CHAPTER V

DISCUSSIONS AND APPLICATIONS

The supreme step forward contributed by this study was the origination of Miscellaneous Acquisition Capability (MAC) approach. This chapter was subsequently planned to discuss the concept in terms of its implications, and applications. For making use of this new approach some policy recommendations were also proposed. This chapter as a final point was arranged to 2 major segments, discussion of the result and MAC application in the practice setting and policy recommendation.

5.1 Discussion

To begin with the discussion on current magnitude of discriminate pricing behaviors and unquantifiable second degree price discrimination. The next 3 subsections were aimed at conclusive discussion on how the MAC approach facilitated the suitable utilization of inequality indices for pharmaceutical pricing behavior monitoring. The significance of inequality index which was more meaningful under the MAC approach was detailed. Social welfare implication which has made correspond to the trading context was subsequently illustrated. To end the section, the rapport between MAC and the concept of price elasticity of demand was depicted.

5.1.1 Magnitude of Discriminate Pricing Behaviors

The study found, on the average, half of applicable brands were detected the crucial extent of first degree price discrimination. The existence of discrimination in another way of deliberation implied immaturity of the market. These markets needed to be modified in a proper direction. They would be intervened by directing interventions to decrease the MAC variation and enhancing the market's MAC ($\overline{MAC}$) at the same time. The market's MAC would be increasingly shifted, while the variation would gradually narrow down. When the market was settled after adjusting, the optimal MAC (MAC equilibrium) identification would be possible.

5.1.2 Second Degree Price Discrimination

The second degree price discrimination was unable to assess in this study, since a unit of observation sent to DMSIC was not a transaction of a hospital made to supplier. A unit of observation was a voluntary report which might be the summation of transactions made in a month, two months, six months or any other mean up to each hospital. The extent of second degree price discrimination, if analyzed, would then be the discrimination among the reports of a hospital instead to a unit of product.

Second degree could be the price differences within the same buyer via the package size, the different purchasing times on the regular condition, etc. The direct price comparison would normally be calculated and more convenient for use in real practice. The benefit of monitoring second degree discrimination was then minimal compared with the first and the third degree. This type of price discrimination could be considered to leave in the bound of each hospital management.

However, second degree price discrimination would be indirectly decreased by the MAC approach. Informing the market's MAC to the hospitals to let them know their capability. They will be able to estimate their own optimal price for each transaction.

5.1.3 Inequality Index Under the MAC Approach

The MAC approach plugged the hospitals' MAC into the inequality index formula in place of raw prices and purchasing sizes. The enormous inequality found under the MAC approach could indicate 3 vital concerns. The first was the crucial extent of price discrimination beyond the accepted discrimination under volume discounting schedule. Secondly, it signified that most hospitals in that market utilized lower than the market's MAC to make the contracts with pharmaceutical firm. That meant most of the contracts were dealt at too high price judged against their own purchasing size. Lastly, the significant higher inequality index also implied the strong incidence against the volume discounting direction. Large volume purchasers would be

detected buying the product at a higher price, while small volume hospitals bought at a cheaper rate.

To precisely reflect the market situation of pricing behaviors in trading context, the inequality index under the MAC approach turned out to provide more meaningful information than simple application of typical inequality indices using raw prices and volumes of purchase. Not only the macro perspective of discrimination was presented in terms of the inequality degree, the pricing behaviors of each product trading in the studied market were delineated as well. At the same time the capability of each purchaser in product acquisition was comparatively patterned.

