Decision support system based on socio-demographic segmentation and distribution channel analysis in the US furniture market

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Abstract

Segmentation is the first step to determine potential markets, which plays an important role for every business firm in today's global and changing environment. Choosing segmentation variables makes first influences to the final outcome of the segmentation process. Among many, demographic, geographic, psychological and behavioral criteria are most used to split a market.

In this article, clustering technique will be applied in a socio-demographic segmentation to identify groups of prospective buyers of the high-end US furniture market by analyzing the secondary data. Geographic Information System (GIS) will then be developed to analyze company's distribution channels in each segment to help decision makers to extend their distribution channel in the target market.

Key words: Decision Support System, Marketing, Market Segmentation, Clustering, Distribution Channel Analysis.

1 Introduction

Market segmentation plays an important role in every firm's strategy in today's business. Market segmentation is based on an assumption that heterogeneous market can be divided into a number of smaller homogeneous segments. Segmentation approaching allows firms to handle the diversity of market and also provides a strategic base for them to maximize competitive advantage in each segment (Weinstein, 1994).

Since the first introduction by (Smith, 1956), market segmentation has been to be popular and be applied in most market analysis processes. According to (Croft, 1994), "Market segmentation is the process of identifying different groups of users within a market who could possibly be targeted with separate products or marketing programs".

Market segmentation consists of three core stages: Segmenting, Targeting and Positioning. At first, the segment variables are identified with appropriate segmentation techniques (*segmenting*). Segmentation results then serves to find out which segments to compete in and to focus on (*targeting*). It then has to decide how it wants to *position* itself on the market against its competitors in terms of products, marketing program, distribution channels, etc (Majurin, 2001).

Although market segmentation is widely used in various domains, its applications on furniture market are still limited, as there are no more than a few papers for Taiwan and Finland furniture markets. This study aims to apply an approach of visualizing social-economics factors to segment the U.S. Furniture market. We first determine the segmentation variables for the furniture market. Clustering technique will then be applied to identify targeted market. In each segment, localization of distribution channels with geographic information system contributes a close look of the current enterprise's position in the market.

This article is organized as follows. At first, a literature review on the U.S. Furniture market and the market segmentation bases is presented. The case study, the data sources, the segmentation methods and the distribution channel analysis are outlined in the next section. Finally, this article concludes with some propositions for further research.

2   Literature review

2.1   U.S. furniture market

The United States is the largest and the most competitive furniture market in the world with more than 120 exporting countries (Florence, 1990). According to the Office of the United States Census (Census Bureau) in 2007, the value of imported furniture in the United States reached 27.24 billion dollars. It increases 154% compare to year 1998.
In 1998, Canada was the first supplier country, followed by China and Mexico. Since 2000, Canada's market share in the U.S. furniture market has dropped, while those from Asian countries (mainly China) have grown rapidly. Since 2000, China has replaced Canada as the largest furniture exporting country to the US market. In 2007, China is the source of 50% of the US total imported furniture, Canada took second place with a share of 16% (U.S. Census Bureau, see Murillo, 2007), as illustrated in figure 1. Not only be taken the first place from China, Canada furniture exporting business also suffers quite a high pressure from Mexico, the right next player, who is still in the third places.

For Canadian furniture firms, this falling down signals a problem in strategic approach as the demand still sharply increases. It raises a question for turning back to the market analysis process.
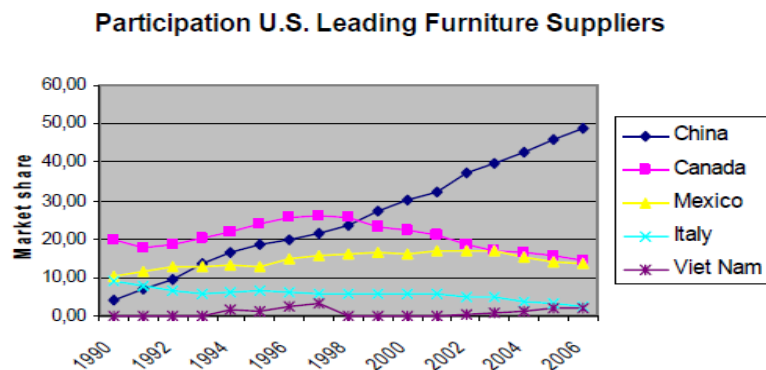

