

Competitiveness of Textile and Apparel Industries in the United States and Japan

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ABSTRACT

The purpose of this study was to examine how textile and apparel industry competitiveness in developed countries, namely the United States and Japan, are related to trade and knowledge between 1962 and 2010. This study proposed and tested a theoretical framework to examine the relationship between trade and competitiveness, and between knowledge and competitiveness. The framework was developed based on competitive advantage theory, and the hypotheses were formulated based on comparative advantage theory as well as new growth theory. The Granger causality test was employed to test the hypotheses. No relationship was found between trade and competitiveness in U.S. and Japanese textile and apparel industries. A causal relationship was found between knowledge and competitiveness in the U.S. apparel industry, but not Japanese textile and apparel industries and the U.S. textile industry. The results from this study provide policy implications about how to increase competitiveness of textile and apparel industries.

Keywords: textile and apparel industries, trade balance, productivity, the United States and Japan, competitiveness, Granger causality test

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Scholars believe textile and apparel industries in developed countries are losing their competitiveness (Dickerson, 1999; Taplin & Winterton, 2004). The number of employees and the market share of domestically-produced goods in the developed countries are steadily declining while imports are rapidly increasing. In an attempt to maintain competitiveness in domestic textile and apparel industries, many developed countries actively use trade

policies, such as the Multi Fiber Agreement (MFA), to control the amount of imports (Rivoli, 2014; Weder & Wyss, 2013). The trade policy approach to increase competitiveness of domestic textile and apparel industries generates a substantial amount of research (e.g., Arpan et al., 1982; Blinder, 1990; Krueger, 1996; Murray, 1995); yet, the effect of this approach on industry competitiveness still remains unclear (Beason & Weinstein, 1996).

Another stream of research claims competitiveness in textile and apparel industries in developed countries depends on knowledge—a technical know-how of transforming input factors into output in an efficient way in a production process (Krugman, 1991; Romer, 1986). In other words, how well knowledge is used in transforming input factors to output provides a competitive edge in an industry (Bertacchini & Borrione, 2009). In the context of textile and apparel industries in developed countries, knowledge in design and product development, supply chain management, marketing, and craftsmanship are believed to result in greater competitiveness (Rantisi, 2002). However, to date there is neither research to investigate the effects of knowledge on competitiveness in textile and apparel industries, nor a study to compare the effects of both trade and knowledge on competitiveness in these industries.

To address this gap in literature, this research examined how trade and knowledge were related to competitiveness in textile and apparel industries. Two countries, the United States and Japan, were selected for the study. Both countries had similar levels of economic development (OECD, 2011). However, their approaches to maintain/increase competitiveness of their respective textile and apparel industries were based on different perspectives—trade perspective in the United States and knowledge perspective in Japan (Chapple, 1999; Yoshimatsu, 2000). The authors utilized time series analysis – specifically Granger Causality test, to identify causal relationships between competitiveness and trade and competitiveness knowledge over fifty years. Understanding how the use of different perspectives impacted competitiveness of textile and apparel industries in the United States and Japan might be useful for policy-makers, as well as industry business owners in developing policies and strategies for these industries and businesses.

Literature review

What is competitiveness—How to achieve it?

A significant body of research speaks to the importance of the competitiveness discourse. Scholars agreed competitiveness is an ability to achieve economic prosperity of a society or its standard of living (Aiginger, 2006). Level of income was considered a primary factor determining the standard of living, as well as equity in income distribution and employment level (Aiginger, 2002; Frey & Stutzer, 2002). Scholars believed people with high incomes achieved a higher standard of living than people with low incomes because high income individuals were happier with more material things and enjoyed a higher social status (Frey & Stutzer, 2002). An individual's standard of living was also influenced by equity in income distribution because a person's perception of the standard of living depended on how he / she was doing compared to people around them (Aiginger, 2006; Frey & Stutzer, 2002). Frey and Stutzer (2002) noted whether a person is employed or not also determined the standard of living because unemployment resulted in not only income loss, but psychological cost, such as depression and loss of self-esteem. Even with a well-established stream of research on what competitiveness intended to achieve, understanding how to achieve it was still limited in the current competitiveness discourse (Krugman, 1994), especially, in the field of textile and apparel.

In this study, two prevalent perspectives on how to achieve competitiveness are presented and explained: They include the trade perspective and the knowledge perspective.

Trade and competitiveness. Some scholars believe how well an industry sells its products and how much the same product categories import from the global market—trade—determines competitiveness of an industry (European Commission, 1999). They argue, the larger the total export amount of product categories is than the total import amount of the same product categories in an industry, the better production process the

industry has over its global competitors, resulting in better competitiveness (Clark & Guy 1998; Krugman, 1996). Trade surplus—more exports than imports—generates greater income for industry workers and, as a result, the standard of living for these workers improves. However, this position of the effect of trade on competitiveness is criticized by many scholars, who argue trade among countries is not related to industry competitiveness, but based on final prices of products (Krugman & Obstfeld, 1999; Leamer, 1985).

