Abstract

Forest products are an important component of the U.S. economy through consumption, investment, and trade. With rapid economic growth in parts of the world, and with new trade liberalization policies, the volume and value of U.S. forest product trade has been increasing. The exchange rate has been commonly perceived as the most important macroeconomic variable affecting trade flows of forest products. U.S. forest industries competing internationally have argued strongly for depreciation policies, as this would presumably improve their competitiveness in the world markets. This study reports that deviations in the U.S. exchange rate contemporaneously affect exports and trade balances in selected forest product trade, while imports do not respond simultaneously to exchange rate innovations. However, a shock in the exchange rate has long-lasting effects on future forest product trade components. A shock in exports does not affect imports in the short run, but slightly affects import levels in the long-run. A shock in imports affects current and future exports with the re-exporting patterns.

Keywords: Vector autoregression, exchange rate, impulse response functions, lumber trade

Introduction

Forest products (e.g., wood, wood pulp, paper and paper board) are one of the important components of the U.S. economy through consumption, investment, and trade. With rapid economic growth in parts of the world, and with new trade liberalization policies, the volume and value of the U.S. forest product trade has been increasing. In this paper, I define forest product trade using Harmonized Schedule (HS) code 44 (Wood), 47 (Pulp of wood), and 48 (Paper and paperboard). Baek (2007) defines forest product trade based on the Bulk, Intermediate, and Consumer-Oriented (BICO) code. The different definitions yield different data and results associated with U.S. forest product trade. The exchange rate has been commonly perceived as the most important macroeconomic variable affecting trade flow of forest products. The U.S. forest industries competing internationally have argued strongly for depreciation policies, as this would presumably improve their competitiveness in the world markets. As quoted in Bolkesjø and Buongiorno (2006), representatives of the U.S. forest industries have called forcefully for policies that would decrease the value of the U.S. dollar. In fact, the U.S. forest product trade has been in a deficit since 1989 while the value of the U.S. dollar, on
average, increased against the Canadian dollar in 1992-1995, 1997-1999, and 2000-2002. However, with the fall in the value of the U.S. dollar since 2002, the U.S. trade deficit in forest products has broadened to its peak in 2005 at about $17 billion dollar, up 56.14% from 2002. Therefore, the U.S. forest industry may slightly grasp the price advantage from depreciation exchange rate policies or there might be exogenous factors affecting the industries’ competitiveness rather than the exchange rate.

Previous studies on the relationship between exchanges rates and international forest product trade have found different results. They mainly focus on the impacts of exchange rate changes on forest product trade volume and prices. The earliest empirical studies defined import price elasticity as the elasticity of import with respect to exchange rates (Adams et al. 1986; Buongiorno et al. 1979; Wisdom and Granskog 2003). Employing the vector autoregression (VAR) model, the previous studies have experienced no exchange rate effect on U.S. lumber imports from Canada between 1974 and 1985 (Buongiorno et al. 1988), only some short term exchange rate effects on Swedish and Finnish forest products exports to the U.S. (Uusivuori and Buongiorno 1990) and both short- and long-run exchange rate effects the U.S. forest product trade (Bolkesjø and Buongiorno 2006). With a descriptive method, McCarl and Haynes (1985) explain that exchange rates influence the softwood lumber trade between the U.S. and its trading partners. The authors summarize that an increasing exchange rate encourages imports and discourages exports into the country, which acts as an implicit import subsidy (tax) for foreign (domestic) producers.

Sarker (1993) finds no short-term effect, but a significant equilibrium relationship between Canadian lumber exports and the Canada–U.S. exchange rate. Jee and Yu (2001) include exchange rates in a multivariate cointegration model of U.S. demand for Canadian newsprint, and they find a significant long-run exchange-rate elasticity of -1.46, using monthly data from May 1988 to December 1996. Wisdom and Granskog (2003) conclude that exchange rates are an important determinant of southern pine exports because changes in exchange rates affect southern pine exports by changing the cost of southern wood in the foreign market. Only two studies have investigated the effect of changes in exchange rate on the U.S. forest product trade balance. Based on a descriptive method, Kaiser (1984) finds that the depreciation of the U.S. dollar is one of the most effective trade policies to increase U.S. forest products exports and thus to stabilize the U.S. trade balance. Baek (2007), on the other hand, adopts the autoregressive distributed lag (ARDL) approach to cointegration, which is to estimate quarterly bilateral trade data between the U.S. and Canada from 1989 to 2005. He also finds that in the short run a change in the value of the U.S. dollar is not a significant factor influencing the U.S. trade in forest products. To our knowledge, there is no related study discovering dynamic patterns of the forest product trade rather than offering the long run exchange rate effects on the U.S. trade value (Bolkesjø and Buongiorno 2006) or offering no exchange rates effects on the U.S. trade balance (Baek 2007).