Participation U.S. Leading Furniture Suppliers

Figure 1 : Participation U.S. Leading Furniture Suppliers (Murillo, 2007)

2.2   Market segmentation bases

Determining segmentation bases is the most important step in market segmentation as it will influence the result of the whole segmentation process. Options of segmentation bases, which depend on the market's characteristics and/or the company's objective, however, are difficult to evaluate. (Majurin, 2001) mentioned that the criteria for effective segmentation can be used in determining segmentation bases. The study following perceptive capability

following perceptive capability was presented in (Wedel & Kamakura, 1998), where they classified market segmentation bases into two main groups: observable and unobservable bases.
The next sections will provide more details of each group. The next sections will provide more details of each group.

Observable bases

Observable group includes cultural, geographic, demographic and socio-economic variables. These kinds of segmentation are based on the assumption that people who have similar geographic and demographic characteristics have the (buying) habits similarly. These variables are easily observable and mostly obtained from available statistic sources (secondary data).
The combination of geographic, demographic and socio-economic (geo-demographic) factors is now widely used in the current applications for market segmentation because it's easy and less expensive to obtain data and provides a quick snapshot of a market (Weinstein, 1994).

(Mitchell & McGoldrick, 1994) clarified the roles of geo-demographic variables and how they can be applied in the UK market. They also gave an overview studying on its pros and cons.
Many case studies of PRIZMTM demonstrated the usefulness of geo-demographics segmentation in the U.S market analysis. Home Pro® based on the PRIZMTM's clusters to identify five target segments to expand their store assortments (Wedel & Kamakura, 1998). Ace Hardware is also used PRIZM to find the targeted customer profiles by looking at the US demographic data. With these results, Ace made a lot of pertinent decisions in store activities and increased their retail sales up 5.4 percent from 2004 (Claritas' case studies).

Unobservable bases

Unobservable group includes psychographics, personality and buying behaviors. These bases suppose that people's activities, interests and opinions are often decisive factors for their consumer goods, (Weinstein, 1994). From its definition 30 years ago, psychographic and life style received wide attention in marketing research. Unfortunately, as almost of data in the unobservable group is collected from primary sources (surveys and/or interviews), they are difficult and it time consuming to collect. On the other hand, they are costly, difficult to measure and hard to implement (Majurin, 2001).

Psychographic segmentation is applied in a broad range of travel market segmentation. (González & Bello, 2002) concluded that socio-demographic criteria are not sufficient to analyze the current travel market. It should include tourist behavior and their lifestyle in order to get an adequate result. (Mitchell, 1983) developed VALS system (Values, Attitudes and Lifestyles) to explain changing U.S. values and lifestyles and it has been used for many companies. By using K-mean, (Mäenpää, 2006) segmented the banking consumers based on their perceptions of the Internet banking services with its finding noting that the fourth cluster of youth, prefer Internet services than the bank office services.
In conclude, (Wedel & Kamakura, 1998) noted that life-style, buying behavior as well as personality provide an actionable basis that is especially useful for the development of adverting but most of research shows that they are neither stable nor responsive.

Table 1 demonstrates a matrix of the strengths of each segmentation bases, based on the criteria for effective segmentation (Wedel & Kamakura, 1998). In most cases, several bases can be used together, utilizing each factor's advantages, to have the most effective result. PRIZM CE is a Canadian consumer segmentation system which combines geo-demographics to psychographics to explain the consumer behaviors.

Bases/Criteria	Identifiability	Substantiality	Accessibility	Stability	Actionability	Responsiveness
Observable: *Demographic, Geographic, etc*	Very good	Very good	Very good	Very good	Poor	Poor
Unobservable: *Psychological, Behavioral, etc.*	Moderate	Good	Poor	Moderate	Good	Poor

Table 1: Evaluation of segmentation bases according to effective segmentation's criteria (Wedel & Kamakura, 1998)

3   Methodology and case study

3.1   Case study

Under the pressure of globalization, competition is increasingly fierce, user's need evolves and becomes increasingly diversified into several segments (Kaynak & Hassan, 1994). This induces new challenges and also, new opportunities to explore improvement in the design, production as well as marketing of products tailored to the market. With over 300 million of population, large territory and diversified cultures, the U.S. market is a challenge for business analysis. Follow a case study developed in collaboration with a company which designs and manufactures high-end furniture, we show how visualizing market segmentation can help to understand the U.S Furniture market.

