



Cyclical Changes in Women's Heel Height and Relationships between Heel Height and Economy

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Women have about 20 pairs of shoes on average (Allen, 2014). The women's shoe market was \$23.8 billion and maintained 57% of the total shoe market in 2013. Even though women's shoes, especially high heels are a very important element of fashion, and the shoe industry has a very similar market system just like the fashion industry, there is no study about shoes in terms of style changes and relations between external factors and heel height cycle.

Therefore, the objectives of this study were to investigate whether heel height changes in the U.S. market occur in a cyclical pattern, whether heel heights show greater within-year variability over time, and whether relationships are observed between the economy and average heel height.

Heel height data from U.S. Vogue's spring and fall editions were analyzed over the time period 1950-2014. Data were measured in millimeter unit using Adobe Illustrator and standardized by dividing the height of the heel by the shoe length through curved sole line. Of 1580 samples, 1300 obtained from 20 samples per year, were selected by the stratified sampling method to make the dataset robust.

To determine whether cyclical progressions of heel height are observed, the yearly averages were standardized by using three-year moving average technique ($\hat{y}_t = (x_t + x_{t-1} + x_{t-2})/3$) to average the irregular component of time series data and give a better indication of the long term fluctuation of heel height; results were plotted. The results showed that the trend line was toward higher heels from the early 1950's to 2011. Two cyclical movements of heel height were observed from 1950 to 2014. The lowest heel heights of each cycle were found in 1968 (about 3.8 centimeters) and 1983 (about 6.7) separated by 16 years. The highest heels occurred in 1955 (about 6.4), 1979 (about 8.2), and 2011 (about 12.5) separated by 24 and 32 years. After the peak in the second cycle in 2011, the heel height gradually decreased until 2014.

To identify the degree of within-year variability of the heel height, the standard deviation of the twenty measurements from the average measurement of a year were calculated, and then decade averages were drawn from yearly averaged standard deviation. A one-way ANOVA was conducted to compare within-year variability of data in heel height over the time period studied by decade. There was a significant difference in within-year variability for the six decades [$F(5, 54) = 16.97, p = .000$]. Post hoc comparisons using Tukey HSD test indicated that the mean score of within-year variability in 1950 ($M = 4.67, SD = 1.52$), and 1960 ($M = 5.07, SD = .92$) were significantly different than 1980 ($M = 9.20, SD = 2.57$), 1990 ($M = 10.97, SD = 2.49$), and 2000 ($M = 11.92, SD = 3.54$). Also, variability in 1970 ($M = 6.73, SD = 2.16$) was significantly different than those of 1980, 1990, and 2000. However, no significant within-year variability was found among 1950, 1960, and 1970; between 1970 and 1980; among 1980, 1990, and 2000. Taken together, these results exhibit the within-year variability is significantly increased through time. This increasing within-year variability in heel height suggests that heel height trend is very

similar to that of clothing styles, which shows a significant increase in within –year variability (Curran, 1999; Lowe & Lowe, 1990).

To analyze the relationships between heel height and economy, the macro-economic indicator of unemployment rate was used for this study. The Dickey-Fuller test results showed that the time series data of heel height and unemployment has a unit root respectively. Therefore, both variables were transformed into their first order differences ($D1Hemline = Hemline_{t+1} - Hemline_t$; $D1Unemployment = Unemployment_{t+1} - Unemployment_t$) to remove any linear trend and make each value a random step away from the previous value. Assumption of heteroskedasity of variance in the residuals and independency of error terms were satisfied in the testing model. The heel height was regressed on the previous year's heel height values and four consecutive previous year values of unemployment to identify any lead effects of unemployment rates on heel height. The model was statistically significant ($R^2 = .22$, $F(5, 54) = 3.04$, $p = .002$). The heel height of the previous year and unemployment of the previous four years together explained 22% of the total variance in heel height. The heel height was not significantly predicted statistically by the unemployment of the previous year, but the results explain that if in a year, unemployment levels were high, women tend to wear lower heels the next year ($B = -.22$, $p = .73$). Also after that year, the following two years, women wear higher heels than the first year ($B = .83$, $p = .19$ and $B = .15$, $p = .82$ respectively).

Based on the analysis of chronological data on heel height and economic factor from 1950 to 2014, the findings were: two cyclical changes in heel height were observed; the long term trend on heel heights showed a gradually increasing pattern; within-year heel height variability exhibited a significant increase through time; unemployment influenced heel height changes, but not in statistically significant levels. The results of this study indicates that it is relatively difficult for shoe companies to forecast the styles of the next season as heel heights have become more varied in the U.S. market in the time periods, but these findings can be useful to shoe companies to develop new collections for coming seasons regarding heel heights.

References

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