According to the comparative advantage theory, (Krugman & Obstfeld, 1999), countries have a trade surplus for those types of products manufactured with high technology, such as sophisticated machinery or highly skilled workers, or low labor costs relative to other countries in the world market. In other words, if a country has a trade surplus, its industries have either relatively high technology, lower labor costs, or both in comparison with industries in other countries. In terms of the relationship between trade and competitiveness, trade surplus as a result of low labor costs does not translate into higher incomes for workers (Davies & Ellis, 2000). In this case, if an industry views trade surplus as an indicator of its competitiveness, it maintains or even lowers wages to keep product costs competitive in the global market. This strategy increases the industry's trade surplus, but lowers its workers' incomes and standard of living—opposing competitiveness' goal (Lee & Karpova, in press). Therefore, trade is inconsequential to competitiveness in terms of increasing its workers' standard of living, which is the goal of competitiveness (Davies & Ellis, 2002; Krugman 1996). Based on comparative advantage theory, the following hypotheses are proposed:

H1: Trade is not related to competitiveness in (a) the U.S. textile industry, (b) the U.S. apparel industry, (c) the Japanese textile industry, and (d) the Japanese apparel industry.

Knowledge and competitiveness.

Another group of scholars believe knowledge, not trade, affects competitiveness through increasing productivity (Chikan, 2008). Productivity is the efficiency of a production process to transform input to output (Coelli et al., 2005). An industry with high productivity produces more output with the same inputs, due to its production process efficiency (Coelli et al., 2005). As a result, workers employed in highly productive industries have higher incomes and a higher standard of living and quality of life (Porter, 1990).

Labor is traditionally viewed as the most important input factor determining productivity in textile and the labor-intensive apparel industries (Nordas, 2004). This perspective is criticized for its limitations in explaining why textile and apparel industries in some developed countries with high labor costs, such as Italy or France, still enjoy highly competitive positions in the world market (Bertacchini & Borrione, 2009). To answer this question, scholars utilize a new type of input factor based on new growth theory—knowledge to explain productivity growth in the textile and apparel industries in developed countries (Filippetti, 2010; Rantisi, 2002). Knowledge in textile and apparel industries is a set of specialized technical know-hows in design, product development, supply chain management, marketing, and craftsmanship, which result in higher productivity (Rantisi, 2002). Because it provides high value added products, knowledge in matured textile and apparel industries is indispensable to increasing productivity (Scott, 2006). In developed countries, the effect of knowledge in textile and apparel industries' competitiveness is more substantial to increase productivity than labor costs, where these economically-advanced nations have a comparative disadvantage (Jones, 1998). Based on the new growth theory, the following hypotheses are proposed:

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H2: Knowledge is positively related to competitiveness in (a) the U.S. textile industry, (b) the U.S. apparel industry, (c) the Japanese textile industry, and (d) the Japanese apparel industry.

Method

Measurement

Competitiveness. Competitiveness in this study was defined as an ability to achieve economic prosperity in a society or its standard of living. Three indicators measured standard of living: (1) income per capita for industry growth; (2) employment growth; and (3) income distribution equity growth. In this study, competitiveness was operationalized as growth of income per capita for the textiles and apparel industries in both the U.S. and Japan. This limitation was dictated by two reasons. First, there was great technical difficulty to measure industry employment level because it was measured by the number of employed workers as a percentage of all employed and unemployed workers, not captured at the industry level in both the U.S. and Japanese secondary data sources (Becker & Gray, 2009; Ministry of Economy, Research and Statistics Department, 2005; Ministry of Economy, Research and Statistics Department, 2005–2010; U.S. Bureau of Labor Statistics, 2008;

U.S. Census Bureau, n. d.). Second, data for equity in income distribution at the industry level was unavailable for both countries (U.S. Census Bureau, 2012; Japanese Statistics Bureau, 2008).