As discussed above, choosing segmentation bases influence the final outcome of market segmentation. In this case of the furniture market in the United States, most furniture manufacturing companies do not have their own distribution channels and rely totally on various chain stores. This situation creates a high complexity and cost prohibitive to obtain information about customer's personality or buying-behavior. Moreover, according to the experts in furniture manufacturing, the demographic, social and economic factors are the most affected in the high-end furniture market at the high-level analysis. Socio-demographic segmentation, therefore, is appropriate for analyzing U.S. Furniture market.

3.2   Data sources

Data was collected from three secondary sources: U.S. Census Bureau, High Point Market's statistics and the company's Sale Reports.

Data from Census Bureau:

The Census Bureau conducts a census of the U.S. population. The census includes demographic information such as age, education, household composition, etc and economic like income, occupation, etc. Data provided by the Census Bureau are reliable and prospective source for market analysis. These data serve to classify consumer into homogenous socio-demographic groups. In market segmentation, the choice of variables should follow experts' opinions in the field. Guided by those in furniture industry, we chose 60 variables among 150 variables provided by Census Bureau for 50 states to analyze. The used data consists of population size, demographic trends, and the percentage of people in certain age groups, housing characteristics, family status, income, and employment. Figure 2 below shows an overview of these data.

State	Population	Family households/ Total households	..	% family with income > X	% house with more than A rooms	% people with income < poverty level	Employee rate
Alabama	4,442,558	68.41%	..	26.12%	86.20%	17.00%	0.93
Alaska	641,724	67.39%	..	43.15%	62.96%	11.2%	0.91
Arizona	5,829,839	66.22%	..	30.88%	74.14%	14.2%	0.94
Arkansas	2,701,431	68.27%	..	21.93%	79.46%	17.20%	0.93
...	...	...	...	...	...	...	...
Virginia	7,332,608	67.10%	..	42.53%	82.49%	10.0%	0.95
Washington	6,146,338	64.25%	..	37.44%	72.40%	11.9%	0.93
West Virginia	1,771,750	67.52%	..	20.27%	86.91%	18.0%	0.93
Wisconsin	5,375,751	64.91%	..	34.47%	79.41%	10.20%	0.94
Wyoming	495,226	65.34%	..	31.84%	80.51%	9.5%	0.95

Figure 2. U.S socio-demographic data

Data from High Point Market:

High Point Market, a part of the International Buyer Program of the U.S. Commercial Service, provides the reliable information of furniture retailers all over the world each year. Many retailers spread over United States participate with this program by advertising their business information to High Point Market, including their address and their revenue. Studying these data from High Point could analyze the localization competiveness in the U.S Furniture market, by putting side by side and evaluating the company's retailers with the others in each area.

Company's sale reports

These fact reports from the company are used to verify the result of clustering and to estimate the value need to increase in each state to reach the maximal sale in group. It also serves to analyze the company retailers' distribution and localization

3.3   Clustering method

Determining the number of clusters is a challenge when doing segmentation work. To find a reasonable cluster, several methods are proposed such as cross-validation, and permutation tests re-sampling. (Singh 1990) recorded that a combination of hierarchical clustering and partitioning clustering is an effective approach for the voluminous or multidimensional data. In our case study, hierarchical clustering technique is first used to determine the reasonable number of cluster. K-mean technique is then tried with each k- provided by HCA to determine the appropriate cluster. We use TANAGRA, a free software in data mining, to perform the segmentation.

