Competition of Imported Wooden Bedroom Furniture in the United States

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Abstract

The United States has been increasing the import of wooden bedroom furniture from the world to meet its domestic needs. Traditional suppliers have been substituted by developing countries such as China and Vietnam over the past decade. To explain this market structure change, a dynamic Almost Ideal Demand System (AIDS) was employed to analyze this import market. Monthly import data of the top seven countries from 2001 to 2008 were collected from the International Trade Commission. The Engle-Granger cointegration test showed that the cointegration relationships existed in this demand system. Both homogeneity and symmetry properties were not rejected in the dynamic AIDS. The superiorities of dynamic AIDS were also revealed in passing several misspecification tests. The U.S. antidumping investigation on China was effective in the short-run, but the trade diversion occurred from China to Vietnam, Indonesia, and Brazil. Finally, the expenditure elasticities suggested that U.S. consumers would spend more money on the wooden bedroom furniture from Vietnam, China, and Malaysia. All the own-price elasticities were significantly negative and the cross-price elasticities indicated the competition among those suppliers. The results from this study are helpful in understanding the competition among suppliers, the consumer behavior in this market, and the impact of antidumping policy.

Keywords: Almost Ideal Demand System (AIDS), antidumping investigation, Engle-Granger cointegration, wooden bedroom furniture

Introduction

The United States has been experiencing a rapid growth in the consumption of furniture and its furniture industry has made significant contribution to the domestic economy over the last decades. Its domestic retail sales steadily grew in recent years, exceeding $100 billion in 2003 (Gazo and Quesada 2005). According to U.S. Bureau of Census (2006), the total value of shipments of furniture reached $85.6 billion in 2006, which was equal to 5.4 % of the manufacturing industries GDP.

However, an increasing share of the rising furniture demand has been met by the large import from foreign countries. The import value of wooden bedroom furniture climbed from $0.6 billion in 1996 to $3.8 billion in 2006. Traditionally, the United States imported furniture from Canada, Italy, and Taiwan, to name a few. At present, the newly developing countries such as China, Vietnam, and Malaysia have substituted the furniture from traditional suppliers and begun to dominate the U.S. furniture import market in recent years. In particular, China has been leading the wooden bedroom furniture market and accounts for 44% market share over 2001 – 2008. This trade phenomenon has led to serious threat to the furniture industry and aroused wide concerns about the future of the domestic furniture industry. To protect the furniture industry, antidumping investigation (U.S. ITC. 2004) on China was conducted during the period of 2003 and 2005. The final antidumping duties (0.83% – 198.08%) have been imposed on the wooden bedroom furniture from China, but its total import value continues to rise at present.

The objective of this study was threefold. First, the consumer behavior in the imported wooden bedroom furniture was examined in this changing market setting. Second, how different supplier countries compete in this market was analyzed. Third, the effectiveness of the antidumping investigation on China during the period of 2003 – 2005 was evaluated. To complete the above objectives, the dynamic AIDS was employed and various tests were used to examine theoretical properties and model robustness. The results from this study are helpful in understanding the competition among suppliers, the consumer behavior in this market, and the implications of the current policy.

Market Overview

The U.S. import of wooden bedroom furniture (*wbf*) has been steadily growing over the period of 1996 – 2008, as shown in Figure 1. U.S. monthly import value was about $50 million in 1996 and reached its peak value of $353.8 million in August 2005. *Bed* is one of the major products of wooden bedroom furniture as defined by the International Trade Commission (ITC). There was an upward trend over the same period. The rapid growth of imported *wbf* was largely due to the increasing import of *bed* from all over the world. In 1996, *bed*'s monthly import value was about $10 million, one fifth of *wbf*. It rapidly climbed to $100 million per month since 2004, about one third of *wbf*.

Traditionally speaking, the U.S. mainly imported the *bed* from suppliers such as Canada, Indonesia, and Italy. The newly developing Asian countries such as China and Vietnam have demonstrated their potentials to dominate the U.S. market. China has been steadily increasing its export to the U.S and become the leading supplier in the U.S. market since 2001. The import

