Study Competition Channel Structure Based on the Differences of Cost and Products*

ZHOU Lan¹  AI Xingzheng²  ZHANG Chi²

¹Publication Company of UESTC  Chengdu  610054  China; ²School of Management Science, UESTC  Chengdu  610054  China)

Abstract  The purpose of this paper is to expand Trivedi’s study on the influence of channel structure, which based on product difference, to cost difference; and analyze the evolution course of channel structure under different conditions. We find that like product difference, cost difference have important influence on the choice of channel structure. This paper has improved the present result and provided proof for the choice of channel structure under different environments.

Key words  channel structure;  evolution equilibrium cost difference;  product difference

The central issue on designing channel of distribution is vertical integration. Will manufacturer distribute products by itself or by independent retail trader? It has different answer about this question. Some documents focuses on two different manufacturers that produce the products with relevant demand. Does the manufacturer select forward direction integration or employ exclusive retail trader? Their channel choice will determine the balanced price and balanced incomes. McGuire and Staelin studied the products with relevant demand produced by two homogenous manufacturers. The results of the study indicate that if the manufacturers’ products belong to the highly substituting one, then decentralization is a Nash balanced tactic. Furthermore manufacturers prefer decentralization channel structure to integration structure¹¹. This is an interesting conclusion, because complete monopoly manufactories would rather select integration structure than decentralization structure. Then it brings about the question: why the manufacturers’ interaction turns out a different result? McGuire and Staelin explain: If retail market highly competition, although maximization income tactic of each multicipital competition manufacturer will result in the retail price out of control, but the income of both sides can be improved. McGuire and Staelin’s powerless explanation has not totally told the truth of this question. K.Sridhar Moorthy exemplified three kinds of situation to indicate that no matter how they compete in retail market, decentralization channel structure will never be a balanced result²². But if products are not competitive but complementary, decentralization channel structure is the balanced result. Any manufacturer must decide how many layers of intermediate traders they need to distribute the products. Among them, weigh the advantages coming out of need not undertake the expenditure of distribution and sales against the costs of losing control of marketing is basic. Traditional contents think the reason of apply intermediate traders is that they have higher efficiency on making products easy to acquire and close to the object market. (Kotler1980). We will seek other reasons to explain why manufacturers will still apply intermediate traders on condition that manufacturers have the same marketing efficiency as distribution traders. Trivedi expanded exclusive retail channel to cross retail channel, analyzed the influences on channel structure that result from the products substituting and shop substituting³³. Our attention will focus on the trade structure with a few upstream manufacturers and they employ downstream distribution traders. And we find the conclusion concerning inter-channel competition relation affect channel structure is based on symmetrical power, and had neglected the influence of the cost difference among manufacturers. So we attempt to find the
possible influences on the choosing of channel structure that result from cost and asymmetric structure, and present a more intact theory for channel structure selection and channel coordinate mechanism under competition environment.

1 The Channel Structure Model

We found the analysis on the situation that there are two manufacturers with cost difference and products difference. There are two kinds of major channel structure: one is integration channel structure (I), namely manufacturers have its own retail traders and decide the retail price; another is non-centralization channel structure (D), namely manufactures sell to the independent retailer with whole price, and retailer decide the retail price. We suppose the basic demand model form is:

\[ q_1 = 1 - p_1 + ap_2 \quad q_2 = 1 - p_2 + ap_1 \]

where parameter \( a \) is the degree of products’ replacement, here we can suppose that \( 0 < a < 1 \).

1.1 II Type Channel Structure Model

When the two manufacturers both choose integration channel structure, the corresponding channel income model is:

\[ m_{i1} = q_1(p_i - c) \quad m_{i2} = q_2(p_i - bc) \]

Here \( b \) is the degree of cost difference among manufacturers, \( 1 > b > 0 \), As described Fig.1.