Estimate the number of cluster with hierarchical clustering:

An agglomerative hierarchical clustering is a sequence of partitioning in which, with each partition, the two segments closest are merged until all object are grouped. The distance between two segments can be measured by the distance between the two members closest or farthest from their centroids. During iteration, a ratio of between-cluster sum-of-squares (BSS ratio) and the gap are calculated. The BSS ratio measures the dissimilarity between clusters (Jain & Dubes, 1988) and it is used to estimate the number of cluster. Other method has been used to estimate the number of cluster is gap statics. Higher value of gap (k) means better compactness when the dataset is clustered into k clusters (Tibshirani, Walther, & Hastie, 2000). A good clustering yields clusters where they have high between-cluster sum-of-squares and high gap value.

With our data, the hierarchical method has been used and the dendogram shows that a division from 50 states from two to four clusters is appropriate (Figure 3).
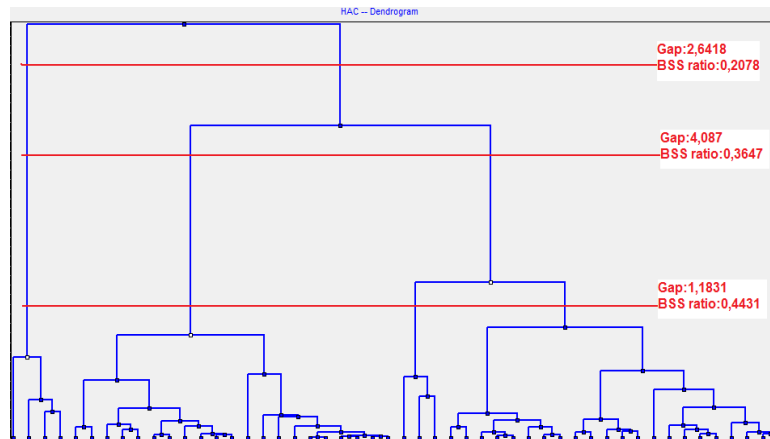

Figure 3. Result of hierarchical clustering

K-mean technique:

The k-means algorithm, belonging to a group of partitioning methods, was developed by (Mc Queen, 1967). These methods aim to group the objects based on its attributes into K number of segments (K is determined). The grouping is done by minimizing the sum of squares of distances between data and the corresponding cluster centric.

After using K-mean with each K from two to four and confrontations with the comments from the company's experts, we have reached a partition into three clusters, which covers the entire United States (Figure 4) (Alaska was voluntarily withdrawn).

As could be seen in Figure 4, the map tells us that 9 states of cluster are mainly located around the Great Lakes with Florida and California. Meanwhile, Cluster 2 contains 12 states, positioned mostly along the north-eastern coast. The other 29 states of Cluster 1 are spread over the territory.
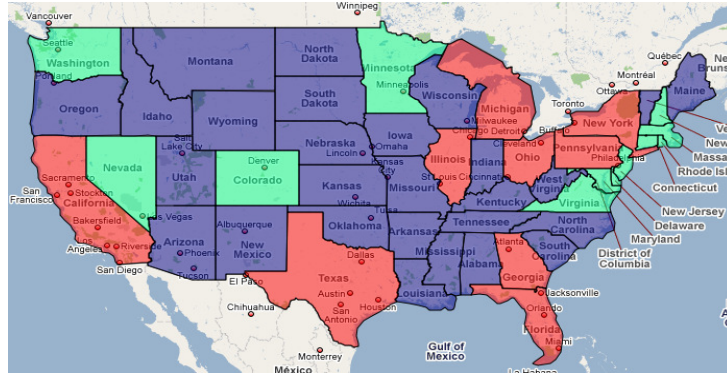
Figure 4. Clusters of the U.S map

Considering to the housing and economic factors, the characteristics which distinguish the three clusters could be described more below (these characteristics are obtained throughout the result of K-mean method).

