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An Analysis of the Short and Long-Run Relationships in the Garment Retail Market
- Is there a trend toward convergence in Fashion?

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ABSTRACT

This paper examines the main trends in the U.S. garment industry concentrating on the fashion retail sector over the period 1992/Q1-2013/Q4. Using FRED retail data, summary statistics and time-series analysis, we investigate the dynamic inter-relationships among three price indices in the apparel market— Consumer Price Index (apparel inflation rate) (CPI), Import Apparel Price Index (IMPX) and Personal Consumption Expenditures (PCE) in Clothing and Footwear. Our findings indicate that there exists a long run, steady relationship among the variables under consideration as indicated by the negative and significant sign of error correction term (ECT). Individually, PEC has a short-run (positive) effect on price increase/decrease for consumers (CPI) whereas IMPX is statistically insignificant. While fashion had traditionally been thought of as having a short-run impact (cyclical) and not long-run (growth or trend), the results indicate that the three price indices are converging over time but at a very gradual pace. The paper concludes by stressing the uses and limitations of time-series analysis for decision-making in this sector.

Keywords: U.S. garment industry, fashion retail statistics and analysis, global apparel industry

INTRODUCTION AND BACKGROUND

The U.S. is the center of the global apparel industry in retail sales, capital investment, export-import trade and employment. It is among the major producers and importers of apparel and competes against key textile exporters in the world economy, especially China and E.U. countries (France, Italy, Germany and the United Kingdom). In 2002, China and Vietnam jointly accounted for 70 percent of total growth in U.S. apparel imports. In 2013, China accounted for 37 percent of U.S. apparel imports while Vietnam captured 10 percent. Despite the emergence of low-cost centers of production since the elimination of textile and apparel import quotas by 2005, the U.S. continues to generate "industry leaders" in brand name apparel with market presence in many countries, such as Gap Inc., VF Corp (7 for All Mankind, Rock and Republic), Levi Strauss &Co. (*Encyclopedia of Global Industries*, 2014:1).

There are many studies to date concentrating on the U.S. apparel industry within various disciplines such as economics, political science, sociology, business administration and management. The primary focus of these studies is the organization and structure of U.S. apparel firms and evolving dynamics in the global textiles and apparel market. They have put the spotlight on sourcing strategies of lead firms in advanced industrialized countries, the rise of developing country suppliers and the involvement of U.S. retailers in overseas production and distribution networks—an emerging trend described as "buyer driven commodity chains" in "Global Value Chain" (GVC) research (Gereffi, 1994;1999, Gereffi and Frederick, 2010).

In current research, there is a growing focus on "retailers, brand marketers, brand manufacturers, and trading firms" as powerful actors in organizing global apparel production (WTO, 2013:22). Rather than only marketing and selling clothing to the public, lead retailers actively coordinate apparel production and distribution networks between fashion centers (U.S., Europe) and local industries in different parts of the world. Retailers maintain direct control over valued added activities such as planning, branding, designing and marketing and also dictate product standards for manufacturing suppliers in less developed countries[i] (WTO, 2013:22-24).

In supply chain management as well, there is a growing recognition of the retail sector's involvement in apparel production by means of global sourcing and "quick response" strategies[ii]. Quick response is a "just-in time" method that delivers fashion products to a mass market at high frequency, large volumes and low prices (Lowson et al., 1999). The U.S. has been on the front lines of "fast fashion" through an increasing consolidation of apparel retailers from the 1980s onwards. This trend is accompanied by a loss of manufacturing jobs and "valued added in the clothing industry in advanced countries", where old fashion centers are absorbing re-exports of merchandise through outsourcing strategies of lead firms (Baiardi et al., 2014:12). Sen (2008) explains how "vertical integration" contributes to U.S. retail manufacturing activities and private label development. In addition to "cost reductions through the elimination of intermediaries, retailers with manufacturing operations are able to respond quicker to changes in consumer demand and have a better control on the quality of products that they sell" (Sen, 2008:571).

Recent research draws attention to the uses and limits of post-Fordist strategies. Doeringer and Crean (2006:353) emphasize the "importance of niche product innovation, small-scale supply chains and flexible retailing" as seen in Italy's creative response to loss of competitive advantage. As noted by Baiardi et al., (2014), Italy seems to be the sole advanced country playing a powerful role in clothing manufacturing with higher employment and value-added products than its European competitors. This advantage, however, comes along with high price of Italian goods, high input costs and "quality upgrading" in "the clothing industry that leaves only high-end firms to survive" (Baiardi et al., 2014:12). Italian model departs from the U.S. model of "fast fashion" that has "failed to tap" similar advantages needed to offset declining industries and jobs (Doeringer and Crean, 2006:353).

Additionally, numerous studies have examined "the process of fashion trend analysis and forecasting" and the implications of such analysis for business for garment firms (Kim et al, 2011). They examined how consumer prices, retail sales and consumption patterns respond to changes in micro and macro environment of fashion industry such as firm innovations, industry conditions, government regulations, global competition and economic growth.

While the bulk of the research in this area focuses on business practices of retail firms within a supply chain framework, there are

few analyses of short-and long-term dynamics in the U.S. apparel retail. Quantitative and qualitative studies tend to model consumer behavior using multitude of methods such as data mining, pilot study (experimental design), retail testing, "hybrid methods for fashion sales forecasting" and even simulation[iii]. Despite the valuable contribution that this literature has made in predicting consumer demand in service industries, it is more in the vein of inventory management, business administration and supply chain review. Furthermore, the accuracy of fashion sales forecasts is constrained by "short-life cycle" of products, "volatile demand", "lack of historical data", and "strong seasonality of sales", as noted by experts (Thomassey, 2010:470).

This paper eschews an overarching management oriented approach and instead aspires to identify short-and long-run relationships in the fashion retail based on time-series methods. The econometric techniques of unit root and co-integration have not been commonly applied to apparel retail[iv] and we hope to address this issue by exploring statistical properties of time-series variables. The co-integration framework is useful for examining the long run relationships between non-stationary variables, especially when analyzing dynamic sectors like banking, finance and fashion retail. It indicates the possibility that even though variables may stray from the equilibrium for a while, they unite upon some long-run value or move together in the long-run. At a time when trends are rapidly changing in fashion, this type of analysis may reveal potential trends in relevant apparel indices.