In this study, competitiveness was operationalized as per capita income growth for each of the four respective industries—textiles and apparel in both the U.S. (Becker & Gary, 2009; U.S. Census Bureau, n.d.) and Japan (Ministry of Economy, 2005; Ministry of Economy, 2005–2011). Income growth was calculated by the difference between income of the current year and income of the previous year, divided by the value of income from the previous year. Trade was operationalized as TBG. Trade balance (*TB*) was calculated as export minus import. To properly represent positive and negative growth of trade balance, TBG was calculated by the difference between trade balance of the current year and trade balance of the previous year divided by the trade balance from the previous year. Knowledge was operationalized as knowledge growth. The Tornqvist index calculated knowledge growth ($\ln\left(\frac{A_t}{A_{t-1}}\right)$) (Diewert, 1976). The index was called TFPG in the total output function, as described in Equation (1) (Fukao et al., 2003; U.S. Bureau of Labor Statistics, 2009b).

$$\ln\left(\frac{A_t}{A_{t-1}}\right) = \ln\left(\frac{Q_t}{Q_{t-1}}\right) - \left[w_k \left(\ln \frac{K_t}{K_{t-1}} \right) + w_l \left(\ln \frac{L_t}{L_{t-1}} \right) + w_{ip} \left(\ln \frac{IP_t}{IP_{t-1}} \right) \right] \quad (1)$$

where

\ln = the natural logarithm of the variable,

$\ln\left(\frac{A_t}{A_{t-1}}\right)$ = knowledge growth, TFPG,

A = knowledge,

Q = total industry output,

K = capital input,

L = labor input,

IP = intermediate purchases input, and

w_k, w_L, w_{IP} = cost share weights.

The growth of knowledge was calculated as the difference between changes in total output and input factors, namely capital, labor and intermediate inputs including material costs for total output. The weights of capital cost, labor cost, and intermediate purchases cost (w_k, w_L , and w_{IP} , respectively) were cost share weights for each variable. Cost share weights were calculated as the means of the cost shares in two consecutive time periods, shown in Equations (2) and (3) (U.S. Bureau of Labor Statistics, 2009b):

$$w_i = \frac{(s_{i,t} + s_{i,t-1})}{2} \quad (2)$$

$$s_{i,t} = \frac{P_{i,t}x_{i,t}}{\sum(P_{i,t}x_{i,t})} \quad (3)$$

where

$P_{i,t}$ = input price per unit of x_i in period t .

By applying the GDP purchasing power parity (PPP) exchange rate for the data between 1962 and 2010, Japanese data were converted into U.S. dollars to capture the difference in “the relative prices of the goods and services that make up the industry’s output in both countries” (Jorgenson, & Kuroda, 1991, p. 30). The consumer price index **accounted** for inflation effects in yearly monetary data for both countries (Bureau of Labor Statistics, 2012; West, 1983). The year 1985 was chosen as a base year for these calculations because it **was** the midpoint of the research period. Based on the operationalization of major research constructs, research hypotheses were revised. Trade was represented by trade balance growth (TBG), competitiveness was represented by income growth (IG), and knowledge was represented by total factor productivity growth (TFPG).

H1: TBG is not related to IG in (a) the U.S. textile industry, (b) the U.S. apparel industry, (c) the Japanese textile industry, and (d) the Japanese apparel industry.

H2: TFPG is positively related to IG in (a) the U.S. textile industry, (b) the U.S. apparel industry, (c) the Japanese textile industry, and (d) the Japanese apparel industry.

Data collection

Import and export dataⁱ for U.S. textile and apparel products were collected for the 1962–2010 period (U.S. Census Bureau, 1961–1972; U.S. Bureau, 1967–

2011)ⁱⁱ. Import and export data for Japanese textile and apparel were collected for the 1962–2010 period from the Japanese kanzei kyokai (n. d.). Data for total output (Q), capital input (K), labor input (L), and intermediate input (IP) for the U.S. textile and apparelⁱⁱⁱ industries were collected from 1961 to 2005 (Becker & Gary, 2009) and from 2006 to 2010 (U.S. Census Bureau, n.d.). Becker and Gray (2009) accumulated production data, including total output (Q), capital input (K), labor input (L), and intermediate input (IP) for the U.S. textile and apparel industries. Data indicating total output (Q), labor input (L), and intermediate input (IP) for the Japanese textile and apparel industries^{iv} were collected from 1961 to 2011 (Ministry of Economy, 2005; Ministry of Economy, 2005–2011). Capital input (K) data for the Japanese textile and apparel industries were collected from 1962 to 2010 (Ministry of Economy, n. d.). The GDP purchasing power parity exchange rate data for Japanese yen to U.S. dollars were collected from the Organization for Economic Co-operation and Development (n. d.). Consumer price index data were collected from the Bureau of Labor Statistics (2012).

Data analysis

The analysis consisted of two parts: (1) preliminary data analysis and (2) the Granger causality test. Preliminary data analysis included the Granger causality test’s assumption check by conducting a stationarity test. Identification of the Granger causality in two time series variables **was** based on multiple regression analysis, where a dependent variable regressed to variable lags of the dependent variable and an independent variable in question (Granger, 1969). Granger explained the causal relationship of two time series variables as follows (Equations (4) and (5)).

