CYCLICAL DEMAND AND PRICING BEHAVIOR OF SEASONAL GOODS: A THEORETICAL MODEL

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ABSTRACT

By employing implicit function theorem and comparative statistics optimization, this paper presents a mathematical model, which examines how the demand, production and price of seasonal goods behave during periods of peak demand. The model explores that an external factor represent a seasonal cycle, such as temperature level or numbers of holiday days, are positively related to demand of such goods whereas the price of these goods behaves “mildly counter-cyclical” or “sticky” to the extent of perfect competition of the market. As an additional implication of the model, whether the stocking possibilities of these final goods affect on their cyclical pricing behavior is also examined.

Keywords: Seasonal demand, pricing decision.

ÖZET

Kapalı fonksiyon teoremi ve karşilaştırmalı istatistik optimizasyon yönteminini kullanarak, bu çalışma, mevsimsel mallara talebin en yüksek olduğu dönemlerde bu malların talebinin, üretiminin ve fiyatlarımanın nasıl bir davranış sergilediğini inceleyen matematiksel bir model sunmaktadır. Model, mevsimsel döngüleri temsil eden sıcaklık, tatil günü sayısı ve benzeri dışsal faktörlerin bu malların talebi ile pozitif ilişkili olduğunu, bu malların fiyatlarının ise piyasanın rekabet derecesi ile doğru oranlı olarak, “az derecede mevsimsel dönmene ters” veya “yapışkan” bir davranış sergilediğini ortaya çıkarmaktadır. Modelin ayrı bir göstergesi olarak, stoklama imkanlarının bu malların mevsimsel fiyatlama davranışını etkileyip etkilemediğini de incelemektedir.

Anahtar Kelimeler: Mevsimlik Talep Fiyatlama Kararı

Introduction

The final consumer demand for some products has a seasonal demand pattern when they satisfy a need that arises only at certain times in a year. These goods can be farm products whose production and their consumption intersect at certain times like

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summer as well as some final products special to certain season within a year, such as heating products and their suplementaries like fuel during winter season or cooling product during hot weather. The examples of these seasonal goods can be altered to tourism services and goods, as well. This characteristic of such goods also stem from consumer buying habits during special days during a year, as well. Producers of these goods, therefore, are faced with a seasonal pattern of distributors’ orders that reflect seasonal trends in consumer demand. Therefore these products or services are supplied and demanded by consumers and producers mostly in “peak-demand seasonal periods”. For the farm products, for example, the weather conditions, in terms of temperature level or the number of warm days in summer that affect their demand and production decisions, are important sources of seasonal shocks to the real economy. On the other hand, the number of off-days for domestic residents for the holiday period within a year and duration or timing of visits of foreigner tourists affects tourism demand, production and its price in tourism market. For the other seasonal goods demand such as energy, coat, swimming necessities and their supplies intersect at certain times in a year. Therefore, we expect that hot or cold weather conditions or higher number of holiday, all in general, reflects coming “peak-demand seasonal periods” in which the consumers wish to consume, make people more willing to consume these goods with a seasonal pattern.

Accordingly, the production and pricing decision of the producers of such goods are formed. In seasonal periods, it is a fact that, the prices of these goods either decline or stay unchanged even if their demands are at peak. This counter-cyclical or sticky behavior the prices have drawn attention of some researchers. For example, Bils (1991), Chevalier, Kashyap, and Rossi (2000) attempted to explain why prices tend to fall during the seasonal demand peak and present some evidence that this is because of counter-cyclical markups. These explanation of decline in prices during high seasonal demand period, that is supposed to occur in imperfect competition, depend on the time-varying the size of wedge between price and marginal cost (Chevalier, Kashyap, and Rossi, 2000: 2). On the other hand, Bils (1989) and Warner and Barsky (1995) propose different approaches by arguing that demand in seasonal periods might be more elastic than usual during demand peaks, leading optimal markups to be counter-cyclical.