This research addresses the question of what affects consumer price index for apparel goods over time. Do personal consumption expenditures (PCE) and import price changes (IMPX) exert significant short and long-run influences on CPI and each other? Short-term data is not useful for this type of analysis. Therefore, we have chosen publicly available variables that are most relevant for analyzing garment sector dynamics on a relatively long time span 1992Q1-2013Q4. Thus, our analysis is limited by the availability of long-term data in retail sector. Using summary statistics, co-integration framework and vector-error correction modeling (VECM), we find that there exists a long run, steady relationship between the variables under consideration, as indicated by the negative and significant sign of error correction term (ECT). While fashion had traditionally been thought of as having a short-run impact (cyclical) and not long-run (growth or trend), the results indicate that the three indices converge to equilibrium over time but at a very slow pace. This can be the result of multitude of factors not explored in this paper, such as short-life cycle of products, unpredictable demand, opposite trends and lack of long-term data in apparel retail.

The rest of the paper is organized as follows. Section 2 discusses stylized facts and descriptive statistics of emerging trends in the apparel retail market in the U.S. Section 3 introduces the methodology and data, followed by results and discussion of empirical analysis in Section 4. The paper concludes by stressing the uses and limitations of time-series analysis for decision-making in apparel retail.

STYLIZED FACTS: APPAREL RETAIL MARKET IN THE UNITED STATES

U.S. textile and apparel industries face major challenges as imports from low-cost producers boost their share of the domestic market. While apparel imports are still subject to tariffs, the WTO Agreement on Textile and Clothing has subjected U.S. producers to foreign competition and increased "contraction in production" since 2005 (Clark and Rees, 2006:1). In 2002, China and Vietnam jointly accounted for 70 percent of all growth in U.S. apparel imports. According to American Textile Manufacturers Institute (ATMI), China's apparel imports accounted for 9 percent of

the US import market when quotas were in place. In 2003, China's share rose steeply to 53 percent after numerous types of clothing were exempted from quota requirements. By 2006, China accounted for 65 percent of global apparel exports while in 2013 it captured 37 percent of the U.S. import market *(Encyclopedia of Global Industries*, 2014).

Source: U.S. Bureau of Labor Statistics, 2014a, Retail Trade Employment

Figure 1. Author's own, Payroll Employment, Fashion-Related Retail Trade Industries, Annual Averages

With a decline in the cost of materials and capital, jobs in apparel manufacturing contracted. As discussed earlier in Doyran (2013), even fashion hubs like New York City declined in considerable terms. From 2002 to 2012 (March), New York State's apparel firms decreased from 2,530[v] to 1,128 (or 55.415 percent) against a 69.446 percent decrease in the number of paid employees--from 41,366 to 12,639 (Appendix 4.3). Over the same period, number of U.S. apparel firms declined by 50.476 percent, from 13038 to 6457 (U.S. Census Bureau, 2002; 2012; Appendix 4.2). U.S. Bureau of Census has not released the complete data for the 2012 Economic Census, therefore we lack figures on U.S. wages and production costs in apparel manufacturing for the year 2012. However, from 2002 to 2007, the most recent period for which the data is available, production workers wages ($1,000) in New York State dropped from 570,575 to 307,863 or 46.043 percent. As the labor component of manufacturing contracted both in terms of wages and jobs, it became less costly to produce, as seen in 39.745 percent decrease in total cost of materials ($1,000)-- from 3,272,788 in 2002 to 1,972,025 in 2007 (U.S. Census Bureau, 2002; 2007; Appendix 4.1).

New York's manufacturing downturn reflects nationwide trends in apparel industry. From 1990 to 2011, "employment in the apparel manufacturing industry has declined by more than 80 percent (from about 900,000 to 150,000 jobs)" (U.S. Bureau of Labor Statistics, Fashion, 2014a). U.S. apparel manufacturing lost around 68.047 percent of its labor force over the period 2002-2012—declining from 350,439 to 111,973 (U.S. Census Bureau, 2002; 2012).

Unlike apparel manufacturing that is facing steep decline in jobs and production, the sector's retail jobs and sales trend upward

over time. There has been an increase in the number of employees in retail trade, clothing and clothing accessories stores over the period 1992-2013. To observe trend more clearly, we summed up each month's figures and obtained total figures for each year. The overall trend indicates that total employment in clothing and clothing accessories stores grew from 14994.6 (thousands of people) in 1992 to 16723.5 (thousands of people) in 2013 or 11.53 percent (FRED, Federal Reserve Bank of St. Louis, 2014; Appendix 4.4). From 1992 to 2013, total clothing sales increased from 199,449 (millions of dollars) to 248,806 (millions of dollars) or 108.295 percent (Figure 2, Appendix 3). Based on these figures, it is clear that jobs and sales gravitate towards the garment retail sector rather than manufacturing. Considering that most garment production takes place overseas, most sales are generated from import goods outsourced elsewhere. This tends to favor retail sector over manufacture.

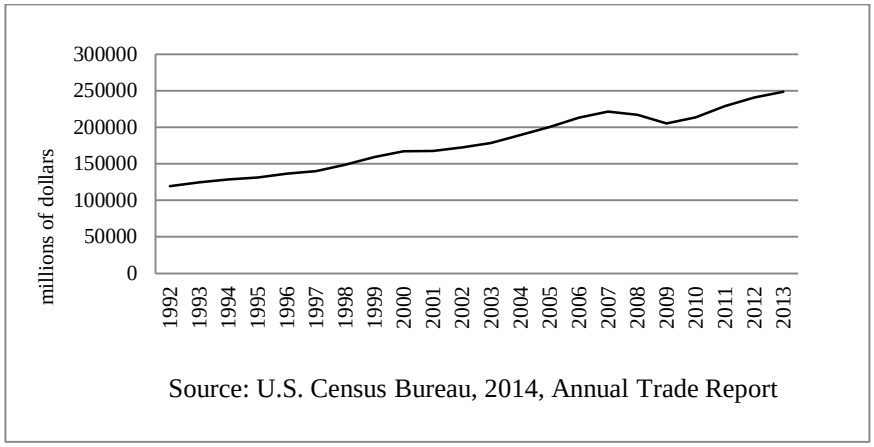


Figure 2. Author's own. U.S. Total Sales of Clothing and Clothing Accessories Stores

When the data is broken into subsectors in retail trade employment, however, one gets a more complex picture than for employment in clothing and clothing accessories alone. As evident in Figure 1 (Appendix 2), employment data is heterogeneous across sectors for the years 1990 and 2011.Within the retail trade industry, women's clothing stores, men's stores, shoe stores, and jewelry, luggage, and leather goods stores experienced decreasing employment from 1990 to 2011[vi]. To the contrary, "industries such as children's and infant/s clothing (118.6 percent), cosmetic and beauty supply stores (82.3 percent), family clothing (63.2 percent), and clothing accessories stores (57.0 percent) all experienced an increase in employment from 1990 to 2011. From 1990 to 2007, employment in family clothing stores increased from 273,700 jobs to 539,800 jobs, or 97.2 percent" (U.S. Bureau of Labor Statistics, 2014a).