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$$X_t = \sum_{j=1}^m \alpha_j X_{t-j} + \sum_{j=1}^m b_j Y_{t-j} + \varepsilon_t, \quad (4)$$

$$Y_t = \sum_{j=1}^m c_j X_{t-j} + \sum_{j=1}^m d_j Y_{t-j} + \eta_t \quad (5)$$

where

X_t, Y_t = stationary time series variables,

m = number of time lags, and

ε_t, η_t = uncorrelated error terms (white noise).

It was understood Y_t caused X_t when b_j was not zero (Granger, 1969). In the same way, X_t caused Y_t when c_j was not zero. If either b_j or c_j was not zero, there was a feedback relationship between X_t and Y_t (Granger, 1969).

The maximum number of time lags, m , was assumed related to the dependent variable. The number of lags chosen for the test was based on Akaike's (1970) final prediction model procedure (Granger, 1969; Thornton & Batten, 1985). The procedure identified one-tenth of the total number of data points was a good rule to identify the number of lags in a Granger causality test. Since the maximum numbers of total data points in this study were 48 and 49 for the U.S. and Japanese textile and apparel industry data sets, respectively, the number of lags for each model was chosen as five. The following equations, a mathematical expression of the proposed model for the Granger causality test, were utilized in the current study (Equations (6) and (7)).

$$IG_t = \alpha_0 + \sum_{j=1}^5 \alpha_j IG_{t-j} + \sum_{j=1}^5 b_j VAR_{t-j} + \varepsilon_t \quad (6)$$

$$IG_t = \alpha_0 + \sum_{j=1}^5 \alpha_j IG_{t-j} + \sum_{j=1}^5 b_j VAR_{t-j} + \varepsilon_t \quad (7)$$

where

IC_t = income growth, and

VAR_t = one of the two independent variables, TBG or TFPG.

Based on the identified maximum number of time lags, regression models with all possible lag structures were created (Akaike, 1970). To choose a final Granger causality model for hypotheses testing, the authors used the following flowchart for Granger causality model selection (Figure 1). First, regression models with one to five time lags from the dependent variable, and one to five time lags of each independent variable were constructed. Regression analyses were

conducted using SAS to determine which model was appropriate as a final Granger causality model for testing research hypotheses. Statistical significance of the models with different lag structures were tested using F-statistics. The p-value was set at 0.1 for identification of the statistically significant Granger causality regression models (Granger, 1969). After statistically significant models for each hypothesis were identified, the statistical significance of time lags of the dependent variable and Granger causality time lags were identified using t-statistics obtained from the same regression analysis that identified F-statistics for the Granger causality models. All time lags of a

causing variable in the statistically significant regression models had statistically significant t -statistics to confirm the causal effect of a dependent variable (Granger, 1969). The statistical significance of any time lags of a dependent variable did not have any effect on building a causal effect of a causing variable on a dependent variable (Granger, 1969).

Finally, if more than two models had consecutive causal time lags with statistically significant t -statistics, Akaike's information criterion (AIC) and Bayesian information criterion (BIC) were used to identify the final Granger causality model (Ott & Longnecker, 1999).