5.1.4 Social Welfare Implication

The social welfare view implied in the formula of inequality indices was well matched to the trading context under the MAC approach. The inequality index resulted in a bigger value in case the society was worse off. The left picture in figure 5.1 illustrated that majority dealt a product at high prices, while only few contracts were cheaper. When a certain mark up percentage was added on the acquisition cost of the pharmaceutical product, it meant that most of patients had to consume the product at too high price.
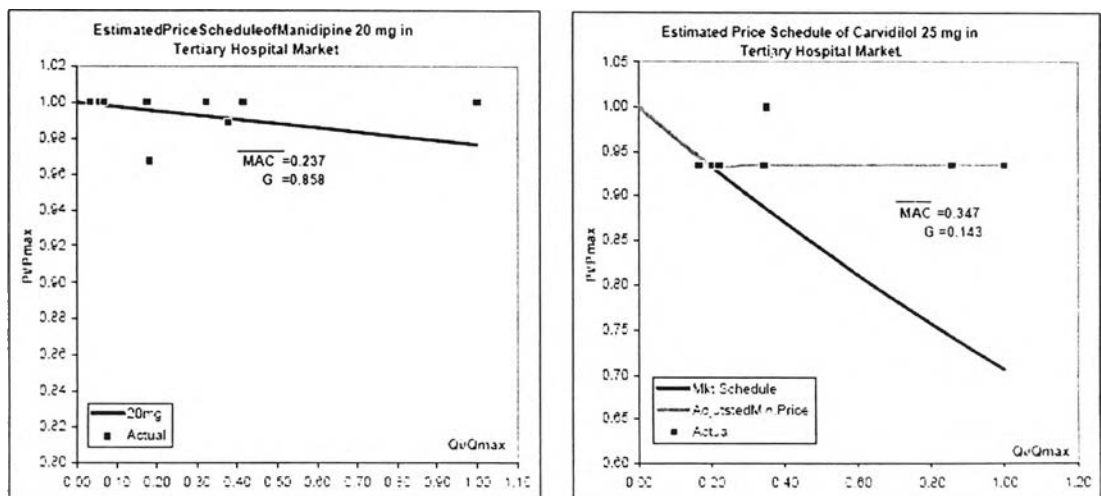

Figure 5.1 Social Welfare Preference was Compatible

Contrastingly, the right hand of figure 5.1 depicted societal better off situation which produced a small inequality index. Most of contracts were

settled at the lowest price, although minority purchased at the high price. This situation facilitated majority of patients could access products at low prices.

5.1.5 MAC and Price Elasticity of Demand

Estimating volume discount schedule by the MAC approach was displayed by plotting function of price on y-axis against function of quantities on x-axis. This plot was similar to the demand function in microeconomic concept, which the reciprocal of the slope was equal to price elasticity of demand (Elasticity = $\Delta Q / \Delta P$). The lower slope points toward the higher price elasticity of demand. The higher elasticity of demand means that a small change of price could result in the large demand change. The price changes under the concept of price elasticity of demand indicate the direction of the change in purchasing size. MAC has been originated as another source beyond the purchasing size to influence price decrease in this study and could be used to estimate the price schedule. Price schedule indicated by higher MAC line was steeper than the lower MAC one. The higher MAC indicated the huge price changing driven by a small change of purchasing size. This meant that the higher MAC markets/buyers had lower price elasticity of demand than the lower MAC as shown in figure 5..
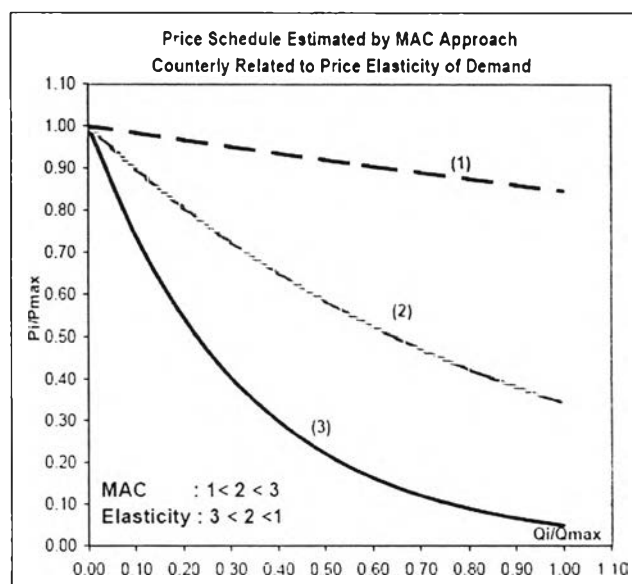

Figure 5.2   MAC and Price Elasticity of Demand

The relationship could be written as $MAC \propto \dfrac{1}{Elasticity}$, since the high

MAC price schedule was denoted as low price elasticity of demand. MAC would be added to microeconomic theory as another factor further than purchasing size (Q) to indicate price change. The high MAC markets/buyers exercised MAC as a main source of acquisition capabilities to acquire their prices. Their purchasing size did not have as much affect as MAC to the decrease in price. On the contrary, the lower MAC markets/buyers employed their purchasing size as a more important source of acquisition capabilities than MAC to obtain their prices.