This paper hypothesizes that there is a relationship between forest product trade (i.e. imports and exports or trade balance) and exchange rate. There are also interrelationships between imports and exports in forest products. This paper differs from those mentioned above in that the objective is to observe dynamic patterns of forest product trade using a structural model of disaggregated trade value. Because different categories of forest products may behave in
different ways, analysis by category is important. In addition, an exchange rate shock may have
an effect that plays out over several years. If so, then cross-section models without lags will
underestimate the total effect of change in exchange rate. To mitigate this problem, we estimate
VAR models for six selected categories of U.S.-Canada forest products imports, exports, and
trade balance. Using various trade shocks and exchange rate shocks, this article exhibits impulse
response functions (IRFs) that describe the response of imports, exports, and trade balance to
exogenous shocks over several periods. Implications of this study could help policy makers to
better understand the dynamic patterns in each forest product market. The remaining sections
present the data, model, empirical results, and implications.

Data

The trade data employed in this article are monthly U.S.-Canada export and import values (in
$1000 U.S. dollars) of selected forest products, from January 1989 to May 2007 (221
observations in each series), gathered from the database of Foreign Agricultural Service, United
States Department of Agriculture (USDA). We selected the U.S.-Canada imports and exports in
six categories based on the 4 digit Harmonized Schedule (HS). The detail of selected forest
products is presented in Table 1. The exchange rate data, or value of Canadian currency in U.S.
dollars, are monthly averages, compiled from the Federal Reserve Bank of St. Louis and Board
of Governors of the Federal Reserve System. The exchange rates vary considerably from January
1989 to May 2007. In the model, the data are converted to a natural logarithm form.

To produce consistent estimates, the data must be stationary across time. Therefore we
performed the Augmented Dickey-Fuller (ADF) unit root test for stationary testing. All data
series are difference stationary where the error term in each series has white-noise properties
tested with Ljung-Box’s Q statistics.

Model

The VAR model treats all variables as jointly endogenous. Each variable is allowed to depend on
its past realization and the real past realizations of all other variables in the system. In addition,
the most basic form of a VAR treats all variables symmetrically without making reference to the
issue of dependence versus independence (Enders 2004). Although this VAR is not derived from
any theoretical model, its tools (i.e. Granger causality, impulse response analysis, and variance
decompositions) can be helpful in understanding the interrelationships among economic
variables and in the formulation of a more structured economic model.
Table 1. Descriptive statistics regarding the data used in the analysis

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean  ($1000)</th>
<th>S.D.  ($1000)</th>
<th>Min  ($1000)</th>
<th>Max  ($1000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood sawn or chipped lengthwise, sliced or peeled (HS 4407)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exports</td>
<td>36,516.62</td>
<td>7,769.62</td>
<td>17,767</td>
<td>55,814</td>
</tr>
<tr>
<td>Imports</td>
<td>442,741.80</td>
<td>140,977.90</td>
<td>146,541</td>
<td>722,963</td>
</tr>
<tr>
<td>Sheets for veneer, for plywood or for similar laminated wood and other wood, sawn lengthwise (HS 4408)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exports</td>
<td>7,697.55</td>
<td>4,533.36</td>
<td>1,251</td>
<td>16,534</td>
</tr>
<tr>
<td>Imports</td>
<td>19,883.23</td>
<td>8,193.37</td>
<td>6,322</td>
<td>39,542</td>
</tr>
<tr>
<td>Particle board, oriented strand board (OSB) and similar board of wood or other ligneous materials (HS 4410)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exports</td>
<td>4,873.08</td>
<td>2,143.37</td>
<td>1,198</td>
<td>10,971</td>
</tr>
<tr>
<td>Imports</td>
<td>97,412.63</td>
<td>74,824.80</td>
<td>7,846</td>
<td>351,199</td>
</tr>
<tr>
<td>Chemical woodpulp, soda or sulfate, other than dissolving grades (HS 4703)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exports</td>
<td>6,703.31</td>
<td>2,292.82</td>
<td>2,788</td>
<td>14,293</td>
</tr>
<tr>
<td>Imports</td>
<td>159,512.60</td>
<td>33,376.79</td>
<td>96,307</td>
<td>261,258</td>
</tr>
<tr>
<td>Newsprint, in rolls or sheets (HS 4801)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exports</td>
<td>1,529.17</td>
<td>1,023.28</td>
<td>184</td>
<td>4,300</td>
</tr>
<tr>
<td>Imports</td>
<td>292,025.10</td>
<td>47,192.98</td>
<td>190,445</td>
<td>449,625</td>
</tr>
<tr>
<td>Uncoated kraft paper and paperboard, in rolls or sheets, other than that of heading 4802 or 4803 (HS 4804)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exports</td>
<td>18,786.74</td>
<td>9,794.86</td>
<td>2,050</td>
<td>47,028</td>
</tr>
<tr>
<td>Imports</td>
<td>25,151.01</td>
<td>9,335.72</td>
<td>3,222</td>
<td>42,997</td>
</tr>
<tr>
<td>Exchange rate (CAD/1 $U.S.)</td>
<td>1.3349</td>
<td>0.14</td>
<td>1.0951</td>
<td>1.5997</td>
</tr>
</tbody>
</table>