3.4   Cluster analysis

Economic factors

Figure 5 displays an image of the three clusters in the economic point of view. These states in Cluster 2 (in cyan color) could be categorized as "Upper middle class", where the average percentage of families' high income is the highest (43.12% compared to 33.2 % of the whole of the USA). Colored in blue, Cluster 1 is labeled as "Lower middle class" with the average percentage of families' high income is the lowest (29% compared to 33% of the average of USA). Moreover, in the Cluster 1, the percentage of people having live below poverty level is the highest (14.02% instead of 12.95 of USA). The states in Cluster 3 can be named "Middle class" as the average of their economic factors is similar with those of USA. These states in Cluster 3 have the red color.
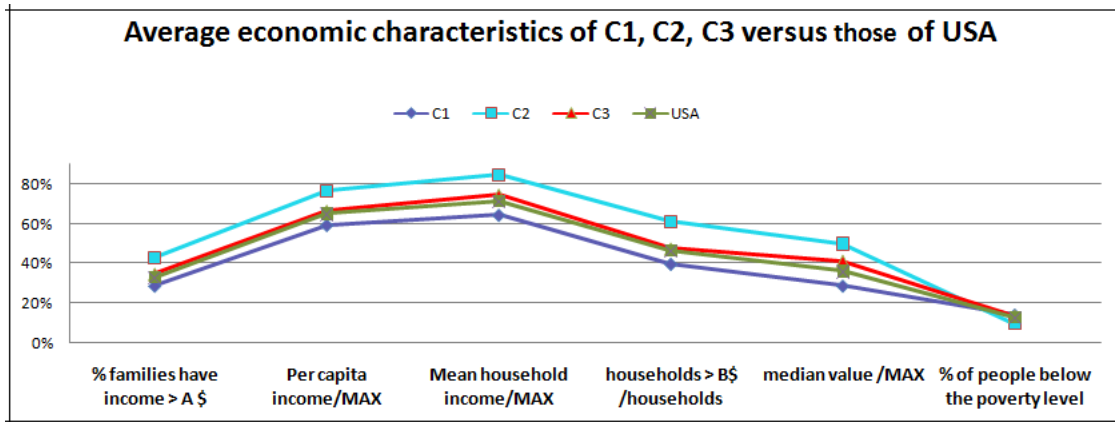

Figure 5: Average economic characteristics of C1, C2, and C3 versus those of USA

Housing factors

Sliding these three clusters with seven housing characteristics brings us the illustration as could be seen in Figure 6. Obviously, Cluster 3 shows its difference. The total number of households in the Cluster 3 is more 3.7 times than those of Cluster 2 and more 5 times than Cluster 1, respectively. It explains the huge number of large house in Cluster 3 although it contains only 9 sates compared with 12 states in Cluster 2 and 29 states in Cluster 1. Cluster 3 also stands first to the number of house which has more than B bedrooms, also with the number of households which has more than C cars (approximate 3.5 times to the Cluster 2 and 4.5 times to the Cluster 1). (The values A, B and C are determined specifically for the company then not public here).
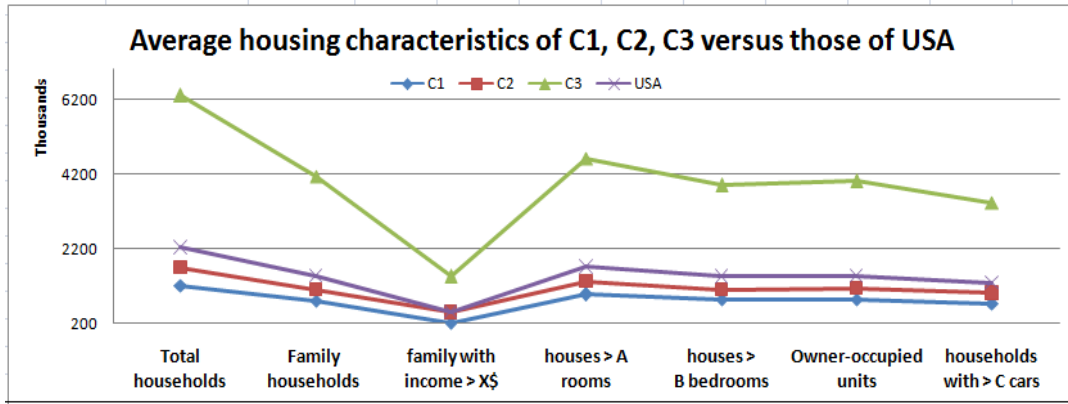
Figure 6. Average housing characteristics of C1, C2 and C3 versus those of USA