5.2 Applications and Policy Recommendations

Another major segment aimed at displaying how the study findings could be benefited in forms of their applications in real practice settings. The segment was organized into 3 main parts. The instant applications were first commenced and followed with the portrait of the idea for long run applications. Last by not least, some policy recommendations facilitating effective applications were brought in.

5.2.1 Instant Application: Purchasing Clue

The result obviously showed that pricing behaviors occurring in the market were the end result of sellers and buyers agreement. It was not just the sellers' matter. Acquiring the best price was fairly grounded from buyers' capabilities which in this study initiated the concept of another source of buyer capabilities beyond purchasing sizes. It was named in this study as "miscellaneous factors". Monitoring the magnitude of this kind of capability would be an alternative mean to monitor pricing behaviors in the market. Fantastically, the essence of this study finding was a mathematical reckoning of miscellaneous acquisition capability (MAC) index and its derivative. Their instant application was illustrated step by step in accordance with how the tool could assert its roles in the data mining processes.

5.2.1.1 Miscellaneous Acquisition Capability (MAC) Index

For each particular product, the purchasers of each market are identified or, for this study, hospitals are grouped according to the level of care, primary, secondary, or tertiary. Other market segmentations could be applied where it was deemed appropriate. Within each level of care, raw prices and purchased quantities of each hospital were then transformed to MAC using the formula (1) and the results were shown in table 5.1.

$$MAC_i = \frac{-\ln(P_i/P_{max})}{(Q_i/Q_{max})}, \begin{cases} \text{for every } P_i > P_{min} \\ \text{adjust } MAC_i = MAC_{max}, \text{when } P_i = P_{min} \end{cases} \quad \text{...............}(1)$$

The market MAC would consequently be determined by arithmetic mean of all hospitals' MAC.

Table 5.1   Capability calculation worksheet

DEMAND	RAW DATA			CAPABILITY CALCULATION			
Hospital	TotalQ	Rounded	Amount	Pi/Pmax	Qi/Qmax	MAC	MAC
						Raw.	AdjMax.
A	47000	6.00	282000	1.000	0.734	0.000	0.000
B	43000	6.00	258000	1.000	0.672	0.000	0.000
C	64000	6.00	384000	1.000	1.000	0.000	0.000
D	16500	6.00	99000	1.000	0.258	0.000	0.000
E	26500	5.00	132500	0.833	0.414	0.440	0.933
F	12500	5.00	62500	0.833	0.195	0.933	0.933
	209500		1218000				1.867

Note

Total Q	= Summation of all purchased quatities
Rounded	= 2 decimal places rounded of price per smallest unit

Pi = price per smallest unit of hospital i
Pmax = the maximum price per smallest unit of the market
Qi = purchased quantities of hospital i
Qmax = the maximum purchasing quantities in the market
MAC(Raw) = MAC before adjusting minimum price per smallest unit
MAC(AdjMax.) = MAC after adjusting minimum price per smallest unit

5.2.1.2 Inequality Measurement Index as a Detector

The MAC of each hospital was plugged in the inequality index formula (2) and (3) instead of raw prices and quantities. The come up Gini-coefficient (G) or Theil index (T) allows the detection and quantification of price discrimination in the market as illustrated in table 5.2.

$$G = \left| 1 - \sum_{i=1}^{N} (\sigma P_{i-1} + \sigma P_i)(\sigma Q_{i+1} - \sigma Q_i) \right| \quad \text{...................}(2)$$

$$T = \ln\left[\frac{\sum\limits_{i=1}^{n} Q_i}{\sum\limits_{i=1}^{n} P_i}\right] + \left[\frac{\sum\limits_{i=1}^{n}(P_i \times \ln(P_i / Q_i))}{\sum\limits_{i=1}^{n} P_i}\right] \quad \dots\dots\dots\dots\dots\dots\dots\dots\dots(3)$$