When the data is ranked by total employment within apparel and accessory stores rather than by subsectors only, it displays variations among major retailers and brand-based manufacturers. For example, TJX companies had the largest workforce in 2011 (166,000 employees), followed by The Gap, Inc., (134,000), Limited Brands Inc., (96,5000), Abercombie & Fitch Co., (85,000), Nordstrom Inc., (52,500) and Ross Stores (49,500) (*Business Insights: Essentials*, 2014)

Another important question is how much consumers spend on apparel goods as a share of disposable income. This can be measured by household expenditures on apparel goods, household consumption as a percentage of disposable income and total sales of clothing stores. As a result of outsourcing, improvements in manufacturing technology, higher worker productivity and global competition for

clothing imports, clothing has become "less expensive both in inflation adjusted prices and as a share of disposable income". In 2012, at US$ 1,736, the U.S. household (on average) spent 2.4 percent of their annual income compared to 9 percent in 1950, according to the *Survey of U.S. Consumer Unit Expenditures* (*Encyclopedia of Global Industries*, 2014:4).

Breaking the data into different components, "apparel designed for women aged 16 and over" has ranked the highest of "any other apparel product or service" in household consumption as a percentage of total apparel expenditures since 1985 (U.S. Bureau of Labor Statistics, 2014a). In 2011, "top U.S. apparel retailers by sales" were The TJX Companies Inc., (US$15,165,000 thousand), The Gap Inc., (US$11,443,000 thousand), Ross Stores Inc., (US$8,805,000 thousand) (*Business Insights: Essentials*, 2014).

Macroeconomic and demographic conditions such as disposable income, economic growth in other nations, and an increasing population in need of clothing affect garment industry conditions. 2010 industry reports were negative over the prospects for U.S. textile mills and apparel manufacturing. A research firm, IBISWorld, listed U.S. mills and apparel manufacturers among "Top 10 Dying Industries" but in a November 2013 report, the firm modified its forecasting based on anticipated growth in GDP. It predicted a revenue growth of 1.8 percent in 2013 and 4.7 percent in 2014, projecting further growth throughout 2018. As the fashion center of the world, the U.S. "alone accounts for nearly 17 percent of the world's apparel revenue" and growth in U.S. GDP accounts for much of the growth in apparel sales globally (*Encyclopedia of Global Industries*, 2014:3).

DATA AND VARIABLES

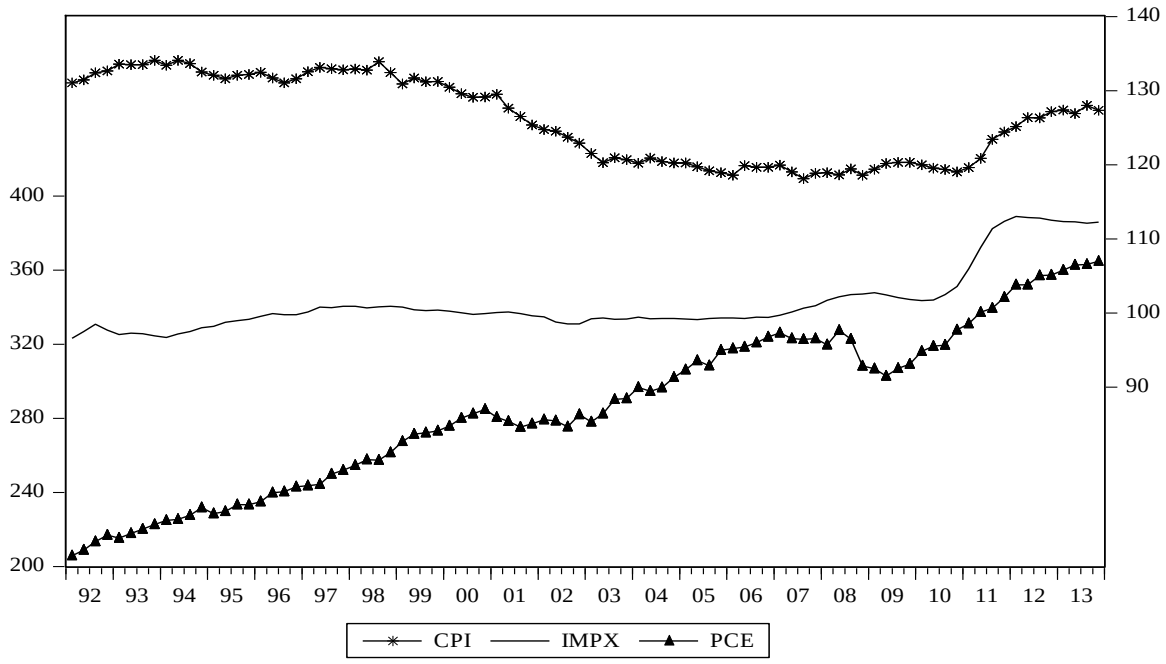
We have chosen the publicly available variables for analyzing garment sector dynamics within a relatively long time span. Since short-term data is not useful for this type of analysis, we included only variables for which we had a minimum of 25 years of data. Although variables on a yearly basis exceed those for monthly or quarterly, the time span of annual data (1993-2011) is not long enough to obtain robust estimates in unit root tests. On the other hand, when considering other variables such as apparel retail trade, disposable income and GDP, perfect correlations (interdependence among explanatory variables) did not facilitate a regression analysis. Therefore, we excluded variables with higher collinearity[vii] (Appendix 1).

Data includes 88 quarterly observations from 1992/Q1 to 2013/Q4. CPI and IMPX are monthly observations (1992/M01-2013/M12) converted to quarterly metrics for the analysis (1992/Q1-2013/Q4)[viii]. PCE are quarterly observations (1992/Q1-2013/Q4). We obtained the data from FRED, Economic Research Division, Federal Reserve Bank of St. Louis, all available at http://research.stlouisfed.org/. CPI is "Consumer Price Index for All Urban Consumers: Apparel, Index 1982-84=100, Monthly, Seasonally Adjusted". PCE is "Personal Consumption Expenditures: Nondurable goods: Clothing and footwear, Billions of Dollars, Quarterly, Seasonally Adjusted Annual Rate". IMPX is "Import (End Use): Apparel, Footwear, and Household Goods, Index 2000=100, Monthly, Not Seasonally Adjusted". Since the data is periodically updated, we used the last login period as the base line during which the data were collected (Appendix 5).