value from China was only \$5.6 million in 1996, but climbed to \$418 million in 2008, accounting for 35.4% market share. Although the annual export value of Vietnam was lesser than China, it still was an important supplier in the U.S. import furniture market. Vietnam began to export its *bed* to U.S. from 2001 and hit \$357.80 million in 2008, closely following China.
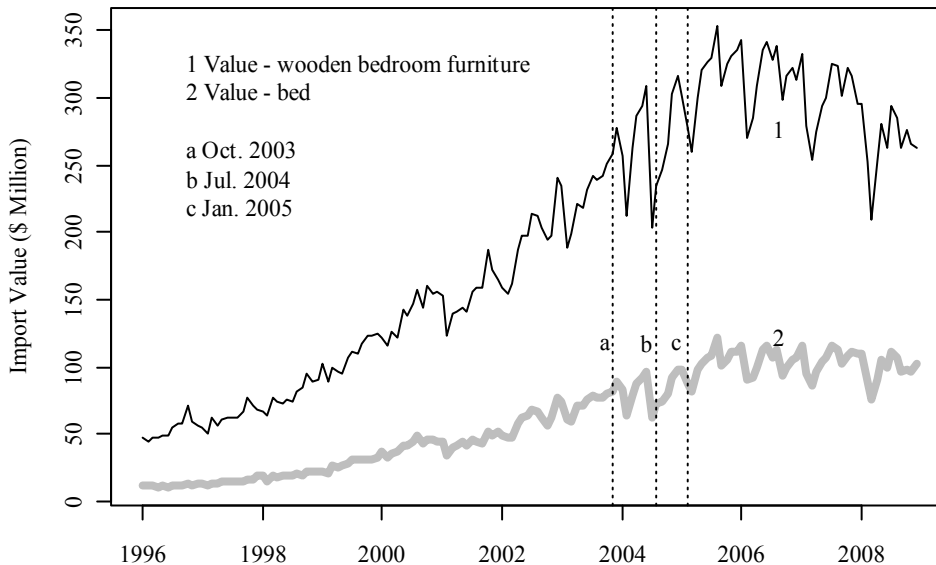

Figure 1. Monthly import value of *wbf* and *bed* from January 1996 to December 2008

Methodology

In this study, a dynamic AIDS was employed to examine the consumer behavior, evaluate the competition among different supplier countries, and assess the effectiveness of antidumping investigation in the imported wooden bedroom furniture market. The seminal AIDS created by Deaton and Muellbauer (1980) has become one of the most popular demand analysis tools for researchers over the past three decades. The frequent application of AIDS over the other demand models is largely due to its outstanding advantages.

AIDS is highly consistent with consumer theory. It can exactly satisfy the axiom of choice. AIDS is also a desirable and flexible demand system, which can take different functional forms to incorporate dynamic factors. Various function forms have been applied in the empirical demand studies so far. Anderson and Blundell (1982)first put forward the dynamic adjustment of consumers' expenditure. With the development of econometric techniques, autoregressive distributed lagged technique allows for several periods of short-run adjustments to long-run equilibrium status in AIDS.

Due to the superiorities mentioned above, dynamic AIDS has been widely used in consumer's expenditure on food (Balcombe and Davis 1996; Karagiannis and Mergos 2002), meat products (Fanelli and Mazzocchi 2002; Karagiannis et al. 2000), olive oil consumption (Duffy 2003), and alcohol market (Seale et al. 2003). It also has been employed frequently in the field of tourism demand analysis worldwide (De Mello and Fortuna 2005; Li et al. 2004)

Considering this imported *bed* market, AIDS can be derived from minimizing the *bed* expenditure function to attain a specific utility level at given prices. It can be expressed as the functions of the logarithms of prices and total expenditure in the following system:

$$(1) \qquad s_i = \alpha_i + \sum_{j=1}^{n} \gamma_{ij} \ln p_j + \beta_i \ln(x/P^*) + \delta_i D_i + \varepsilon_i$$

where s_i is budget share of imported *wbf* from supplier country i ($i = 1,2,\ldots,7$). p_j is the price of *bed* from country j, x is the total expenditure on all of the imported *bed*. The Stone's Price Index is the linear approximation to original price index P, which usually takes the form of $\log p^* = \sum_{i=1}^{n} s_i \log p_i$. Then x is deflated by P^* to get the real total expenditure x/P^*. D_i ($i = 1$) is the antidumping policy dummy, and ε_i is the normal disturbance term with zero mean and constant variance.

To comply with the economic theories, the system of equation [1] is required to satisfy the properties of adding-up, homogeneity, symmetry, and negativity. The adding-up property implies that the sum of all budget shares equals to one, which requires $\sum_i \alpha_i = 1$; $\sum_i \beta_i = 0$; $\sum_i \gamma_i = 0$

Homogeneity requires $\sum_j \gamma_{ij} = 0$ and suggests that the proportional change in the expenditure and all of the prices has no impact on the quantities purchased or the budget allocation. Symmetry implies that the matrix of the price derivatives is symmetric, $\gamma_{ij} = \gamma_{ji}$.