This paper is aimed to give alternative theoretical explanation of demand, production and price movements of final goods with seasonal pattern. A different approach of the cyclical price behavior of these goods, particular, is explored by movements in both demand and supply side of these goods, depending on the sensitivity of real wage to coming seasonal period and to seasonal demand changes on the demand side and degree of competition of the markets and stocking possibilities and costs for these goods on the supply side.
The next section of this study presents a mathematical model that first detects the effect of any external factor such as weather conditions on the demand and discusses the implication these factors on production for goods with a seasonal pattern and pricing decision or policy for such goods’ producers as a result of changes in this external factor. By doing so, the effect of whether perfect market conditions are effective and how storable the good is taken into account. The final section concludes.

2. Model

Consider a consumer chooses $Co$ and $Cs$ to maximize his concave utility function,

$$U = u(Co, Cs, L)$$

subject to

$$Y = CoPo + CsPs$$

and

$$24 = W + L$$

where $Cs$ and $Co$ are the amount of seasonal and other good consumed, $Ps$ and $Po$ are the prices of unit of consumed amount of seasonal and other goods (general price index). The budget constraint expressed above would assume that the individual’s income is completely consumed. $L$ is leisure consumed and $W$ is the total hours worked or overtime hours during the cycle by this individual, and $Y$ is the real income for a given seasonal period, which is defined as the product of total working hours, or overtime hours over the cycle, $W$, and real wage earned by the consumers, $w$. For the sake of notational simplicity, the time indices of all the flow variables in the equations are dropped out.

$$Y = f(wW)$$

Now we assume that the real wage is a function of the demand of seasonal good as well as $T$, where $T$ represents necessary external conditions of peak-demand
seasonal periods such as hot (cold) temperature weather level for the summer (winter) products, or good weather condition level or number of holiday days in which consumers are willing to consume these seasonal goods and services at peak.

\[ w = w(C_s, T) \]  \hspace{1cm} (4)

This assumption depends upon the fact that demand of goods that have seasonal demand pattern reflects a short run demand shock results in general rise in the real price of output, which is meant relative to input prices, i.e., a low real wages, assuming supply of this goods strictly upward sloping because some factors are fixed and remaining factors are subject to diminishing returns in the economy (Bils, 1987: 838 and 1991: 417). However, this assumption can be relaxed towards the conditions that there is no strong relation between the real wages and seasonal good demand since labor contracts in nominal terms may be predetermined for some periods and general price level may not alter in such a short period either. Empirically, the real business cycle theorists (Kydland and Prescott, 1982) have found the procyclical labor productivity. But there is no strong evidence about the real wage procyclicality, instead no relation, or mildly negative relation between real wage and peak demand of seasonal good and services has been found (Geary and Kennan, 1982). That is;

\[ \frac{\partial w}{\partial C_s} \leq 0, \]  \hspace{1cm} (5)

On the other hand, the positive effect of seasonality, for example, good weather or number of warm days on the real wage may not be ignorable. This assumption also allows us to find out how the demand or production of seasonal good is affected by coming spring, or temperature. Since there is a procyclical movement in overtime hours over the cycle, increasing in \( W \), this will of course affect positively average wage rates with a small effect (Bils, 1991:420). Therefore, this small effect assumptions can be easily relaxed towards there is no relationship between these two variables and its implication will be discussed below. Therefore, we, for now, simply assume that
Under the assumption above, consumer’s real income can be rewritten as:

\[ Y = W_w(C_s, T) \]  \hspace{1cm} (7)

By adding these assumptions into the model, the budget constraint can be expressed as,

\[ P_oC_o + P_sC_s = W_w(C_s, T) \]  \hspace{1cm} (8)

Now, the utility function can be rewritten by substitution method as,

\[ U = u \left[ \frac{W_w(C_s, T) - P_sC_s}{P_o}, C_s, (24 - W) \right] \]  \hspace{1cm} (9)