Table 1. Descriptive Statistics of Variables 1992/Q1-2013/Q4

	CPI	IMPX	PCE
Mean	126.1004	101.3818	285.5511
Median	126.4308	99.93333	282.5000
Maximum	134.1000	113.0333	364.8000
Minimum	118.1243	96.60000	205.8000
Std. Dev.	5.701734	4.381935	43.38663
Jarque-Bera	10.15063	59.47831	3.663277
Probability	0.006249	0.000000	0.160151
Observations	88	88	88

Source: FRED, Federal Reserve St. Louis. Table is author's own using *Eviews* 8 descriptive statistics.



Source:FRED, Federal Reserve St. Louis

Figure 3. Author's own - Consumer Price Index for Apparel (CPI), Import Apparel Price Index (IMPX), Personal Consumption Expenditures in Clothing and Footwear (PCE) in $billions

Descriptive statistics (Table 1) display some variations in our data. Standard deviation indicates "amount of variation or dispersion" from the mean and is highest for PCE: 43.38. This indicates that data points are highly volatile or may be dispersed over a wide spectrum of values and given seasonal factors may not follow a normal distribution. Individually, CPI and IMPX are not normally distributed as indicated by Jarque-Bera probabilities of 0.006249 and 0.0000 (under the null hypothesis that "data points are normally distributed"). Although PCE is highly volatile, it follows a normal distribution. According to trend line in Figure 3, apparel price inflation, as measured by CPI declined to 127.4 by the end of 2013 while import price inflation (IMPX) increased from 96.6 in 1992 to 112.3 by the end of 2013. On the other hand, another indicator of core inflation, personal consumption expenditures (PCE) increased to $365 billion by the fourth quarter of 2013.

THEORETICAL EXPECTATIONS

This research addresses the question of what affects consumer price index for apparel goods over the period 1992/Q1-2013/Q4. *Do personal consumption expenditures (PCE) and import price changes (IMPX) exert significant short and long-run influences on CPI and upon each other?* The interdependency of price indices has implications on the pace of their convergence over time. This can reveal patterns and relationships in apparel transaction data that are important to both the business community and to researchers. Furthermore, understanding such patterns contributes to the knowledge and control of dynamics that can affect market or price volatility in the garment sector.

For the general reader and in light of the limited data in hand, however, this paper focuses on main trends using preliminary tools that were available to the author. Given that 3 price indices are important measures of price movements, the question arises whether prices move together in the long-run or converge to equilibrium after deviations from short-run, as would be expected by the "efficient market hypothesis". In other words, the price for the apparel good is the market equilibrium of consumers who demand the good and quantity of goods supplied to the market. Typically, the optimal price is the "profit maximizing price" where marginal revenue equals marginal price. Under the assumption of perfectly competitive markets, "market price is equal to the marginal cost of production" (Baye, 2010:277). Given that we do not have long-term data on sellers' and producers' marginal costs (which could potentially reveal useful information on "markup price" in fashion retail), we ask whether consumption expenditures in apparel (demand conditions) and prices of import apparel would have any significant effect on prices of consumer apparel goods.

There are important studies to date examining various aspects of the CPI ("core goods" versus "core services"), which reveal potential long-term and short-term dynamics in price movements in the U.S.[ix] For example, according to Bauer and Haltom (2004), "significant changes in market structure, trade patterns, productivity growth, and price measurement that have placed downward pressure on goods prices in many components. The components most affected have been apparel, information processing equipment, recreation goods, and transportation goods" (Bauer and Haltom, 2004:14).

There is a downward pressure on price inflation over time. Experts noted that "since late 2001, core consumer inflation rates have declined to levels not seen since the early 1960s" (Bauer and Haltom, 2004:1). Classified under "core goods inflation", however, apparel prices have their own dynamics which may be different from aggregate inflation rate. Likewise, it is hard to predict whether general price inflation derives "from broad based price changes or from price changes in only a few components" (Bauer and Haltom, 2004:1).

Apparel price indices have three components and this study attempts to understand the dynamic relationships between them--consumer price index, import price index, and personal consumption expenditures. Various macro and micro-environmental factors have affected manufacturing and retail prices. Due to the movement of apparel manufacturing to low cost countries, the volume of apparel imports has increased. U.S. apparel production has decreased by approximately 40 percent since 1994 against a rise in apparel imports. Discount stores have become key players in the apparel industry, driving competition and thus "downward pressure" on consumer prices (Bauer and Haltom, 2004:14).

As two of the independent variables, import price index (IMPX) and personal consumption expenditures (PCE) can influence consumer price index (CPI) through one of these channels: Shortages of

raw materials imported (cotton, leather, textile and textile articles, etc.), global competition and the economy (booms and downturns). Import price index can be an important sign of domestic inflation since "some inputs to domestic production, as well as consumption, are imported" (U.S. Bureau of Labor Statistics, 2014b). If there is a scarcity of imported cotton, for example, manufacturers will charge retailers more, which will increase the price of cotton clothing for consumers. Similarly, customers' disposable income and personal consumption expenditures increase during economic booms. Consumers "may buy more clothing, increasing sales for clothing manufacturers, wholesalers and retailers" hence putting upward pressure on apparel prices (Suttle, 2014). Therefore, we expect that IMPX and PCE positively affect or determine consumer apparel index (CPI) over the studied period.

METHODOLOGY AND THE MODEL

We analyze the relationship between CPI, IMPX and PCE employing a co-integration framework and Vector Error Correction modeling (VECM). Introduced by Engle and Granger (1987) and Johansen (1988) and Johansen-Juselius (1990), a co-integration technique is used to verify whether any long-run relationships exist among variables or whether they are independent. When variables are co-integrated, VECM is "used for estimating both short term and long term effects of one time series on another" within an OLS framework (Best, 2008:1). Furthermore, since fashion had traditionally been thought of as having a short-run impact (cyclical) and not long-run (growth or trend), this type of analysis allows for distinguishing "permanent" from "transitory" effects within a certain type of industries. This can reveal useful information about dynamic relationships among the variables (Nielsen, 2005:2).

Before constructing a VECM, we specify a standard OLS equation as follows:

$$CPI_t = \beta_0 + \beta_1 IMPX_t + \beta_2 PCE_t + \mu \quad (1)$$

where CPI, IMPX, PCE are the values of time-series at time *t* observed at quarterly 1992/Q1-2013/Q4. π is the random error or "white noise" capturing any unobserved factors that affect the dependent variable—Consumer Price Index for apparel goods (CPI).