In this study, time series property of all the variables have been investigated by Augmented Dickey-Fuller (ADF) unit root test first. The Engle-Granger (1987)cointegration and error correction techniques are integrated into the AIDS to consider both long-run and short-run consumer behavior. The dynamic AIDS (Feleke and Kilmer 2007; Karagiannis et al. 2000)can be formulated as follows:

$$(2) \qquad \Delta s_{it} = \psi_i \Delta s_{i,t-1} + \sum_{j=1}^{n} \gamma_{ijt} \Delta \ln p_{jt} + \beta_i \Delta \ln(x_t/P_t^*) + \eta_i ECT_{it} + \delta_i D_{it} + u_{it}$$

Δ is the first-difference operator and ψ measures how the habit persistence influences the current consumption. ECT is calculated as $ECT_i = a_i + \sum_{j=1}^{n} \gamma_{ij} \ln p_j + \beta_i \ln(x/P^*) + \delta_i D_i - s_i$ and η measures the speed of short-run adjustment.

In the specification of above models, the adequacy of the models should be examined, especially in modeling dynamic AIDS. First, the data used in this study are time series data which are often auto correlated. The Breusch-Godfrey (BG) test is used to test the hypothesis of no serial correlation in those variables. Second, the assumption of homoscedasticity means that the variance is constant at each observation point. A failure of this assumption may result in the invalid inferences. The Breusch-Pagan (BP) test is employed to test heteroscedasticity. The assumption of normally distributed error term is tested by Jarque-Bera LM test. For the test of functional misspecification, Ramsey's Regression Specification Error Test (RESET) is adopted.

In addition, the assumption of parameter constancy is tested by cumulated sum of squares (CUSUMSQ).

Researchers and policymakers are usually interested in the expenditure elasticity, own-price elasticity, and cross-price elasticity. In this study, all those elasticities were calculated by the estimated parameters from AIDS and the average budget shares (s_i) throughout the whole sample period. The formulas are listed as follows:

(3)   Expenditure elasticity: $\eta_i = 1 + \left(\dfrac{\beta_i}{s_i}\right)$

(4)   Marshallian (uncompensated) elasticity: $\varepsilon_{ij}^M = -\delta_{ij} + \dfrac{\gamma_{ij}}{s_i} - \beta_i(\dfrac{s_j}{s_i})$

(5)   Hicksian (compensated) elasticity: $\varepsilon_{ij}^H = -\delta_{ij} + \dfrac{\gamma_{ij}}{s_i} + s_j$

where $\delta_{ij} = 1$ if $i = j$ and $\delta_{ij} = 0$ if $i \neq j$. In addition, both long-run and short-run elasticities can be calculated by the above formula.

Data Sources and Variables

In order to analyze the consumer behavior and competition in this import market, several factors were taken into consideration in this study. First, the definition of imported wooden bedroom furniture was introduced. The subject of this study was mainly focused on the specific furniture under HTS9403.50.9040, which is defined as the wooden furniture of a kind used in the bedroom (*bed)* by International Trade Commission (ITC). Second, the time period covered from January 2001 to December 2008. One major reason was that this market structure has undergone a dramatic change during the past decade. Another important reason was that Vietnam began to export its *bed* to the United States from January 2001 and has experienced tremendous growth in this market during the period of 2001 – 2008. Hence, to analyze the current market structure and the competition among newly developing countries, this study focused on the period from January 2001 to December 2008.

After identification of the time period, major and representative suppliers need to be selected. The aggregate import value of top seven suppliers represented 85% of the total import during the period of 2001 and 2008. They were China (44.2%), Vietnam (11.7%), Indonesia (7.8%), Malaysia (6.4%), Canada (6.3%), Brazil (4.4%), and Italy (4.2%). All the other countries were aggregated into the Rest-of-world (ROW) (15.0%). Next, the monthly cost-insurance-freight (*CIF*) (dollars) and quantity (piece) data were collected from ITC to construct the variables in AIDS. The total expenditure was the total *CIF* value of *bed* imported from all over the world. The budget share of each supplier was the percentage of the *CIF* value of that supplier over the total expenditure. The import price measured by the unit value of imported *bed* was calculated as *CIF* value over quantity.