The first order conditions yield us
\[
\frac{\partial U}{\partial Cs} = \frac{\partial U}{\partial Co} \left( \frac{\partial w}{\partial Cs} W - \frac{Ps}{Po} \right) + \frac{\partial U}{\partial Cs} = 0 \equiv H
\]

\[
\frac{\partial U}{\partial Co} = \frac{\partial U}{\partial Co} - \frac{\partial U}{\partial Cs} Ps = 0
\]

\[
\frac{\partial U}{\partial W} = \frac{\partial U}{\partial Co} w(Cs, T) \frac{\partial U}{\partial Po} - \frac{\partial U}{\partial L} = 0
\]

By implicit function theorem, demand for seasonal good \((Cs^*)\), other good \((Co^*)\), individual's labor supply \((H^*)\), and optimum leisure consumed \((L^*)\) can be characterized respectively:

\[
Cs^* = c_s(Po, Ps, T, 24),
\]

\[
Co^* = c_o(Po, Ps, 24),
\]

\[
W^* = w(Po, Ps, Cs^*, T).
\]

\[
L^* = 24 - W^*
\]

2.1. Demand of Seasonal Goods with Respect to Cycle

Now we can easily detect how coming spring affects the demand of seasonal good by implicit function differentiation rule.

\[
\frac{\partial Cs}{\partial T} = \frac{\partial H}{\partial T} \frac{\partial U}{\partial Cs}
\]

\[
\begin{pmatrix}
\frac{\partial U}{\partial W} \frac{\partial \delta w}{\partial W} - \frac{\partial \delta w}{\partial Po} \frac{Ps}{Po} \\
\frac{\partial U}{\partial Co} \frac{\partial \delta w}{\partial Co}
\end{pmatrix}
+ 2 \begin{pmatrix}
\frac{\partial U}{\partial W} \frac{\partial \delta w}{\partial Cs} + \frac{\partial U}{\partial Co} \frac{\partial \delta w}{\partial Co} \frac{\partial \delta w}{\partial Cs}
\end{pmatrix}
\geq 0
\]
Given the assumptions shown in Equation (5) and (6), both nominator and denominator are positive and the effect of external conditions of peak-demand seasonal periods on the demand of seasonal good, for example, the effect of good weather temperature and respectively increasing duration of holiday on tourism service demand, is positive. The demand of seasonal goods is an increasing function of the seasonality such as good weather or higher number of off-days. This is because of the existence of labor contracts within a year and the possibility of wage increase in the labor market of goods with a seasonal pattern of demand may be offset by wage decrease in the other labor market of other goods.\(^\text{Co}\).

This positive effect is well-known fact that the demand of seasonal goods increases during peak-demand seasonal periods. However the magnitude of this positive effect is always a theoretical and empirical question. The positive response of demand to the external factor alters depending upon the possibilities whether the real wage is sensitive to seasonal demand changes, as well as to the external factors such as temperature in this example. If the assumption given in Equation (5) is relaxed towards the condition that there is no relation between real wage and peak demand of seasonal good or services, this positive effect, given in Equation (12) will be smaller that eventually cause a relatively small price increase stemming from an increase in demand prior to movement in the supply of these seasonal goods. In addition to relaxing assumption given Equation (5), if the positive effect of seasonality, for example, good weather or number of warm days on the real wage is, given in Equation (6) ignored or observed as a trivial effect, the nominator of Equation (12) will be smaller, leaving only the middle part of nominator in the equation. In either case of relaxing assumptions of given Equation (5) or Equation (6), on the other hand, gives similar result that reflects that the final seasonal good demand is less sensitive positively to seasonality. Exercising different options of these assumptions determining the positive magnitude of Equation (12) will be handful in interpreting the pricing behavior of seasonal good below.