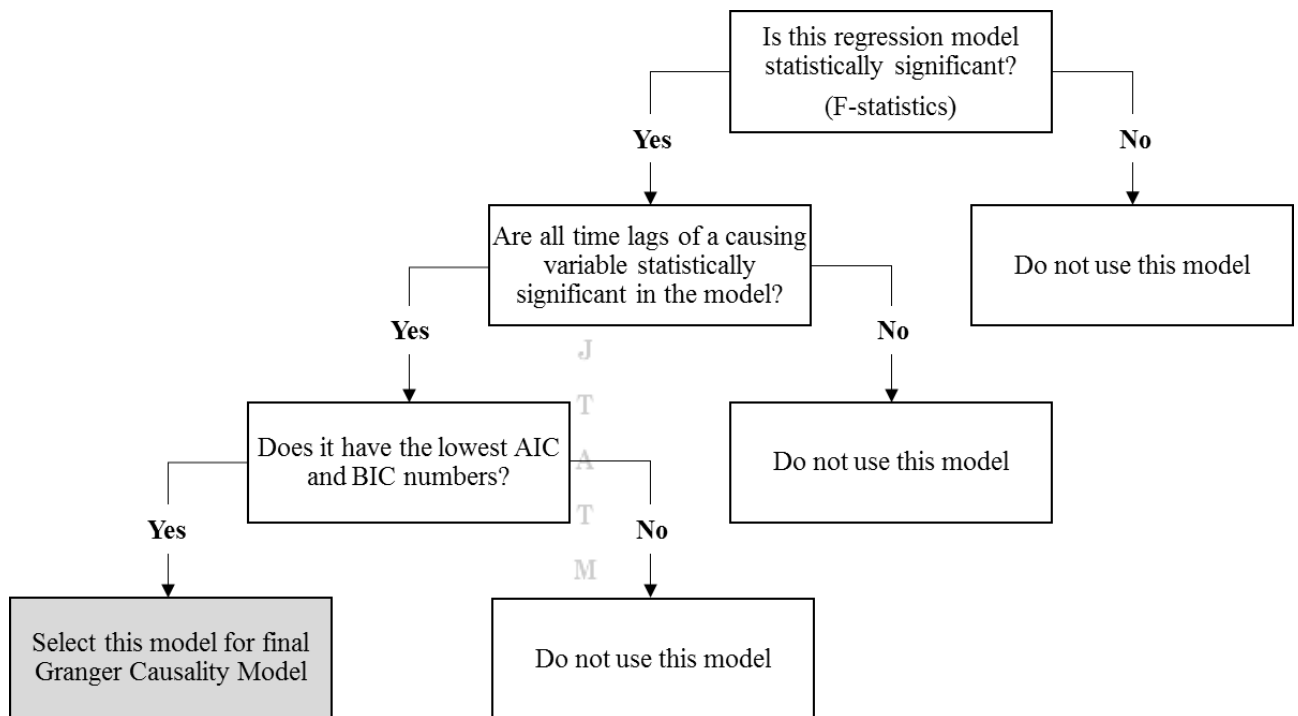


Figure 1. Flowchart of Granger causality model selection.

Preliminary Data Analysis

Outlier detection and stationarity test. Data were checked for outliers as part of the data cleaning procedure before any statistical analysis was completed to avoid a model estimation bias. Outliers were defined as “abnormal observations which are either too large or too small as compared to the rest of the observations” (Zaharim, Rajali, Atok, Ibrahim, & Razali, 2009, p. 363). Based on Cook’s distance analysis, data points of TFPG in the U.S. apparel industry in 2008, and TFPG in the Japanese apparel industry in 1971 were identified as outliers. An examination of the type of outliers (e.g., additive or level shifts) showed the two identified outliers were additive (Jong &

Penzer, 1998), and were deleted to allow for accurate model estimation (Longnecker & Ott, 2004).

To perform the Granger causality test, all variables used to identify causal relationships were stationary (Granger, 1969). Visual analyses of ACF and PACF graphs for income growth, trade balance growth, and productivity growth in the U.S. and Japanese textile and apparel industries demonstrated no identifiable patterns in the data (e. g., gradually decreasing peaks or sudden disappearance of peaks). It was concluded no time correlations existed among data points in the data sets, and alteration of the variables was not necessary.

Results

Granger causality test

Hypotheses 1a-d. To test Hypothesis 1a-d, the statistical significances of the regression models were identified using F -statistics at first (Figure 1). Table 1 shows F -statistics for the Granger causality models that identify the effect of TBG on IG. In the

U.S. textile industry, six of the models explaining the causal effect of TBG on IG had p -values less than 0.1. In the U.S. apparel and Japanese textile industries, none of the models explaining causal effect of TBG on IG had a p -value less than 0.1. In the Japanese apparel industry, 17 of the models explaining causal effect of TBG on IG had p -values less than 0.1 (Table 1).

Table 1. F-Statistics for Granger Causality Models of TBG on IG

	Lags of TBG ⁺⁺	Lags of IG ⁺				
		1	2	3	4	5
U.S. Textile Industry	1	0.469	0.408	0.458	0.61	0.738
	2	0.539	0.29	0.363	0.494	0.601
	3	0.27	0.088*	0.043**	0.072*	0.091*
	4	0.345	0.139	0.077*	0.115	0.142
	5	0.474	0.173	0.086*	0.128	0.181
U.S. Apparel Industry	1	0.136	0.123	0.216	0.241	0.243
	2	0.177	0.188	0.298	0.338	0.33
	3	0.163	0.135	0.206	0.175	0.214
	4	0.249	0.216	0.298	0.251	0.278
	5	0.3	0.285	0.366	0.28	0.346
Japanese Textile Industry	1	0.321	0.413	0.548	0.417	0.386
	2	0.238	0.292	0.378	0.205	0.281
	3	0.221	0.257	0.315	0.145	0.173
	4	0.342	0.369	0.43	0.217	0.243
	5	0.466	0.492	0.547	0.303	0.33
Japanese Apparel Industry	1	0.101	0.046**	0.012**	0.005***	0.009***
	2	0.204	0.091*	0.017**	0.003***	0.005***
	3	0.259	0.113	0.024**	0.007***	0.011**
	4	0.361	0.183	0.045**	0.013**	0.021**
	5	0.451	0.211	0.065*	0.024**	0.036*

Note. *: p -value between 0.05 and 0.1, **: p -value between 0.01 and 0.05.