The methodology starts with examining the stationary properties of all variables. As is well known in time-series analysis, OLS can produce "spurious" results when variables in their original units of measurement are non-stationary or follow a time-trend. The data display trend when the current value of time-series are correlated with their last period's value—a problem known as autocorrelation in econometrics. Non-stationary behavior is caused by "unit root" or "stochastic trend" in time-series and should be tested before including variables in statistical analysis (Nielsen, 2005:1). Thus, before estimating a regression equation, we tested the variables for the unit root. The ADF test statistic (Table 2) confirms that all variables contain unit roots (or non-stationary) in levels – the computed p value is higher than critical value of 5 percent and fails to reject the "null hypothesis of unit root". When we took the first difference of the series, however, they all became stationary indicating that they had no unit root (the computed p value is lower than the critical value of 5 percent) Therefore, we concluded that the series are first-difference stationary or integrated of order I (1). The confirmation of stationary ensures that our variables are free of spurious outcomes and thus ready for use in co-integration analysis and VECM.

Table 2. Augmented Dickey-Fuller (ADF) and Philips Perron Unit Root Test Results

Variables (Level)	ADF t-statistic	Philips Perron t-statistic	Variables (First Difference)	ADF t-statistic	Philips Perron t-statistic
CPI: Intercept	- 1.086(0.718)	-1.076 (0.722)	Δ(CPI):Intercept	-7.045 (0.000)	-7.165(0.000)
CPI: Trend& Intercept	0.437(0.999)	- 0.224(0.991)	Δ(CPI):Trend& Intercept	-7.18(0.000)	-7.259(0.000)
CPI: None	-0.524(0.486)	- 0.415(0.530)	Δ(CPI):None	-7.062(0.000	-7.296(0.000)
IMPX: Intercept	-0.647(0.853)	0.184(0.970)	Δ(IMPX):Intercept	-4.240(0.001)	-3.859(0.003)
IMPX: Trend& Intercept	-2.134(0.519)	- 0.977(0.941)	Δ(IMPX):Trend& Intercept	-4.524(0.002)	-4.021(0.011)
IMPX: None	1.098(0.928)	1.662(0.976)	Δ(IMPX):None	-4.096(0.000)	-3.741(0.000)
PCE: Intercept	-0.408(0.902)	- 0.466(0.891)	Δ(PCE):Intercept	-8.605(0.000)	-8.607(0.000)
PCE: Trend& Intercept	-1.944(0.622)	- 2.431(0.361)	Δ(PCE): Trend& Intercept	-8.553(0.000)	-8.650(0.000)
PCE: None	4.701(1.000)	4.020(1.000)	Δ(PCE):None	-4.376(0.000)	-7.546(0.000)

Notes: The ADF (Augmented Dickey Fuller) and Philips Perron unit root tests are performed using *Eviews* 8 statistical software. These tests examine the "null hypothesis of unit root (non-stationary)" against the "alternative hypothesis of no-unit root (stationary)" at 1 percent and 5 percent or 0.01 and 0.05 significance levels. The figures in parenthesis are the p-values next to t statistics, which denote the rejection of the null hypothesis of non-stationary at 1 percent significance level for all variables (second column). D refers to first difference of the variables Δ or I (1).The optimal lag lengths are automatically selected by SIC (Schwarz Info Criterion).

Two or more I (1) time-series variables are likely to be co-integrated if a "linear combination" of these series is I (0)—i.e., stationary (Engle and Granger, 1987; Wooldridge, 2013:845). When variables are co-integrated, the "data are never expected to drift too far away from each other, maintaining an equilibrium relationship" (Best, 2008:3). Although the co-integration technique verifies the existence of a long-run relationship among the variables, it does not provide a mechanism to correct deviations from the short to the long-run. Thus, Vector Error Correction Model (VECM) is used to estimate the short and long-run elasticities for CPI and to measure any adjustments to equilibrium among the I(1) variables.

Table 3. Johansen Co-integration Test Summary

Hypothesized	*Trace Statistic*	*Max-Eigen Statistic*
None*	44.060 (0.038)	34.143(0.003)
At most 1	9.916 (0.928)	7.142(0.890)
At most 2	2.774 (0.902)	2.774(0.902)
Trace and Max-Eigen value test indicate 1 cointegrating eqn(s) at the 0.05 level * denotes the rejection of the hypothesis at the 0.05 level MacKinnon-Haug-Michelis (1999) p-values (in parenthesis)		
Notes: The co-integration test is carried out using *Eviews 8* statistical software and between the level series of variables. * indicates the number of co-integrating relationships at the 0.05 level according to Trace and Maximum Eigenvalue statistics showing 1 co-integrating equation. The tests examine the "null hypothesis of no co-integration" against the "alternative hypothesis of co-integration". The appropriate lag length for the Johansen test is determined by finding the optimal lag for underlying VAR. This is done by running an unrestricted VAR in level series of variables with different lags (from lag 1 to lag 12) and selecting the optimal lag (2) that satisfies the VAR stability condition (Lütkepohl, 1991) and minimizes the Akaike Information Criterion (AIC) and serial correlation in VAR residuals. Given that the Johansen test and VECM are running in first differences, we ran these tests with "optimal lag minus 1".		

The premise to use the VECM is that all variables included in the model are stationary. Furthermore, in time-series analysis, when variables are integrated of order one, I(1) and simultaneously co-integrated we should estimate a VECM. The first condition of the Johansen co-integration test is to verify that all variables are I(1), which we do in the unit root test part. Therefore, before constructing a VECM in the next section, we confirmed that all variables are 1) non-stationary in their original units of measurement (levels) but 2) become stationary at the first difference level (Table 2 confirmed I(1)) and 3) co-integrated (Table 3). Because of the multivariate nature of time-series, we carried out the co-integration test using the Johansen (1988) methodology as opposed to Engle-Granger (1987) two-step method, as explained above.

RESULTS AND DISCUSSION

Since our variables—CPI, IMPX, PCE—are I(1) and simultaneously co-integrated, we can confirm a 1 co-integrating relationship among them (Table 3) and proceed with an error correction model (Eq.2). This ensures that our variables move together in the long-run and excludes the possibility of non-causation between the co-integrated series (Granger, 1988). Although our variables may move arbitrarily for a while, the error correction mechanism will make them converge upon a long-run value. The advantage of using VECMs is that they "difference the data to achieve stationary and use an error correction term to replace the long-run information lost through differencing" (Fanchon and Wendel, 1992:1).