Table 5.2   Inequality index calculation worksheet

DEMAND	GINI CALCULATION							
Hospital	PropH	PropCap	CumCap	CumH	A	B	A*B	Thiel
			0.000	0.000				
A	0.167	0.000	0.000	0.167	0.167	0.000	0.000	#NUM!
B	0.167	0.000	0.000	0.333	0.167	0.000	0.000	#NUM!
C	0.167	0.000	0.000	0.500	0.167	0.000	0.000	#NUM!
D	0.167	0.000	0.000	0.667	0.167	0.000	0.000	#NUM!
E	0.167	0.500	0.500	0.833	0.167	0.500	0.083	0.549
F	0.167	0.500	1.000	1.000	0.167	1.500	0.250	0.549

sum   0.333   1.099
G   0.667   Thiel

Note
PropH   = Proportion of a hospital shared from all hospitals in the same market
PropCap   = Proportion of a hospital's MAC shared from total MAC
CumCap   = Cummulative of PropCap
CumH   = Cummulative of PropH
A   = $CumH_{i+1} - CumH_i$
B   = $CumCap_{i-1} + CumCap_i$
Thiel   = the calculation of Theil index

Table 5.3   Descriptive summary

Secondary	n	min	max	mean	sd	CV	WAP	G	T
P	6	5	6	5.667	0.516	0.091	5.814		
Q	209,500	12,500	64,000						
MAC	6		0.933	0.311				0.667	1.099

Note
Secondary   = Secondary hospital market
P   = Purchased price/smallest unit
Q   = A year summation of purchased quantities
n   = Number of hospitals purchased the product,
            Overall quantities purchased by n hospitals
min   = Minimum Value   max   = Maximum Value
mean   = Arithmetic average   sd   = Standard deviation
CV   = Coefficient of variation   WAP   = Quantity weighted average price
G   = Gini index   T   = Theil index

Gini and Theil were both picked up for inspection, since the literatures pointed out that the different indices were sensitive to different parts of distribution (Hayes & Ross, 1998). Gini coefficient was the most popular and more sensitive to the middle portion than the tails of a distribution (Hayes & Ross, 1998; Jenkins & Jantti, 2005; Litchfield, 1999; Xu, 2004). There was disagreement of literatures about Theil index sensitiveness. Litchfield in 1999 indicated Theil index, an index ($\alpha=1$) in Entropy class, applied equal

weight across the distribution (Litchfield, 1999), while Hayes and Ross denoted that Theil was more sensitive to the inequality at lower end of distribution (Hayes & Ross, 1998). Although the index sensitivity to different portions of distribution could not be observed in this study, the functional finding from both indices application was revealed as following.
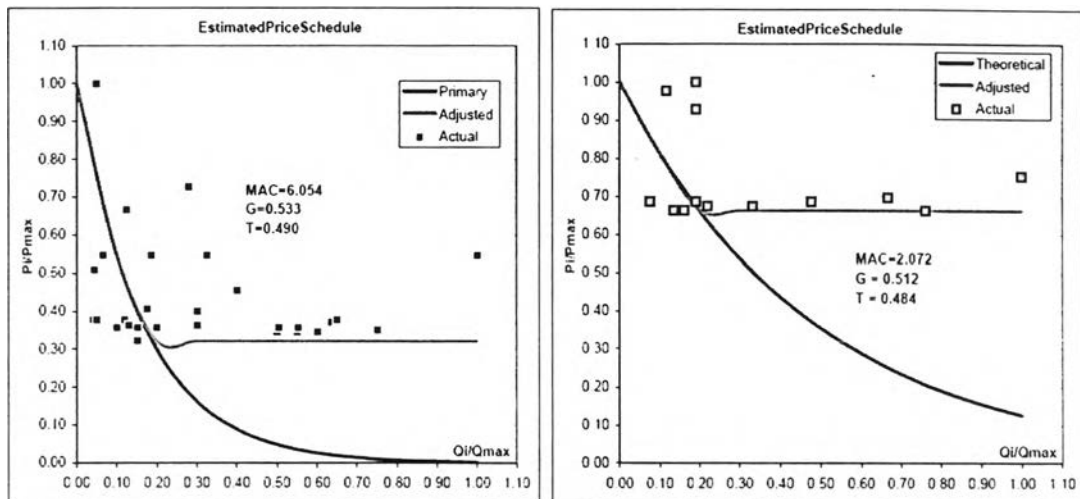
Figure 5.3   The Stronger Social Welfare Implication of Gini Index

Both Gini and Theil indices in this study were very well consistent to each other. The trivial contraries between two indices were observed only when the magnitude of the indices was close to the critical value 0.500. These entities were detected price discrimination behaviors by the significant level of single index either Gini or Theil. The Gini index has been outstanding to point toward social welfare sense as inllustrated in figure 5.2. In case of the majority purchased the product at too high price but not much different from the reference condition, the Gini was higher than Theil. The Theil index was superior in terms of sensitivity (the larger scale) and calculation simplicity.