⁺ The number represents the number of time lags for IG variables represented in the model. For example, 4 means the model had four time lag variables for IG, $\alpha_1IG_{t-1} + \alpha_2IG_{t-2} + \alpha_3IG_{t-3} + \alpha_4IG_{t-4}$.

⁺⁺ The number represents the number of time lags for TBG variables represented in the model. For example, 4 means the model had four time lag variables for TBG, $\beta_1TBG_{t-1} + \beta_2TBG_{t-2} + \beta_3TBG_{t-3} + \beta_4TBG_{t-4}$.

To examine the causal effect of TBG on IG in causal models with significant F -statistics, the authors investigated the lag structure of the statistically significant models for the six U.S. textile industry and seventeen Japanese apparel industry models. All TBG time lags in the statistically significant regression models should have statistically significant t -statistics to confirm the causal effect of TBG on IG. The statistical significance of any IG time lags does not have any effect on building a causal effect of TBG on IG (Granger, 1969). The analyses showed none of the models had statistically significant sets for all TBG time lags in the U.S. textile and Japanese apparel industry models (Table 1). Hypotheses H1a-d, trade balance growth is not related to income

growth in the U.S. and Japanese textile and apparel industries, was supported.

Hypothesis 2a-d. To test Hypothesis 2, statistical significance of regression models was identified using F -statistics at first (Figure 1). Table 2 shows F -statistics of Granger models that identified causal effects of TFPG on IG. In the U.S. textile industry, none of the models explaining causal effect of TFPG on IG had a p -value less than 0.1. In the U.S. apparel industry, 13 of the models explaining causal effect of TFPG on IG had p -values less than 0.1. In the Japanese textile industry, 17 of the models explaining the causal effect of TFPG on IG had p -values less than 0.1. In the Japanese apparel industry, none of the models explaining causal effect of TFPG on IG had a p -value less than 0.1.

Table 2. F-Statistics for Granger Causality Models of TFPG on IG

	Lags of TFPG ⁺⁺	Lags of IG ⁺				
		1	2	3	4	5
U.S. Textile Industry	1	0.785	0.71	0.513	0.653	0.768
	2	0.743	0.648	0.618	0.725	0.821
	3	0.496	0.433	0.463	0.58	0.652
	4	0.555	0.489	0.533	0.638	0.698
	5	0.413	0.292	0.336	0.412	0.492
U.S. Apparel Industry	1	0.040**	0.033**	0.068*	0.103	0.089
	2	0.095*	0.071*	0.125	0.172	0.146
	3	0.097*	0.039**	0.068*	0.059*	0.045**
	4	0.166	0.074*	0.115	0.098*	0.071*
	5	0.255	0.109	0.162	0.152	0.113
Japanese Textile Industry	1	0.36	0.442	0.582	0.39	0.355
	2	0.279	0.406	0.551	0.36	0.375
	3	0.074*	0.129	0.199	0.189	0.193
	4	0.115	0.175	0.255	0.204	0.176
	5	0.184	0.263	0.353	0.286	0.245
Japanese Apparel Industry	1	0.182	0.312	0.296	0.335	0.417
	2	0.317	0.449	0.413	0.452	0.531
	3	0.478	0.599	0.544	0.576	0.648
	4	0.786	0.723	0.664	0.683	0.743
	5	0.748	0.825	0.768	0.78	0.826

Note. *: p -value between 0.05 and 0.1, **: p -value between 0.01 and 0.05.

†: The number represents the number of time lags for IG variables represented in the model. For example, 4 means the model had four time lag variables for IG, $\alpha_1 IG_{t-1} + \alpha_2 IG_{t-2} + \alpha_3 IG_{t-3} + \alpha_4 IG_{t-4}$.

†† The number represents the number of time lags for TFPG variables represented in the model. For example, 4 means the model had four time lag variables for TFPG, $\beta_1 TFPG_{t-1} + \beta_2 TFPG_{t-2} + \beta_3 TFPG_{t-3} + \beta_4 TFPG_{t-4} + \beta_5 TFPG_{t-5}$.