The first order conditions is

\[ \frac{\partial m_{i1}}{\partial p_1} = 1 + (c - 2p_i) + ap_2 = 0 \]
\[ \frac{\partial m_{i2}}{\partial p_2} = 1 + (bc - 2p_2) + ap_1 = 0 \]

The tactics solutions and incomes based on price game are

\[ p_1 = \frac{2 + a + ab + 2c}{4 - a^2} \quad p_2 = \frac{2 + a + ac + 2bc}{4 - a^2} \]
\[ m_{i1} = \frac{(2 + a + abc - 2c + a^2c)^2}{(4 - a^2)^2} \]
\[ m_{i2} = \frac{(2 + a + ac - 2bc + ba^2c)^2}{(4 - a^2)^2} \]

1.2 DD Type Channel Structure Model

When the two manufacturers both choose non-centralization channel structure, As described Fig.2, the corresponding channel income model is

\[ m_i = (w_i - c)q_i \quad m_2 = (w_2 - bc)q_2 \]
\[ r_i = q_i(p_i - w_i) \quad r_2 = q_i(p_2 - w_2) \]

The solutions based on manufacturer Stackelberg game are

\[ \frac{\partial r_i}{\partial p_i} = 1 + (w_i - 2p_i) + ap_j = 0 \]

The balanced solution is

\[ p_1 = \frac{2 + a + aw_1 + 2w_1}{4 - a^2} \quad p_2 = \frac{2 + a + aw_2 + 2w_2}{4 - a^2} \]
\[ \frac{\partial m_i}{\partial w_i} = \frac{2 + a + aw_1 - 4w_1 + 2a^2w_1 + 2c - ca^2}{4 - a^2} = 0 \]
\[ \frac{\partial m_2}{\partial w_2} = \frac{2 + a + aw_2 - 4w_2 + 2a^2w_2 + 2bc - bca^2}{4 - a^2} = 0 \]

It’s easy to obtain the following solutions

\[ w_1 = \frac{6a - 3a^2 + 8c - 8a^3 - 2a^4 + 2a^5 + 2abc}{16 + 4a^4 - 17a^2} \]
\[ w_2 = \frac{6a - 2a^3 + 8bc - 8bc^2}{16 + 4a^4 - 17a^2} \]

\[ 3a^2 - 2ca - 2a^3bc - ca^3 \]
\[ 16 + 4a^4 - 17a^2 \]

Bring them into expressing type \( p_1 \) and \( p_2 \), getting the game equilibrium

\[ p_1 = \frac{48 + 6a^4 - 34a^2 + 36a + 4a^3 - 24a^4 + 12abc}{(16 + 4a^4 - 17a^2)(4 - a^2)} \]
\[ 10bc - 2bc^2 + 14ca^2 - 3ca^3 - 16c \]
\[ (16 + 4a^4 - 17a^2)(4 - a^2) \]

\[ p_2 = \frac{48 + 6a^4 - 34a^2 + 36a + 4a^3 + 24a^4 + 122ca}{(16 + 4a^4 - 17a^2)(4 - a^2)} \]
\[ 10ca^3 - 2ca^5 + 14ca^2 - 3bca^4 - 16bc \]
\[ (16 + 4a^4 - 17a^2)(4 - a^2) \]
1.3 DI Type Channel Structure Model

When the two manufacturers both choose mixing channel structure, As described Fig.3, the corresponding channel income model is

\[ m_i = \frac{6a - 3a^3 + 8 - 8c + 9ca^2 - 2a^3}{(16 + 4a^4 - 17a^2)(4 - a^2)} \
\]

\[ m_i = \left[ \frac{6a - 3a^3 + 8 - 8bc + 9ca^2}{(16 + 4a^4 - 17a^2)(4 - a^2)} \right] \times \]

\[ + \frac{16 + 12a + 4bca - 4ca^3 - 16c + bca^2 - 14a^2}{(16 + 4a^4 - 17a^2)(4 - a^2)} \]

the first order conditions based on retail trader 1 is

\[ \frac{\partial r_i}{\partial p_i} = 1 + (w_i - 2p_i) + ap_i = 0 \]

the first order conditions based on retail trader 2 is

\[ \frac{\partial m_i}{\partial p_i} = 1 + (bc - 2p_i) + ap_i = 0 \]

the first order conditions based on retail trader 1 is

\[ p_1 = \frac{2 + a + w_1}{4 - a^2} \]