Empirical Results

Model estimation and tests

The time series properties of budget share, import price, and total expenditure were formally examined by ADF unit root test first. All the results were listed in Table 1. The null hypothesis of unit root in budget share failed to reject at 5% significance level, which suggested that all of them had unit roots over 2001 – 2008. All of the import prices were not stationary except Malaysia and Canada. Finally, the ADF test suggested that the total expenditure also had unit root. However, all the first-difference variables were stationary. These results indicated that the level of data series were integrated in order 1, but the first-difference data were zero.

The next step was to examine the long-run equilibrium relationship in the imported *bed* market by Engle-Granger cointegration test. The results in Table 2 indicated that all the equations were cointegrated at the 5% significance level. Due to the existence of long-run relationship in this market, the dynamic AIDS can be further established to consider the short-run consumer behavior. After the first-difference of all the variables, the dynamic AIDS [2] were estimated by SURE again.

Table 1. ADF unit root test of budget share, import price, and total expenditure Jan. 2001 to Dec. 2008

Variable	Level ADF					First-differenced ADF		
	T & C	Trend	None	Lag	Order	None	Lag	Order
Budget share								
s.CN	-2.54	-1.77	-0.92	12	I(1)	-1.68	11	I(0)
s.VN	-1.92	1.50	2.35	11	I(1)	-2.96	10	I(0)
s.ID	-2.22	-2.60	-1.34	10	I(1)	-3.93	9	I(0)
s.MY	-1.93	-1.34	0.22	1	I(1)	-15.81	0	I(0)
s.CA	-2.25	-2.33	-3.90	10	I(1)	-4.73	9	I(0)
s.BR	-1.73	-0.44	-1.08	8	I(1)	-5.97	7	I(0)
s.IT	-3.05	-1.21	-1.94	9	I(1)	-2.90	8	I(0)
s.ROW	-0.01	-2.08	-1.13	11	I(1)	-2.56	10	I(0)
Import price								
ln(p.CN)	-1.58	-1.96	0.53	11	I(1)	-6.28	10	I(0)
ln(p.VN)	-1.69	-1.40	-0.57	11	I(1)	-6.80	10	I(0)
ln(p.ID)	-2.41	-2.25	0.77	2	I(1)	-11.17	1	I(0)
ln(p.MY)	-4.52	—	—	3	I(0)	—	—	—
ln(p.CA)	-4.06	—	—	6	I(0)	—	—	—
ln(p.BR)	-3.20	-3.36	-0.93	7	I(1)	-6.10	6	I(0)
ln(p.IT)	-2.60	-1.53	0.60	1	I(1)	-15.48	0	I(0)
ln(p.ROW)	-3.98	-3.02	0.28	1	I(1)	-14.58	0	I(0)
Total expenditure								
ln(TotExp)	-1.49	-2.15	1.97	4	I(1)	-9.03	3	I(0)

Table 2. Cointegration test of equations in AIDS

Equation	ADF (T & C)	ADF (T)	ADF (N)	Lag	Cointegrated?
eq. China	-2.60	-2.06	-2.07	3	Yes
eq. Vietnam	-2.28	-1.19	-3.07	1	Yes
eq. Indonesia	-2.46	-2.33	-2.33	6	Yes
eq. Malaysia	-3.43	-2.70	-2.70	4	Yes
eq. Canada	-3.31	-3.04	-3.07	4	Yes
eq. Brazil	-5.54	—	—	3	Yes
eq. Italy	-4.81	—	—	9	Yes

As mentioned previously, misspecification tests were essential for the parameter explanation and further elasticity calculation. A summary of misspecification tests in dynamic AIDS were presented in Table 3. All the error terms did not have serial correlation problems at the 1% significance level by BG test. The results of BP test indicated that all the error terms have constant variance. In addition, all the functions except Italy were correctly specified at the 1% significance level. The error terms in five out of seven equations were normally distributed. The hypothesis of stable parameters failed to reject in all the equations. Therefore, the superiorities of the dynamic AIDS were further supported by passing those misspecification tests.

Demand elasticities

In this study, the long-run expenditure, own-price, and cross-price elasticities were calculated by the formula [3], [4], and [5] from the estimated parameters of equilibrium AIDS. The short-run elasticities were calculated by the coefficients of dynamic AIDS with the same formula.

Both long-run and short-run expenditure elasticities and their p-values were given in Table 4. All the long-run expenditure elasticities were positive and statistically significant at 1% significance level except Canada and Italy. The demand of *bed* from Vietnam, Malaysia, and China were elastic. Among them, Vietnam had the highest expenditure elasticity of 2.737, followed by Malaysia with 1.977 and China with 1.130. These results indicated that the more expenditure spent on the imported bed, the more *bed* would be imported from Vietnam, Malaysia, and China in the long-run. As for the short-run expenditure elasticities, all of them except Canada were also positive and statistically significant at 1% significance level. Vietnam and China were detected as the major supplier countries in the short-run.