To examine the causal effect of TFPG on IG in causal models with significant F -statistics, the authors investigated the lag structure of the statistically significant models for the thirteen U.S. apparel industry models and one Japanese textile industry significant model (Table 2). All TFPG time lags in the statistically significant regression models should have statistically significant t -statistics to confirm causal effect of TFPG on IG. The statistical significance of any income growth time lags did not have any effect on building causal effect of TFPG on IG (Granger, 1969). An investigation of the significant Granger causality models for the U.S. apparel industry revealed the parameter estimator of TFPG time lags in the causal model with first order income growth time lag (IG_{t-1}) and first order productivity growth time lag ($TFPG_{t-1}$) was statistically significant. All remaining 12 statistically significant models did not have statistically

significant TFPG time lags. Therefore, the lag structure for causal effect of TFPG on IG in the U.S. apparel industry was determined as the model with one TFPG time lag and one IG time lag. For the Japanese apparel industry, the only model with statistical significance did not have all statistically significant TFPG time lags.

The Granger causality test provided evidence of a causal effect of TFPG on IG in the U.S. apparel industry. The results of the analyses showed the model with the first order total factor productivity growth ($TFPG_{t-1}$) and the first order income growth (IG_{t-1}) was statistically significant (Equation (8)). The parameter estimator (0.408) of the first order total factor productivity growth ($TFPG_{t-1}$) showed a positive causal effect of total factor productivity growth on income growth in the U.S. apparel industry.

$$IG_t = -0.003 + (0.408^*) \times TFPG_{t-1} + (0.291^*) \times IG_{t-1} + \varepsilon_t \quad (8)$$

This result was interpreted as follows: if there was a 1% increase in TFPG, there was a 0.408% increase in IG of the U.S. apparel industry workers next year. Hypothesis H2b, total factor productivity is positively related to income growth in the U.S. apparel industry, was supported. Hypotheses H2a, H2c and H2d were rejected. No relationship was determined between total factor productivity growth in the U.S. textile industry and Japanese textile and apparel industries.

The results of the Granger causality test showed the first set of the hypotheses, proposing no causal relationship between trade and competitiveness, was supported for

the four industries: the textile and apparel industries in the United States and Japan. Hypotheses H1a, H1b, H1c, and H1d were supported. The results of the Granger causality test showed the second set of hypotheses, proposing a positive causal effect of knowledge on competitiveness, was partially supported. Hypotheses H2a, H2c, and H2d were not supported. No relationship was found between knowledge and competitiveness in the U.S. textile industry and the Japanese textile and apparel industries. Hypothesis H2b was supported. A positive causal effect of knowledge on competitiveness was found in the U.S. apparel industry (Table 3).

Table 3. Summary of the Research Hypotheses Testing Results

Hypotheses	The United States		Japan	
	Textile industry	Apparel industry	Textile industry	Apparel industry
H1: Trade is not related to competitiveness.	H1a Supported	H1b Supported	H1c Supported	H1d Supported
H2: Knowledge is positively related to competitiveness.	H2a Not supported	H2b Supported	H2c Not supported	H2d Not supported

Discussion and conclusions

In this study, how trade and knowledge affected textile and apparel industry competitiveness in two developed countries, the United States and Japan, over a 48-year period between 1962 and 2010 was examined. This research utilized competitive advantage theory, comparative advantage theory, and new growth theory to develop and test research hypotheses. It was found trade had no effect on competitiveness in the U.S. and Japanese textile and apparel industries. These findings were consistent with previous empirical research (e.g., Ezeala-Harrison, 1995) and comparative advantage theory (Krugman & Obstfeld, 1999). The comparative advantage theory assumed industrial competitiveness was not related to trade balance because a high trade balance meant either a highly productive industry or a low labor cost industry. Therefore, a high trade balance did not guarantee increased welfare of the industry’s workers.

Findings supported the influence of knowledge on competitiveness in the U.S. apparel industry. The identified relationship indicated a 1% increase in knowledge resulted in a 0.408% increase in the U.S. apparel industry competitiveness. No relationship was found between knowledge and competitiveness in the U.S. textile and Japanese textile and apparel industries.

Scholars argued the U.S. apparel industry had decreasing competitiveness because of rapidly increasing imports in the

domestic market (Dickerson, 1999; Taplin & Winterton, 2004). However, in current research it was empirically demonstrated among the four industries included in this study, the U.S. apparel industry was the only industry with a positive effect of knowledge (measured by total factor productivity growth) on industry competitiveness. This might have been a result of two causes: (1) the U.S. apparel industry labor composition and (2) industry structure. The industry was known for its massive restructuring during the 1980s, when most production assembly operations were moved to low labor cost countries. This restructuring resulted in a changing industry labor force—the number of manufacturing, blue-collar jobs declined substantially, while the number of white-collar workers with university degrees continued to increase (Hodges & Karpova, 2006). White-collar professionals were involved in activities that demanded knowledge and expertise to be successful in innovation, product strategy, marketing, and supply chain management, as well as development of strong global brands (Gereffi, Humphrey, & Sturgeon, 2005). In turn, these highly qualified professionals called for higher incomes. This fact was emphasized in Nordas’ study (2009) of the U.S. apparel industry’s labor force composition. Nordas showed the cost proportion of skilled labor in gross output in the U.S. apparel industry (5.8%) was higher than the Japanese apparel industry (4.0%) in 2001. Furthermore, the U.S. apparel industry