Equation (2) represents the Vector Error Correction (VECM) model. Basically, *Eviews* takes the first difference of the series and adds one lagged value of the residuals from the co-integrating equation (error correction term) as another explanatory variable[x].

$$\Delta CPI_t = \alpha + \beta \Delta IMPX_{t-i} + \gamma \Delta PCE_{t-i} + \varphi EC_{t-i} + \varepsilon_t \quad (2)$$

where i is the number of lags, *i.e,* 1 lag according to optimal lag minus 1. EC_{t-i} is the lagged error correction term or the residual of the co-integrated relationship. φ is the coefficient of the co-integrated, long-run equation (C1, Table 4), which measures the "speed of adjustment to equilibrium" between the variables. Δ denotes the first

difference of variables Y(t)-Y(t-1) and e_t is the error term ("white noise") with the classical properties. Whereas β and γ capture the short-run impact of IMPX and PCE on CPI, the coefficient of EC (φ) captures the joint, long-run impact of the variables on CPI. Specifically, EC measures how fast the adjustment towards the long-run equilibrium is made, indicating the percentage of the disequilibrium or instability corrected in CPI (apparel inflation) from one period to the next.

Table 4 displays the results for the long-run and short-run relationships between the apparel prices. Overall, R Square is 35 percent indicating that data may not be strongly fitted but risk is lower because Prob. (F Statistic) supports the regression at 1 percent critical value or 0.01. The coefficient of the lagged EC, C(1) denotes the speed of adjustment to equilibrium among the variables and is negative (-0.17) and statistically significant (1 percent). This indicates that our variables are co-integrated; import price changes and personal consumption expenditures have a significant effect on consumer prices for apparel goods in the long-run.

Furthermore, for the long-run relationship to be statistically significant, the sign of EC should lie between 0 and -1 and the findings satisfy this requirement. The nearer the sign of EC to -1, the faster the convergence (1 indicates full adjustment), indicating a move back towards equilibrium. But in our case it is nearer to zero (-0.17) so it indicates a very "slow convergence" towards equilibrium among consumer price index (CPI), import price index (IMP) and personal consumption expenditures (PCE). EC measures how fast the adjustment towards the long-run equilibrium is made, indicating the percentage of the disequilibrium or instability corrected in CPI from one period to the next. In our case, a deviation between CPI and the long-term equilibrium in one period is automatically corrected in the next period by about 17 percent. This means that import price changes (IMP) and consumer spending on apparel goods (PCE) together will have a delayed (slow) effect on CPI but this effect is statistically significant (p value 0.0001).

Table 4. Results of VECM Estimation Procedure

Dependent Variable: D(CPI)				
Method: Least Squares				
Sample (adjusted): 1992Q3 2013Q4				
Included observations: 86 after adjustments				
D(CPI) = C(1)*(CPI(-1) - 1.50711931659*IMPX(-1) + 0.0164260754202				
PCE(-1) + 0.329621620789@TREND(92Q1) + 7.3008974413) +				
C(2)*D(CPI(-1)) + C(3)*D(IMPX(-1)) + C(4)*D(PCE(-1)) + C(5)				
Variables	Coefficient	Std. Error	t-Statistic	Prob.
EC (t-1)	-0.173065***	0.041262	-4.194308	0.0001
D(CPI(-1))	0.075214	0.095966	0.783754	0.4355
D(IMPX(-1))	0.151047	0.139193	1.085167	0.2811
D(PCE(-1))	0.037437*	0.019799	1.890888	0.0622
Const.	-0.140739*	0.081083	-1.735745	0.0864
R-squared	0.352390	Diagnostic Tests		
Adjusted R-squared	0.320409	Breusch-Godfrey LM Test		0.8076
S.E. of regression	0.637791	Breusch-Pagan-Godfrey		0.1772
F-statistic	11.01881	Normality (Jarque-Bera)		0.6080
Prob(F-statistic)	0.000000	Durbin-Watson stat		1.960238

Notes: The language of this table is *Eviews* 8 output. ***Significant at 1 percent level or 0.01; ** Significant at 5 percent level or 0.05; *Significant at 10 percent level or 0.1. D refers to first difference of the variables Δ or I (1). As Durbin-Watson statistics approaches to 2, it indicates lower serial correlation. Based on other diagnostics tests, our model is free of serial correlation (Breusch-Godfrey LM Test), heteroskedasticty (Breusch-Pagan-Godfrey test) and residuals are homoscedastic and normally distributed (Jargue-Bera probability).

The coefficients other than C1 [ECT(t-1)] indicate short-run relationships. Based on the results of VECM, there is only 1 significant relationship between the independent variables and CPI. The lagged coefficient of personal consumption expenditures [D(PCE(-1))] has a significant, positive effect (0.037) on Consumer Price Index. This effect, however, is significant at 10 percent level in the short run (p value is 0.062). The coefficient of lagged PCE indicates that current apparel prices are likely to increase (or decrease) when the last (or previous) period's personal consumption expenditures were higher (or lower). In other words, one unit increase (decrease) in last quarter's PCE leads to 0.037 units increase (decrease) in current period's CPI or apparel prices. Given that PCE is often used as a predictor of price inflation, the positive association of PCE with CPI is consistent with the information reported in previous studies (Baum and Haltom, 2004).

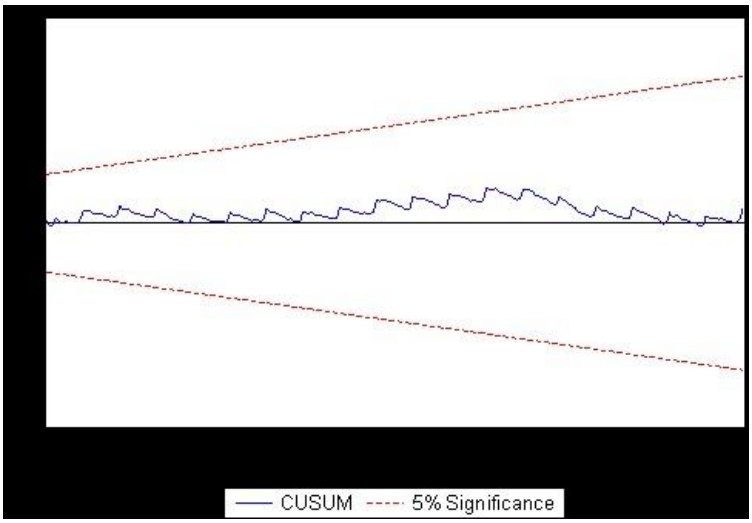


Figure 4: Stability of the VECM, dependent variable Δ CPI_t

Finally, we checked the stability of the Vector Error Correction Model by running the CUSUM test—the Cumulative Sum of Recursive Residual. The results are reported in Figure 4 indicating that our model is stable over time, ie., zigzag line is within two lines. While this may indicate no major structural breaks in price dynamics over the studied period (1992-2013), other stability tests may be needed given the surge of instability post-2007 crisis. The data period, however, was not long enough to employ other tests most efficiently.