It’s easy to obtain the following solutions

\[ p_1 = \frac{2 + a + (2 + a + bca + 2c - ca^2)}{(4 - a^2)} \]

The first order conditions when the \( p_1, p_2 \) had been brought into expressing type \( m_1 \)

\[ \frac{\partial m_i}{\partial w_i} = \frac{2 + a + c + 4a^2 + 2a^2 + 2c - ca^2}{2(2 - a^2)} \]

1.4 ID Type Channel Structure Model

When the two manufacturers both choose mixing channel structure, As described Fig.4, the corresponding channel income model is

\[ m_i = \frac{6a - 3a^3 + 8 - 8c + 9ca^2 - 2a^3}{(16 + 4a^4 - 17a^2)(4 - a^2)} - \]

\[ \frac{16 + 12a + 4bca - 4ca^3 - 16c + bca^2 - 14a^2}{(16 + 4a^4 - 17a^2)(4 - a^2)} \]

\[ + \frac{16 + 4a^4 - 17a^2)(4 - a^2)}{2(2 - a^2)(4 - a^2)} \]

the first order conditions based on retail trader 1 is

\[ \frac{\partial r_i}{\partial p_i} = 1 + (w_i - 2p_i) + ap_i = 0 \]

the first order conditions based on retail trader 2 is

\[ \frac{\partial m_i}{\partial p_i} = 1 + (bc - 2p_i) + ap_i = 0 \]

the first order conditions based on retail trader 1 is

\[ p_1 = \frac{2 + a + w_1}{4 - a^2} \]

It’s easy to obtain the following solutions

\[ p_1 = \frac{2 + a + (2 + a + bca + 2c - ca^2)}{(4 - a^2)} \]

The first order conditions when the \( p_1, p_2 \) had been brought into expressing type \( m_1 \)

\[ \frac{\partial m_i}{\partial w_i} = \frac{2 + a + c + 4a^2 + 2a^2 + 2c - ca^2}{2(2 - a^2)} \]

the first order conditions based on retail trader 1 is

\[ p_1 = \frac{2 + a + (2 + a + bca + 2c - ca^2)}{(4 - a^2)} \]

It’s easy to obtain the following solutions

\[ p_1 = \frac{2 + a + (2 + a + bca + 2c - ca^2)}{(4 - a^2)} \]
get the tactic solution
\[ p_1 = \frac{2 + a + aw_2 + 2c}{4 - a^2} \quad p_2 = \frac{2 + a + 2w_2 + ac}{4 - a^2} \]

The first order conditions when the \( p_1, p_2 \) had been brought into expressing type \( m_2 \)
\[ \frac{\partial m_2}{\partial w_2} = \frac{2 + a + ca - 4w_2 + 2a^2w_2 + 2bc - bca^2}{4 - a^2} = 0 \]
\[ w_2 = \frac{2 + a + ac + 2bc - bca^2}{2(2-a^2)} \]

then have
\[ p_1 = \frac{8 - 3a^2 + 6a - 2a^3 - 3ca^2 + 2abc - bca^3 + 8c}{(4 - a^2)(2 - a^2)} \]
\[ p_2 = \frac{6 - 2a^2 + 3a - a^3 + 3ca - ca^3 + 2bc - bca^2}{2(4 - a^2)(2 - a^2)} \]
\[ m_2 = \frac{[2 + a + ac + 2bc - bca^2/2(2-a^2) - 2c]}{(2-a^2)(4-a^2)} \]
\[ [[1 + (2 + a + ac + 2a + ac + 2bc - bca^2)/2(2-a^2) - 2c](2-a^2) + d[2 + a + ac + 2a + ac + 2bc - bca^2/2(2-a^2) - 2c]] \]

\[ M_{21} = \frac{(1 - \frac{1}{2} - 2 + ca + 2bc - bca^2)/2(2-a^2) - 2c}{(2-a^2)(2-a^2)} +
(2-a^2)/2(2-a^2) + a(2 + a + 1/2)(2 + a + ac + 2bc - bca^2/2(2-a^2) - 2c)/2(2-a^2) +
(2-a^2)/2(2-a^2) + a(2 + a + 1/2)(2 + a + ac + 2bc - bca^2/2(2-a^2) - 2c)/2(2-a^2) +
(2-a^2)/2(2-a^2) + a(2 + a + ac + 2bc - bca^2/2(2-a^2) - 2c)/2(2-a^2) + (1/2 + 1/2)
\]

\[ \text{Tab.1 Channel evolution process} \]