With regard to the change of quantity in response of own-price, Marshallian own-price elasticities were calculated and listed in Table 5. Both long-run and short-run values were negative and significantly at the 1% significance level, as expected from consumer theories. All the values were elastic and sensitive to the change of its own price in addition to China. In addition, both long-run and short-run own-price elasticities of China were relatively lower than the other competitors. This result implied that trade policy in order to increase the price of bed from China would have limited impacts on its demand quantities, which was consistent the ineffectiveness of antidumping investigation on China.

Table 3. Misspecification tests of dynamic AIDS

Equation	BG	BP	RESET	J-B	CUSUMSQ
eq. China	0.01**	0.93	0.76	0.48	0.40
eq. Vietnam	0.10*	0.91	0.05*	0.00***	0.06*
eq. Indonesia	0.06*	0.11	0.02**	0.26	0.71
eq. Malaysia	0.31	0.35	0.07	0.43	0.20
eq. Canada	0.02**	0.34	0.10	0.61	0.88
eq. Brazil	0.07*	0.74	0.30	0.01**	0.78
eq. Italy	0.09*	0.32	0.00***	0.00***	0.02**

***, **, * denotes significance at 1%, 5%, and 10%, respectively.

Table 4. Long-run and short-run expenditure elasticity

Country	Long-run		Short-run	
	Estimates	p-value	Estimates	p-value
China	1.130	0.000	1.352	0.000
Vietnam	2.737	0.000	1.358	0.000
Indonesia	0.561	0.000	0.594	0.000
Malaysia	1.977	0.000	0.713	0.000
Canada	-0.636	0.000	-0.126	0.890
Brazil	0.865	0.000	0.762	0.000
Italy	-0.417	0.017	0.745	0.004
ROW	0.197	0.002	0.629	0.000

Hicksian cross-price elasticities were calculated under the assumption of keeping the utility constant. The short-run cross-price elasticities were reported in Table 6. If the price of *bed* from China went up by 1%, the imported quantities from Vietnam and Malaysia went up by 0.43% and 0.53%, respectively. The results suggested that the *bed* from China can be substituted by the import from Vietnam and Malaysia. In contrast, the 1% increase of price from Vietnam and Malaysia resulted in the 0.11% and 0.08% increase of import from China. Moreover, the degrees of substitution were asymmetric. Malaysia and Vietnam had higher cross-price elasticities than China to each of them.

Antidumping investigation effects

The purpose of antidumping policy on China was to curtail the import from China, and furthermore, to protect the furniture industry in the United States. In this study, both the long-run and short-run antidumping effects were detected in the AIDS, listed in Table 7. In the long-run, after the preliminary determination was implemented to collect antidumping duties in July 2004, the imports share of China decreased by 6.3% while the import from Vietnam, Indonesia, and Brazil increased by 3.9%, 0.9%, and 2.6%, respectively. This result indicated that the reduction of import from China diverted to the other countries such as Vietnam, Indonesia, and Brazil. In the short-run, the import from China decreased by 13.8%, but the import value from Vietnam, Indonesia, and Brazil increased by 5.4%, 2.2%, and 2.0% at the same time. There was a sharp drop of China's budget share and were sudden jumps of Vietnam, Indonesia, and Brazil.

Table 5. Long-run and short-run Marshallian own-price elasticity

Country	Long-run		Short-run	
	Estimates	p-value	Estimates	p-value
China	-0.503	0.001	-0.886	0.000
Vietnam	-2.743	0.000	-1.010	0.000
Indonesia	-1.003	0.000	-0.972	0.000
Malaysia	-1.074	0.000	-1.108	0.000
Canada	-1.041	0.000	-1.037	0.000
Brazil	-1.151	0.000	-1.025	0.000
Italy	-1.195	0.000	-1.056	0.000
ROW	-0.741	0.000	-0.909	0.000