When combining the result with sales data, we noted that the total sale in Cluster 1 is the lowest although it contains 29 states. As against, Cluster 3 has only 9 states but its sales are the highest (almost 3 times of the total sale of Cluster 1) (Figure 7). The analysis above pointed out that Cluster 3 presents a potential markets for company.
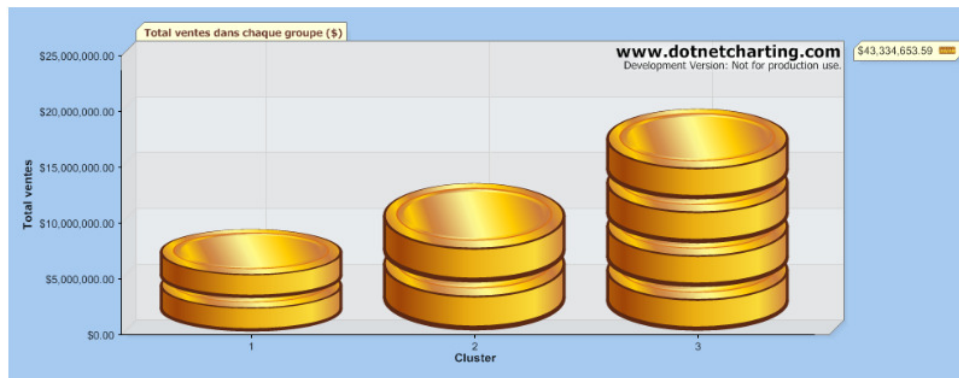

Figure 7. Total sale in each group

To this point, the study could help us to gain an impressive result of identifying 9 states in cluster 3 as the convincing potential markets. However, they are still in very raw level and there are still not enough details for company to make a concrete decision. In order to provide a close look with more illustrative expression, we developed a decision support system based on the Geographic Information System (GIS) and the clustering result. The System aims to visualize and analyze the current position of company's distribution channel, in comparison with other competitor's. It helps to recognize their spots arrangement in these potential states, supporting to formulate the appropriated decision making activities.

3.5   Distribution channel analysis

Geographic Information System can be understood as an information system that integrates stores, edits, analyzes, shares, and displays geographic information (Martin, 1995). GIS has been applied in various domains, including market analysis.

In this study, a GIS was developed to provide a tool to analyze, locate and graphically represent the spatial company's distribution channel as well as high point retailer in each state. On the map, each point is identified by its latitude and longitude. We first geo-code the address of each retailer into latitude and longitude then posted it into Google map through the API functions provided by Google. This can help the decision makers to see the results displayed geographically and visually to optimize retail location and allocation. The system can also provide the detail of each retailer which can help company to control the sale of his distribution channel.

We remarked that most of the high-point retailers are in the Cluster 3, which has 784 over 1556 retailers with turnover over 5 millions. Among 9 states of this cluster, Florida and California are the most with 115 and 124 retailers, respectively. However, the company's distribution channel here is quite scattered, which indicates that there might be lack of the consideration in these states. Considering to the retailers' network in California in figure 8, whereas company's retailers are represented in green marker, high point retailers are displayed in yellow marker and Target's retailers marker has violet color.
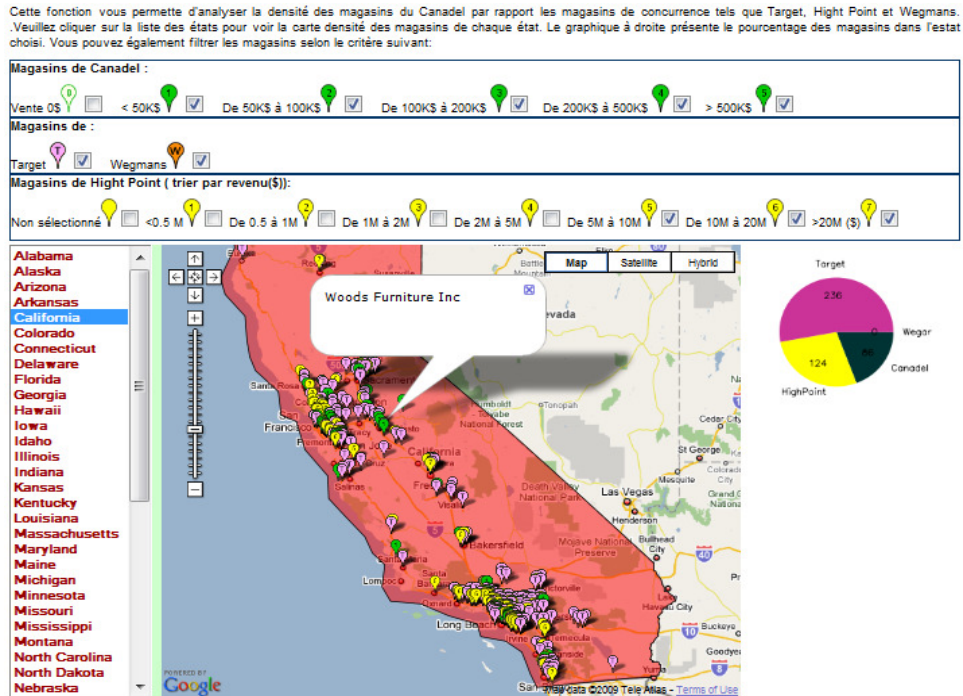

