producing/processing concerns are now somehow able to pass on rises in corn-based feed costs to consumers This ability apparently did not exist for the more numerous and smaller poultry producers of the early period

During the recent period, we found more statistical significance of relationships among corn, farm poultry, and retail poultry prices than in the earlier period The analyses of the decompositions of forecast error variance of the two models underscore this finding of more statistical significance in the relationships We conducted the Sims test for structural change on the PC-PL-PM price transmission Evidence was sufficient at the 5-percent significance level to suggest structural change in the retail price equation

We found a drastic change in the past 30 years in some of the dynamic characteristics of price transmission within the corn-farm poultry-poultry meat complex Our procedures did not allow us to explain the reasons for this change Knowledge of the change could influence the recommendations of policymakers Explanation of the change could lead to interesting professional exchanges

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