### 2.2. Cyclical Production and Pricing Behavior

Now, we can analyze the production and pricing decision for goods with either a seasonal demand or production cycle with perfect competitive market assumption. Consider a representative firm which produce seasonal good, \(C_s = Q\) by a production function by utilizing only variable factor in the short term, that is, labor input \(W\) as, \(Q = q(W)\). Its cost and profit functions can be expressed as follows;
\( Cs = q(W) \) and \( W = q^{-1}(Cs) \)

\[ TC = wW = w(Cs, T)q^{-1}(Cs) \tag{13} \]

\[ \Pi = PsCs - wq^{-1}(Cs) \]

This firm produces the optimal level of output, \( (Cs^*) \) which maximize its profit can be found by using the well-known rule (REF) for the inverse function differentiation.

\[
\frac{\delta \Pi}{\delta Cs} = Ps - \frac{w}{\delta q} = 0 \tag{14}
\]

\[ Cs^* = c_s(Po, Ps, T) \tag{15} \]

Let say there is \( N \) number of consumers and \( M \) number of identical firms in the market for seasonal goods. The market equilibrium occurs when the total demand and production of the good intersect. That is,

\[ Nd(Po, Ps, t, 24) - Ms(Po, Ps, T) = 0 \equiv F \tag{16} \]

Implicit function theorem allows us to define the pricing decision, \( (Ps^*) \) as follows;
$P_s^* = p_s(P_o, T)$ \hspace{1cm} (17)

Now we can find the effect of weather changes on the firms price decision by implicit function differentiation rule,

$$\frac{\delta P_s^*}{\delta T} = \frac{\delta F / \delta T}{\delta F / \delta P_s} = \frac{N \frac{\delta l}{\delta T} - M \frac{\delta c}{\delta T}}{N \frac{\delta l}{\delta P_s} - M \frac{\delta s}{\delta P_s}} \leq 0 \hspace{1cm} \text{(18)}$$

The denominator is negative, characterizing a global maximum. The nominator has two terms. The first term is positive, derived from our first analysis that represents the positive effect of temperature on the demand of seasonal good. As indicated while we were interpreting the result of Equation (12) above, the response of demand of seasonal goods to the seasonality conditions alters depending on the sensitivity of real wage to coming seasonal period and to seasonal demand changes. If these responses are trivial to be ignored, for example, if the real wages do not alter during peak demand in tourism sector as well as duration in holiday periods, the first part of nominator in Equation (18) will be small and the net effect of demand and supply of these goods on their price will be supply oriented and hence price behavior of the seasonal goods will be as to decline. The second term has also important role here, and alters with the different characteristics of seasonal output, such storable conditions, and the degree of competition or monopoly of the market.

First assume that the storing (stock) costs are zero or very small to be ignored and there is some degree of monopoly (imperfect competition in the good market). In this case, even if the warm weather has positive effect on the production, firms do not tend to increase production as well as demand increases with respect to coming spring. This implies the nominator has positive sign and there will be price up with respect to increase in temperature. However, with a perfect competition market assumption, there will be firm entry, increasing $M$, production rises in the seasonal good market. This will cause the second term to increase, and nominator closes to zero, which implies that price is sticky with respect to seasonality (weather temperature increases, in the example).
Now assume that storage costs for firm are high and again the firm has at least some monopoly power. In that case, since the storage (stock) costs are high and the seasonal goods produced must be completely consumed simultaneously, the response of production to the weather changes will be higher just up to the amount of increase in the demand with respect to weather changes. Since there are some barriers for firms to enter market and $N$ is greater than $M$, the positive effect of $T$ on the price may still affect. However with the perfect competition case, the number of firms will increase and the first and second term of numerator may be equal, which implies that prices are downward or sticky.

**Conclusion**

In this paper, the effect of good weather on consumer demand of a seasonal good and price decision by the producer has been analyzed. Our conclusion is that the fluctuations in demand are much greater in magnitude than those in prices: Prices appear “sticky.” Period with higher expected seasonal demand will have higher productivity even though this higher demand is fully foreseen at the time firms set their prices. These results hold as long as we assume the real wages in seasonal goods sector do not alter response both to coming seasonality and to rise in seasonal demand. This result is still effective with a perfect competition market, no matter how storable conditions and costs of the goods are. However, the effect of some other characteristics of seasonal output or demand may be different and is worth for further empirical studies for a specific country case.
References


