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Introduction

Structural change has been a focus in the food demand literature. Studies have analyzed structural change using a variety of different approaches and methodologies. This paper uses time and demographic changes in U.S. labor markets as motivation to examine structural change under a new context. Over the past five decades, there have been large changes in the composition of the U.S. labor force. Specifically, more females have entered the labor force. Previous literature has noted how females entering the labor force has affected the demand for different food products. This is notable in meat demand. Understanding how these will affect consumer behavior is important. This study examines the effects of time and female labor participation on U.S. consumer meat demand. The goals of this study are: 1) To measure structural change in meat demand over time and when it occurred over the last fifty years, and 2) To measure structural change in U.S. meat demand and when it occurred due to changes in female labor participation over the last fifty years.
American meals have traditionally revolved around meat consumption. Looking at the figure above, it suggests that underlying preferences in meat demand have changed over this time period. This is most apparent in beef and chicken. Beef consumption increased into the seventies but then hit a peak in the mid-seventies and then fell and has leveled off. Chicken consumption experienced continuous growth over the last half-century. Pork consumption were flat during this time period.
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Data
Quarterly data on consumption and retail prices for beef, pork, chicken were collected from various USDA sources for the 1960–2013 period. To account for seasonality, quarterly dummy variables are used. Data on female labor was collected from the Federal Reserve Bank of St. Louis. Specifically, the FRED system compiles indicators in a host of areas. The Female Labor Participation Rate was used. The data was collected in quarterly format. To account for seasonality, the data was fourth–differenced.
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Methodology

When modeling meat demand, a framework that has been employed is what is known as an inverse demand system. In such a system, normalized prices adjust to exogenous changes in quantities. Short-run supplies are assumed to be perfectly inelastic because of production lags and a reasonably short shelf-life. The Inverse Almost Ideal Demand System (IAIDS) will be used here. It was introduced by Eales and Unnevrhr and also developed independently by Moschini and Vissa. It is:

\[ w_i = \alpha_i + \sum_j \delta_{ij} \ln(q_j) + \beta_i (\ln(Q)) \]

where \( \ln Q = \alpha_0 + \sum_i \alpha_i \ln(q_i) + \frac{1}{2} \sum_i \sum_j \delta_{ij} \ln(q_i) \ln(q_j) \)

Interpretation of ordinary demand relies largely on evaluation of elasticities. For inverse demands, interpretation is based on comparable measures called flexibilities. They measure the percentage change in normalized prices to changes in quantities. Flexibilities can be calculated from the above estimated coefficients. In order to model structural change, the following model is developed:

\[ w_{it} = f(X_t, \theta_1)(1 - G(t^*; \gamma, c)) + f(X_t, \theta_2)G(t^*; \gamma, c) + e_{it} \]

where \( \theta_i \) is the set of parameters explaining meat demand for two different regimes that are determined by a transition variable \( t^* \). Transition occur from regime one to regime two according to the transition function, \( G \), which is a function of \( t^* \). \( \gamma \) and \( c \) are parameters that describe characteristics of the transition function. The model above is an offshoot of the time-varying regression models considered in a univariate context by Terasvirta. These are known as Smooth Transition Regression (STR) models. A common specification of the transition function is the first order logistic function:

\[ G(t^*; \gamma, c) = \frac{1}{1 + e^{-\gamma(t^*-c)}} \]

where \( \gamma \) is the speed of adjustment parameter that determines the speed with which the model shifts from one regime to another. The centrality parameter, \( c \), determines at what point in the sample the structural change is fifty percent complete.
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### Results

<table>
<thead>
<tr>
<th>Flexibilities</th>
<th>Beef</th>
<th>Chicken</th>
<th>Pork</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef</td>
<td>-0.70795</td>
<td>0.02501</td>
<td>-0.08350</td>
</tr>
<tr>
<td>Chicken</td>
<td>-0.19498</td>
<td>-0.50204</td>
<td>-0.29352</td>
</tr>
<tr>
<td>Pork</td>
<td>-0.27346</td>
<td>-0.20613</td>
<td>-0.60904</td>
</tr>
<tr>
<td>Scale</td>
<td>-0.87937</td>
<td>-1.1908</td>
<td>-1.08862</td>
</tr>
<tr>
<td>LLK:</td>
<td>1609.577</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In the basic Inverse AIDS model, all own-price flexibilities are negative. All scale flexibilities are negative and in the vicinity of negative one.
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Using time as a transition variable, there was a smooth transition from regime one to regime two. The $\gamma$ parameter is equal to 6.24 and $c$ is .4350. This indicates that the smooth transition from regime one to regime two occurred around 1983. In both regimes all own-price flexibilities are negative. In both regimes, all scale flexibilities are negative.
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Using time as a transition variable, there was a smooth transition from regime one to regime two. The $\gamma$ parameter is equal to 5.28 and $c$ is 5.97. The individual transitions time are indicated in the bottom right picture above while the transition function itself is in the top right picture above. Several transitions starting in the mid-60’s and lasting into the mid-80’s. This also coincided with larger number of females entering the labor force. In both regimes, all own-price flexibilities are negative. In both regimes, all scale flexibilities are negative.
Conclusion

Structural change in U.S. meat demand was examined using an Inverse AIDS model in combination with smooth transition regressions. Results indicate that structural change did occur over the last fifty years. In terms of time, there was a smooth transition from one regime to another around 1983. In terms of female labor participation, there were several regime changes. These occurred from the mid-60’s until the mid-80’s. This period is consistent with larger number of females entering the labor force. This methodology not only pinpoints when there was structural change but also suggest what consumers might be reacting to. This provides researchers with another tool to add to their toolkit in modeling structural change. These results can be informative to industry, policy makers, and researchers who examine and analyze this particular market.
References