SUMMARY AND CONCLUSIONS

In recent years analysts have reported a decline in consumer inflation rates to levels not seen since the early 1960s. Given the general slowdown in the U.S. economy and left shift in aggregate demand, researchers have become concerned about "near inflation prospects" and how price dynamics will unfold in the short-and long-run (Baum and Haltom, 2004:1). Unlike other sectors of the economy, garment retail is subject to unpredictable demand, short-life cycle of

products, price competition and mass production. This leads logically to consider whether apparel prices have dynamics independently of other prices.

The bulk of the research in this area focuses on supply chain practices of retail firms and sales forecasting within a business administration framework. The study's main objective was to examine trends in publicly available data, particularly the short and long-run linkages between apparel price dynamics, which have been relatively understudied by previous researchers. The econometric techniques of unit root and co-integration have not been commonly applied to apparel retail and we hoped to address this issue by exploring statistical properties of our variables. We analyzed in particular the impact of import price index and personal consumption on consumer apparel prices over the period 1992/Q1-2013/Q4.

Our findings indicate that there exists a long run, steady relationship among the variables studied, as indicated by the negative and significant sign of "error correction term". Individually, PCE has a short-run (positive) effect on price increase/decrease for apparel consumption whereas IMPX is statistically insignificant. Overall, the co-integration analysis and VECM indicate that apparel prices are becoming integrated over time but at a very gradual pace.

The results highlight the uses and limitations of time-series analysis for decision-making in apparel retail. While apparel price indicators seem to maintain long-run relationships, they converge to equilibrium at a very slow pace, as indicated by the sign of error correction term (17 percent). By implication, this indicates that any policies aimed at personal consumption (i.e., fiscal stimulus including low interest rates, tax cuts, increase in public spending, etc.) and import price index (lowering trade barriers) will have a "delayed effect" on apparel prices. Although this effect is significant, it is not sufficient to draw policy conclusions and cautions against drawing any generalizations with regard to price setting in apparel sector. This can be the result of multitude of factors not explored in this paper, such as short-life cycle of products, unpredictable demand, opposite trends and lack of long-term data in apparel retail.

Finally, the short-run effect of PCE on CPI indicates that any changes in consumer spending will have a "temporary" effect on apparel prices. After all, prices vary among apparel items and retailers and there is no single cause of price determination in this sector. Therefore, it is necessary to examine firm-level data in addition to sectorial data. Future research should also examine survey and qualitative data that affects consumer demand for fashion goods in different markets, such as disposable income, social class, culture, status, life styles and demographics (gender, age, ethnicity).

Possibilities for future research are comparing price dynamics in other industries. More research is needed on industries where prices are unlikely to behave in the same manner. How prices move in different markets (ie., geographical locations) within the garment industry is another direction of research. For example, using a multivariate co-integration analysis and VECM, Lamba (2005:1) noted that three South Asian equity markets (India, Pakistan, Sri Lanka) are slowly "becoming more integrated with each other" and among them India is most affected price movements in developed markets—U.S., U.K., and Japan. The same type of analysis can be applied to price movements in fashion centers within the U.S. (New York, Los Angeles, Miami) or outside of the U.S.

Short-term over long-term trends are likely to persist in garment industry, although it is too soon to tell without complete data in other variables. This paper revealed some trends and dynamics in apparel sector that are important to both the business community and to researchers.

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Appendix 1. Correlations among variables (assumption of no perfect collinearity)

Correlations among all variables (level form/non-stationary)

	CPI	IMPX	PCE
CPI	1	-0.17	-0.72
IMPX	-0.17	1	0.74
PCE	-0.72	0.74	1

Source: FRED, Federal Reserve St. Louis. Table is author's own using Eviews 8 group statistics.

Correlations among independent variables (level form/non-stationary)

	IMPX	PCE
IMPX	1	0.74
PCE	0.74	1

Source: FRED, Federal Reserve St. Louis. Table is author's own using *Eviews* 8 group statistics

Correlations among independent variables (first difference form/stationary)

	DPCE	DIMPX
DPCE	1.000000	0.132776
DIMPX	0.132776	1.000000

Source: FRED, Federal Reserve St. Louis. Table is author's own using *Eviews* 8 group statistics

Variance Inflation Factors
Date: 07/02/14 Time: 12:17
Sample: 1992Q1 2013Q4
Included observations: 86

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C(1)	0.001703	1.409667	1.409667
C(2)	0.009210	1.150001	1.147577
C(3)	0.019375	1.542669	1.409038
C(4)	0.000392	1.303169	1.025916
C(5)	0.006574	1.389950	NA

Appendix 2. Data for Figure 1 (Retail Trade Employment)

	1990	2011
Cosmetic and beauty supply stores	60,900	111,000
Men's clothing stores	94,200	56,100
Women's clothing stores	360,300	285,100
Children's and infants' clothing stores	34,900	76,300
Family clothing stores	273,700	446,700
Clothing accessories stories	37,900	59,500
Other closing stores	129,300	117,500
Shoe stores	215,900	183,200
Jewelry, luggage, and leather goods stores	166,900	131,700

Source: U.S. Bureau of Labor Statistics, Current Employment Statistics
http://www.bls.gov/spotlight/2012/fashion/
Wholesale and Retail Trade Employment: Current Employment Statistics
Nonfarm payroll employment, fashion-related wholesale and retail
trade industries, annual averages, 1990–2011

Appendix 3. Data for Figure 2

	Total Sales of Clothing and Clothing Accessories (millions of dollars)
1992	119449
1993	124615
1994	128580
1995	131201
1996	136653
1997	140190
1998	148948
1999	159221
2000	167112
2001	167593
2002	172308
2003	178417
2004	189393
2005	200233
2006	213009
2007	221552
2008	217225
2009	205123
2010	213524
2011	228705
2012	240686
2013	248806
percent change	1.082947534 (108.3 % increase)