Table 6. Short-run Hicksian cross-price elasticity

Impact on demand	Change in price of							
	China	Vietnam	Indonesia	Malaysia	Canada	Brazil	Italy	ROW
China	—	0.113	0.011	0.076	-0.021	0.017	0.023	0.069
	—	(0.001)†	(0.733)	(0.000)	(0.402)	(0.428)	(0.298)	(0.092)
Vietnam	0.427	—	0.134	-0.034	0.097	0.016	0.094	0.117
	(0.001)	—	(0.078)	(0.556)	(0.152)	(0.763)	(0.055)	(0.218)
Indonesia	0.061	0.201	—	0.068	0.241	0.043	0.007	0.305
	(0.733)	(0.078)	—	(0.386)	(0.004)	(0.546)	(0.905)	(0.009)
Malaysia	0.530	-0.063	0.084	—	0.148	0.090	0.099	0.174
	(0.000)	(0.556)	(0.386)	—	(0.063)	(0.148)	(0.072)	(0.092)
Canada	-0.150	0.180	0.298	0.148	—	0.193	-0.012	0.387
	(0.402)	(0.152)	(0.004)	(0.063)	—	(0.008)	(0.862)	(0.002)
Brazil	0.174	0.043	0.075	0.128	0.274	—	0.103	0.194
	(0.428)	(0.763)	(0.546)	(0.148)	(0.008)	—	(0.204)	(0.200)
Italy	0.249	0.265	0.014	0.151	-0.018	0.111	—	0.253
	(0.298)	(0.055)	(0.905)	(0.072)	(0.862)	(0.204)	—	(0.115)
ROW	0.202	0.091	0.159	0.073	0.162	0.057	0.069	—
	(0.092)	(0.218)	(0.009)	(0.092)	(0.002)	(0.200)	(0.115)	—

Table 7. Long-run and short-run antidumping investigation effects

Dummy	China	Vietnam	Indonesia	Malaysia	Canada	Brazil	Italy
Long-run effect							
Antidumping †	-0.063	0.039	0.009	-0.014	-0.007	0.026[**]	-0.012
Short-run effect							
Antidumping †	-0.138[***]	0.054[***]	0.022[*]	0.002	-0.004	0.020[**]	0.000

Antidumping †: Imposed antidumping duties from July 2004.

Conclusions

The United States has been increasing the import of wooden bedroom furniture from the world to meet its domestic needs. Over the last decade, traditional suppliers have been substituted by the newly developing countries in Asia such as China and Vietnam. The antidumping investigation against China was implemented by ITC in order to protect the furniture industry in the U.S. To explain this market structure change, dynamic AIDS was employed to analyze the consumer behavior, and furthermore, evaluate the effectiveness of this antidumping investigation. Monthly disaggregate data of the top seven suppliers from 2001 to 2008 were collected from the ITC.

The empirical results in this study reached several conclusions about the consumer behavior, market competition, and antidumping effectiveness in this market. First, both consumers' long-run and short-run choices on the imported wooden bedroom furniture were detected. The expenditure elasticities disclosed that the U.S. consumers will spend more expenditure on the wooden bedroom furniture imported from Vietnam, Malaysia, and China in the long-run. Among them, Vietnam has demonstrated its great potential to be the top one supplier to the U.S. market. As indicated by the own-price elasticities, the imported quantities from most countries were sensitive to the change of its own price in both short-run and long-run. In particular, Vietnam had the highest own-price elasticity. In particular, both long-run and short-run own-price elasticities of China were inelastic, which indicated the less sensitive change in response of price and further explained the ineffectiveness of antidumping investigation.

The degrees of competition and substitution were revealed by the cross-price elasticities between those supplier countries. The degree of substitution among those pairs was not symmetric. The potential of Vietnam to dominate this market were further proved its significant cross-price elasticities in both long-run and short-run. The cross-price elasticities were relatively small, which were not elastic. The small magnitude of those cross-price elasticities implied that they were far from perfect substitutes. These results further indicated that the U.S. consumers do have different preferences on the imported wooden bedroom furniture from all over the world.

As a trade protection instrument, antidumping investigation did not work as it intended to reduce the import. The affirmative determination and imposition of antidumping duties led to 13.8% drop on the import value of China. However, the trade diversion took place from China to Vietnam, Indonesia, and Brazil at the same time, which was consistent with the discussion by Brenton (2001). Overall, the effectiveness of this antidumping policy was not obvious, which can be further evidenced by the continuous growth of total import value.

This study brings up several interesting questions. For example, the competition among domestic and imported *bed* can be further studied, which will describe a more accurate picture of this market. However, the same definition of *bed* and sales data are needed to incorporate into this demand system. Moreover, whether this market is integrated or not is also of great interest. Further examining the welfare change after the implementation of antidumping policy can improve our understanding of the benefits of domestic retailer, producers, and consumers.

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