However, to apply the indices as screening criteria in this context, the sense of social welfare was priority. This study thus recommended the Gini-coefficient accompanied by another critical value in order to overcome indices incoherence and to enhance sensitivity. The products with Gini index

greater than 0.450 would also be signified as watchful entities, while one with greater than 0.500 will be alerted for intensive interventions.

5.2.1.3 Market's Discounting Schedule

The product with critical magnitude of price discrimination identified by inequality index was picked up for more thorough investigation of the situation.
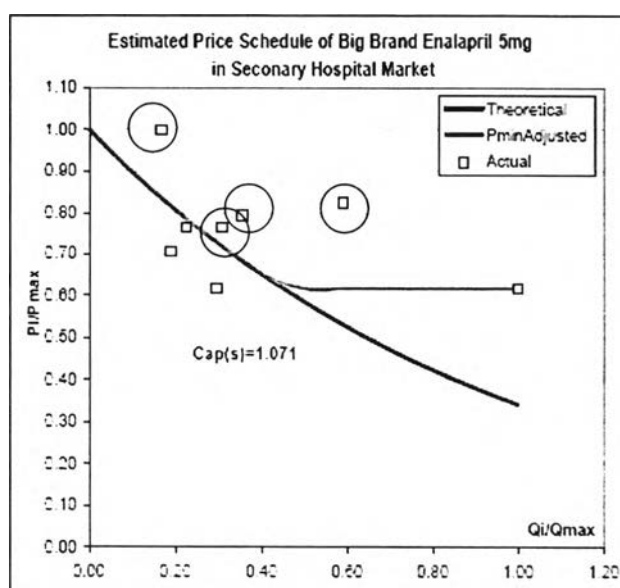

Figure 5.4   Estimated price schedule of a market

From figure 5.3, Arithmetic mean of the hospitals' MAC ($\overline{MAC}$) was used to estimate the market price schedule by MAC derivative formula. Comparing the schedule and the actual contracts facilitated identifying unfair contracts.   The optimal price based on purchasing sizes dealing with a particular product could be determined for every unfair contract.

The most important process was the feedback information to the hospitals.   The hospital's MAC, the market MAC ($\overline{MAC}$) as well as the attached pricing schedule, and the optimal price could individually be a feedback for each hospital.   This information would challenge the hospital to increase their MAC to obtain their optimal price.   This would result in the decrease of the magnitude of price discrimination in the long run.   For hospitals that have the MAC bigger than the $\overline{MAC}$, their own MACs and the

accord pricing schedule would then be used as a feedback or their recommended reference instead of using the $\overline{MAC}$ since their purchasing capabilities were already exceeded that of the market. These data would support them to individually estimate their optimal price, when their next purchasing size was different.

5.2.2 Long Run Applications- System Strengthening Assistance

The MAC approach for monitoring pricing behaviors in the market would be continuously implemented. Long run monitoring will consequently facilitate the following applications.

5.2.2.1 Longitudinal Monitoring

Long run implementation of the MAC approach will provide a different dimension of analysis. Both the MAC of each hospital or level of care and the extent of price discrimination of each product will be monitored over time horizon. Some other measurements might be constructed from this kind of monitoring. However, at least the rise and fall patterns of crucial indicators could be determined, which will provide another dimension of market situation for policy decision making.

5.2.2.2 MAC Equilibrium (Optimal MAC)

When the MAC approach has been practiced continuously for a sufficient period of time, it will be possible to identify the optimal MAC for each type of product. After a period of adjustment, the long standing MAC could imply market equilibrium. That equilibrium has been brought about by the sellers and buyers agreement. That level of MAC would be defined as the optimal MAC, which will be a target challenging the system (both hospitals themselves and policy makers) to achieve, when the similar products are contracted.

5.2.2.3 Factors Enhancing MAC

Strengthening the hospitals' MAC and reducing MAC variation among hospitals at the same time would be the standpoint of the MAC approach. By the long run extensive implementation, another application on the identification of factors enhancing the hospitals' MAC would then become possible. Factors enhancing the hospitals' MAC would be gradually made known. This will be the crucial source of the system intelligence, since hospitals themselves and related parties will concretely know how to enhance their hospitals' MAC.