Source: Percentage change is calculated by dividing the difference (change) between 1992 and 2013 by original (first) number. U.S. Total Sales of Clothing and Clothing Accessories Stores (millions of dollars), Seasonally adjusted sales, US Census Bureau: http://www.census.gov/econ/currentdata/ Business and Industry TIME SERIES / TREND CHARTS

Appendix 4.1. Data for "Stylized Facts"

	New York State	New York State		
	Apparel manufacturing	Apparel manufacturing		
Year	2002	2007		
Production workers wages ($1,000)	570575	307863	-0.46043	46.0 % decrease
Total cost of materials ($1,000)	3272788	1972025	-0.39745	39.7 % decrease
Source: U.S. Census Bureau, County Business Patterns: http://censtats.census.gov/cgi-bin/cbpnaic/cbpdetl.pl				

Appendix 4.2. Data for "Stylized Facts"

	United States	United States		
	Apparel manufacturing	Apparel manufacturing		
Year	2002	2012 (March)		
Number of establishments	13038	6457	-0.504755331	50.48 % decrease
Source: U.S. Census Bureau, County Business Patterns: http://censtats.census.gov/cgi-bin/cbpnaic/cbpdetl.pl				

Appendix 4.3. Data for "Stylized Facts"

	New York State	New York State		
	Apparel manufacturing	Apparel manufacturing		
Year	2002	2012 (March)		
Number of establishments	2530	1128	-0.55415	55.42 % decrease
Number of employees	41366	12639	-0.69446	69.45 % decrease
Source: U.S. Census Bureau, County Business Patterns: http://censtats.census.gov/cgi-bin/cbpnaic/cbpdetl.pl				

Appendix 4.4. Data for "Stylized Facts"

	All Employees: Retail Trade: Clothing and Clothing Accessories Stores, Thousands of Persons, Monthly, Seasonally Adjusted
1992	14994.6
1993	15111.9
1994	15131.5
1995	14956.2
1996	14646.4
1997	14835.3
1998	15229.1
1999	15674.3
2000	15853.9
2001	15856.9
2002	15746.2
2003	15641.6
2004	16378.9
2005	16978.7
2006	17402.5
2007	17974.6
2008	17611.1
2009	16373
2010	16264.7
2011	16354.2
2012	16655.9
2013	16723.5
percent change (1992-2013):	0.115301509
	11.53 % increase
Source: http://research.stlouisfed.org/fred2/series/CES4244800001# FRED Graph Observations, Federal Reserve Economic Data, Link: http://research.stlouisfed.org/fred2, Economic Research Division, Federal Reserve Bank of St. Louis	

Appendix 5. Variables used in Econometric Analysis (VECM)

Y (dependent variable)	CPI	Consumer Price Index for All Urban Consumers: Apparel, Index 1982-84=100, Monthly, Seasonally Adjusted (1992/M01-2013/M12 converted to quarterly metrics)
X1	PCE	Personal consumption expenditures: Nondurable goods: Clothing and footwear, Billions of Dollars, Quarterly, Seasonally Adjusted Annual Rate (1992/Q1-2013/Q4)
X2	IMPX	Import (End Use): Apparel, footwear, and household goods, Index 2000=100, Monthly, Not Seasonally Adjusted (1992/M01-2013/M12 converted to quarterly metrics)
Source	Variables	Federal Reserve St. Louis Data Link: http://research.stlouisfed.org/fred7

Appendix 6. Raw Data Used for Empirical Analysis (VECM): Data in Table 1, Table 2, Table 3, Table 4, Figure 3, and Figure 4.

[1]Drawing from Gereffi et al., (2005), Tokatli and Eldener (2004), Schmitz and Knorringa (2000) among others, Aspers (2010) shows how working with foreign buyers (large retail chains like H&M, Top Shop, Marks & Spencer) allows "functional upgrading" in design and product marketing among apparel manufacturers in less developed countries. Upgrading involves moving from just "assembly production" to a "full package production" with "increased skills content". In the process, firms develop the capacity of interpreting designs, making samples, sourcing the necessary inputs, overseeing product quality, meeting the retailer's price, ensuring "on-time delivery", and even promoting brand development (Aspels, 2010:191).

[2]See especially Hunter et al., (1996), Richardson (1996), Abernathy et al., (1999), Gibbon (2002), Gartner and Stillman (2001), Swoboda et al., (2010), to name a few.

[3]For a review of research in sales forecasting in fashion retail, see Liu et al., (2013). For this line of research, see particularly Courty and Li (1999), Subrahmanyan (2000), Fisher and Rajaram (2000), Choi (2007), Anderson and Simester (2008), Thomassey (2010), Fumi et al., (2013), among others.

[4]There is a wide literature on stationary and co-integrating properties of time-series and panel data in different sectors of the U.S. economy. Much of it concentrates on retail banking, food-beverage retail, energy sector, electronics retail, financial sector. While some focuses on the export sector as a whole, import-export trade and even clothing/apparel manufacturing, there are few studies (to our knowledge) that examine the time-series properties of apparel retail data. For recent research in clothing manufacturers/exporters within a panel framework, see Bairdi et al., (2014).

[5]These figures are subject to change (by a slight amount) due to unadjusted nature of data. The Census Bureau updates the figures periodically. Therefore, the last log in period is taken as the benchmark.

[6]Fashion-apparel retail lacks consistent, monthly data on various subsectors of the industry and different sources operationalize variables differently. Despite general industry codes in Monthly Retail Data (U.S. Census Bureau, 2014), one notices overlapping categories that are classified separately in other sources such as shoe stores, jewelry stores, leather goods, etc. (U.S. Bureau of Labor Statistics, 2014a).

[7]Examining the correlation matrix of the estimated variables, Gujarati (1988:299) suggests that "if the correlation coefficient between two regressors is high, in excess of 0.8, then multicollinearity is a serious problem" (cited in Naguib, 2012:64). Hence, we excluded variables with higher collinearity (in excess of 80 percent). We also instructed *Eviews* to run VIF (Variance Inflation Factors) on VECM output (Appendix 1). Individual VIFs are less than 10 and Mean VIF is less than 5, indicating that there is no serious collinearity problem among variables.

[8]The method/guideline used to generate the quarterly metrics that we used as our measurements for the reader is outlined in *Eviews* software and also in Lardaro (2014:6-7), http://www.uri.edu/artsci/ecn/lardaro/ZV/EViews_Intro.pdf

[9]On this topic, see additionally Liegey (1994) and Clark (1999).

[10]Once the optimal lag is determined via Johansen procedure, *Eviews* 8 performs VECM through Estimate VAR option by automatically converting the variables into first differences. Therefore, we did not have to difference the data manually.