<table>
<thead>
<tr>
<th>region</th>
<th>old structure</th>
<th>new structure</th>
<th>( M_1 )</th>
<th>change profit</th>
<th>new structure</th>
<th>( M_2 )</th>
<th>change profit</th>
</tr>
</thead>
<tbody>
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<td>I</td>
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<td>DI</td>
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<td>ID</td>
<td>&gt;0</td>
<td>&lt;0</td>
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</tr>
<tr>
<td>II</td>
<td>DD</td>
<td>ID</td>
<td>&gt;0</td>
<td>DI</td>
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<tr>
<td>III</td>
<td>DI</td>
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<td>&gt;0</td>
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</tr>
</tbody>
</table>

To \( c=0.1 \), channel evolution process as Tab.1, we can get the result of channel evolution process by numerical calculation. (For other fetching values to \( c \), region structures got by numerical simulation have similar structure characteristic. So it does not influence the general characteristic.) Evolution process is: DD → DI → ID II. At region I, numerical calculations indicate manufacturers’ income: II1>DD1,
II2>DD2. Namely at this region II type channel structure is the final Nash equilibrium result, at this moment the product market belongs to the low competition environment.

2.2 Region II analysis

Region II is the below area enclosed by the border line on which the first manufacturer’s income in II type structure equal to that in DD type structure and the another border line on which the second manufacturer’s income in II type structure equal to that in DD type structure. To c=0.1, channel evolution process as Tab.1, we can get the result of channel evolution process by numerical calculation. Evolution process is: DD → DI(ID) → II. At region II, numerical calculations indicate manufacturers’ income: II1<DD1, II2>DD2. Namely at this region II type is the final stable channel structure, at this moment the product market belong to the competition environment with minor cost difference.

2.3 Region III Analysis

Region III is the area enclosed by the border line on which the first manufacturer’s income in II type structure equal to that in DD type structure, the border line on which the second manufacturer’s income in II type structure equal to that in DI type structure, and the another borderline on which the second manufacturer’s income in DD type structure equal to that in DI type structure. To c=0.1, channel evolution process as Tab.1, we can get the result of channel evolution process by numerical calculation. Evolution process is: DD → DI(ID) → II. At region IV, numerical calculations indicate manufacturers’ income: II1<DD1, II2<DD2. Namely at this region DD type channel structure is the final stable channel structure. The evolution will worsen the second manufacturer’s income, and it will equally worsen the first manufacturer’s income. Namely as a whole, the optimal channel structure for conspiratorial manufacturers is DD type. But due to the personal local selfish conduct, the balanced result turns out to be the second optimal choice II type, that is the convict’s predicament area. At this moment the product market belong to the high competition environment.

2.4 Region IV Analysis

Region IV is the right-hand area enclosed by the border line on which the second manufacturer’s income in DD type structure equal to that in DI type structure. To c=0.1, we can get the result of channel evolution process by numerical calculation. Evolution process divide into two kinds of situations: 1) DI(ID) → DD; 2) DI(ID) → II. And the two kinds of channel structure both are stable Nash equilibrium. But the choice of the balanced route depends on manufacturer’s tactics of first move as well as the process of coordination and communication for the information in advance. Numerical calculation indicate manufacturer’s income III1<DD1, II2<DD2. Namely at this region DD type channel structure is the optimal Nash equilibrium result. At this moment the product market belong to the high competition environment.

References


Brief Introduction to Author(s)

ZHOU Lan (周岚) was born in 1963. She is now an editor in Publication Company of UESTC.

AI Xingzheng (艾兴政) was born in 1969. He is now an Associate Professor in School of Management Science, UESTC. His research interests include supply chain and channel coordination mechanism.

ZHANG Chi (张迟) is now a graduate student in School of Management Science, UESTC. His research interests include supply chain and channel coordination mechanism.