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had a unique industry structure, which was the center of buyer-driven commodity chains referred to as “industries in which large retailers, branded marketers, and branded manufactures play the pivotal roles in setting up decentralized production networks in a variety of exporting countries” (Gereffi, 1999, p. 42). Firms in buyer-driven commodity chains generated profits not only from production, but also from high value-added activities, such as research, design, sales, marketing, and financial services, and work as “strategic brokers in linking overseas factories” for creating strong global brands (Gereffi, 1999, p. 43). Many U.S. apparel brands without any domestic production facilities misclassified themselves as apparel manufacturers (NAICS 315) (Ha–Brookshire & Dyer, 2008). For example, Liz Claiborne Inc., a famous global apparel brand, registered as NAICS 315: Apparel Manufacturing, even though the company did not own any production facilities domestically or abroad (Gereffi, 1999).

The investigation of textile and apparel industry competitiveness in the United States and Japan contributed conceptually and practically to the existing body of competitiveness research. Empirically, for the first time, this research examined whether the industry performance in trade and knowledge affected competitiveness in the United States and Japan’s textile and apparel sectors. This was the first study to combine three important economic theories—competitive advantage theory (Porter, 1990), comparative advantage theory (Krugman & Obstfeld, 1999), and new growth theory (Krugman, 1991; Romer, 1986)—to propose and test a theoretical framework. This research demonstrated no relationship between industry performance in trade, measured by trade balance growth, and competitiveness of an industry, measured by the industry workers’ income growth. The findings from this research proved earlier theoretical propositions—no causal relationship existed between trade and competitiveness (Krugman, 1994; Krugman & Obstfeld, 1999; Verma, 2002)

The findings from this research had important practical implications for textile and apparel firms, and policy-makers in developed countries. The research results pointed out how apparel and textile firms and industries in developed countries increased their competitiveness. While the findings of the study did not provide support for the causal relationship between knowledge and competitiveness in the U.S. textile and Japanese textile and apparel industries, this causal relationship was confirmed for the U.S. apparel industry. The discrepancy in the research results could be due to the fact that in the U.S. apparel industry, knowledge played a greater role in competitiveness than in the other three industries. Indeed, the U.S. apparel industry was known to place a stronger focus on high value-added activities, such as innovation and product strategy, marketing, and supply chain management, creating well-known global brands (Gereffi, 1999; Gereffi et al., Humphrey, 2005). The large proportion of high value-added activities in the U.S. apparel industry might have resulted in the growth of knowledge being easier to capture in this study. This result had an implication for other consumer goods industries, such as shoe industries in developed countries. Consequently, these industries might benefit from focusing on high value-added activities.

Professional associations, government officials and policy-makers in the United States and Japan, as well as those in other countries interested in textile and apparel industry competitiveness, can use the results of this study to formulate strategies supporting their domestic industries. Governments should create policies to increase industrial competitiveness of domestic textile and apparel industries. These policies depend on whether an industry focuses on value-added activities, such as innovation, product strategy, marketing, and supply chain management, or not. If an industry is still producing domestically and does not focus on value-added activities, policies should be developed to encourage industry restructuring and increase high value-added activities. If an industry already

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focuses on high value-added activities, policies should be developed to encourage further increases in the industry's productivity. They might invest in the creation, accumulation, and sharing of knowledge in innovation and product strategies, marketing, and supply chain management by encouraging development of industry clusters or agglomerations.

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ⁱBoth U.S. and Japanese textile and apparel import and export data was based on Standard International Trade Classification (SITC) SITC 65 (Textile yarn, fabrics, made-up articles, n.e.s., and related products) for textile data and SITC 84 for apparel data.

ⁱⁱThe years between 1962 and 2010 were chosen because they were the latest possible complete data sets available at the time this research completed data collection.

ⁱⁱⁱThe U.S. textile industry manufacturing data was based on North American Industry

Classification System (NAICS) 313 (Textile Mills) and NAICS 314 (Textile Product). The U.S. apparel industry manufacturing data was based on NAICS 315 (Apparel Manufacturing).

^{iv}The Japanese textile industry manufacturing data was based on Japan Standard Industrial Classification (JSIC) 11 (Manufacture of Textile Products): Textile for the textile industry data and clothing for the apparel industry data.