Figure 8. Distribution channel in California

In California, company lacks a great part of market share in Los Angeles, whereas a lot of high-point retailers. Moreover, in Ohio (Figure 9), a lot of high-point retailers are located in Columbus while company's distribution channel is mainly located in Cleveland. Company needs to review his distribution channel and analyze the competitors in these places.
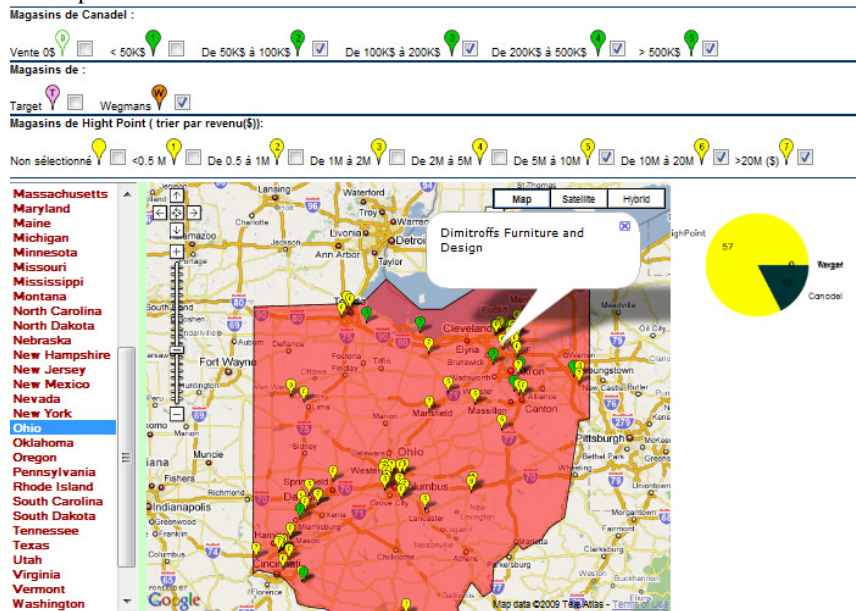

Figure 9. Distribution channel in Ohio

Firms can, based on this result, formulate the strategies of distribution channel allocation to expand their sales in such state of the target market.

4   Conclusion

The results confirm that socio-demographic segmentation could be successfully applied to the U.S. Furniture market. The three formed segments are distinguished by different characteristics. The Cluster 3 which includes 9 states which have most of high point retailers represents the target market. The analysis of distribution channel help to identify the location that firm needs to play attention to in order to expand their market share.
Our research can also consider various prospects:
- Working directly with the company data to analyze market changes in the real time.
- Analysis of market competition in each group.
- Analysis of the correlation between the contents of a store and local sales.
- Measuring the impact of the introduction of a new product on the sales floor.
- Forecasting the demand of each state based on the historical sales data in 5 years.

5   Acknowledgments

6   Reference

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