5.2.2.4 MAC Application for Collective Purchasing

The applications under the MAC approach were also suitable for the context of collective purchasing, which seemed to be the trend in public acquisition policy. In this study, the unit of analysis had to be determined based on price discrimination concept under the context of self purchasing. Each hospital under the same level of care was then the unit of analysis for assessing the first degree price discrimination, whereas each level of care was used for the third degree price discrimination. In the real setting, the unit of analysis under the MAC approach could be flexible, when the context and the research or policy questions were changed. In collective purchasing context, the unit of analysis might be changed to each purchasing group, province, or geographical regions, etc. instead of the hospitals under the same level of care for the first degree or the level of care for the third degree analysis as used this study. Moreover, in case of the quality of the product belonged to the same generic name among firms was considered indifferent, the MAC approach analysis could be done by treating every brand of the same generic name as an identical product. The applications of MAC are quite dynamic and bound by no limitation for the proposed context.

5.2.3 Policy Recommendation

The applications mentioned above will be more real and powerful by the few following adjustments.

5.2.3.1 Reporting Schedule

The present practice is very flexible, since the hospitals voluntarily send their data to the center any time. From the observation, the hospitals sent their data to the center in huge variety manners; monthly, varied from 1 to more than 20 times a year in different months. The MAC approach needed the periodic reporting with consistent schedule interval. For example, once a year reporting plan could schedule the date of data reporting, e.g., no later than January 31, 06 for the data covered purchasing transactions since January 1, 05 to December 31, 05. However, establishing an appropriate reporting schedule is very critical, since it emerges great consequence and has to deliberately take many factors into account. For instance, how sensitive of price changing through a year, hospitals' burdens, etc. At the same time, the feedback information of the analyzed pricing behaviors from the information center needs to be timely effective and efficient.

5.2.3.2 Real Purchasing Sizes

Purchased quantity collection was not the main objective of this current database management. The reported purchased quantities were thus not concerned or monitored as closely as the prices. The MAC approach will be different, because purchasing sizes data are very vital for the MAC calculation. The whole or all purchasing quantities of a product by a hospital have to be collected. The establishment of a report schedule would make purchasing size data collection easier. The hospitals would friendly be asked for their teamwork by letting them know their benefit from the MAC approach. The real purchasing size reporting makes them know their real MAC to contract the product at suitable price. The partial purchasing size reporting causes over estimation of the MAC index which will put them in a more difficult target to achieve, specifically a new target price.

5.2.3.3 Actual Price

The hospitals differently reported their contracted prices. Some reported billing prices, while some recorded the net price. The billing price is price stated in price list or invoice, while the net price is price after adjusting free complimentary products under sale promotion program. An informal discussion with a few sellers was performed in this study. An amaze information was that suppliers nowadays offered the identical product prices, while competing each other through differentiating percentage of free complimentary products. This information confirmed the essence of net price report. The actual acquisition cost of hospitals has to be seriously ensured by hospital collaboration and software assistance. The hospitals would be informed that high price reporting causes under estimated MAC. The hospital purchasing performance will consequently be under estimated.

Conclusion

This study has crossed through a very big step of discovering the MAC approach which was not originally designed. This breakthrough concept is expected to be a landmark for price monitoring mechanism and it applications are extensive and not locally limited at least for environments comparable to Thailand. Under the MAC approach, the study purposes of characterizing as well as estimating the price discrimination were empirically conducted using the DMSIC database for 5 pharmacologic drug groups. The factors influencing the price inequality were also examined. The results concluded that approximately 40-50 percents of analyzed entities were found first degree price discrimination with significantly higher incidence in the primary hospital market. About one-third of the product entities purchased by every level of care were found third degree price discrimination. Notice that not every product could be analyzed for third degree price discrimination due to the different nature of health services based on level of care. Fewer products were identically used by all 3 levels of hospitals. However, within the same level of care, variety of branded products, under the same generic item, were also found. More brands of an identical entity would benefit the hospital purchasers as higher competition among vendors would drive down

the cost as well as the price variation as reflected by inequality. To reduce the competition, however, manufacturers could differentiate their products by formulating or designing some variation, e.g. different strengths, dosage forms, package sizes, etc. With fewer competitors, the study found that the degree of price inequality among the primary hospital market was significantly larger.

To conclude the study, the implications and practical applications of the MAC concept to current purchasing situation have been detailed. Some policies have been recommended so that further steps to improve hospital purchasing performance could be achieved.