Suppose we have three variables, we can let the time path of each variable be affected by current and past realizations of each variable sequence. Consider the simple system with one lag:

\[ x_t = b_{10} - b_{12} y_t - b_{13} z_t + \gamma_{11} x_{t-1} + \gamma_{12} y_{t-1} + \gamma_{13} z_{t-1} + \varepsilon_{xt} \]  
\[ y_t = b_{20} - b_{21} x_t - b_{23} z_t + \gamma_{21} x_{t-1} + \gamma_{22} y_{t-1} + \gamma_{23} z_{t-1} + \varepsilon_{yt} \]  
\[ z_t = b_{30} - b_{31} x_t - b_{32} y_t + \gamma_{31} x_{t-1} + \gamma_{32} y_{t-1} + \gamma_{33} z_{t-1} + \varepsilon_{zt} \]  

where it is assumed that all left hand side (LHS) variables are stationary. The error terms, \( \varepsilon_{xt} \), \( \varepsilon_{yt} \), and \( \varepsilon_{zt} \), are white-noise disturbances with standard deviations of \( \sigma_x \), \( \sigma_y \), and \( \sigma_z \) respectively and are uncorrelated white-noise disturbances.

Equations (1)-(3) are the structure of the system incorporating feedback. The LHS variables are allowed to contemporaneously and continuously (long run effect) affect each other. \( \varepsilon_{xt} \), \( \varepsilon_{yt} \), and \( \varepsilon_{zt} \), are pure innovations (or shocks) in \( x_t \), \( y_t \), and \( z_t \) respectively. In addition, for example, \( \varepsilon_{xt} \) could have an indirect contemporaneous effect on \( y_t \) and/or \( z_t \) if \( b_{12} \) and/or \( b_{13} \) are not equal to zero.

Using matrix algebra, we can write the system in the compact form:

\[
\begin{pmatrix}
1 \\
 b_{21} \\
 b_{31}
\end{pmatrix}
\begin{pmatrix}
x_t \\
y_t \\
z_t
\end{pmatrix}
= 
\begin{pmatrix}
b_{10} \\
b_{20} \\
b_{30}
\end{pmatrix}
+ 
\begin{pmatrix}
\gamma_{11} & \gamma_{12} & \gamma_{13} \\
\gamma_{21} & \gamma_{22} & \gamma_{23} \\
\gamma_{31} & \gamma_{32} & \gamma_{33}
\end{pmatrix}
\begin{pmatrix}
x_{t-1} \\
y_{t-1} \\
z_{t-1}
\end{pmatrix}
+ 
\begin{pmatrix}
\varepsilon_{xt} \\
\varepsilon_{yt} \\
\varepsilon_{zt}
\end{pmatrix}
\]
or $Bv_t = \Gamma_0 + \Gamma_1 v_{t-1} + \varepsilon_t$

where $B = \begin{pmatrix} 1 & b_{12} & b_{13} \\ b_{21} & 1 & b_{23} \\ b_{31} & b_{32} & 1 \end{pmatrix}$, $v_t = \begin{pmatrix} x_t \\ y_t \\ z_t \end{pmatrix}$, $\Gamma_0 = \begin{pmatrix} b_{10} \\ b_{20} \\ b_{30} \end{pmatrix}$,

$\Gamma_1 = \begin{pmatrix} \gamma_{11} & \gamma_{12} & \gamma_{13} \\ \gamma_{21} & \gamma_{22} & \gamma_{23} \\ \gamma_{31} & \gamma_{32} & \gamma_{33} \end{pmatrix}$, $\varepsilon_t = \begin{pmatrix} \varepsilon_{xt} \\ \varepsilon_{yt} \\ \varepsilon_{zt} \end{pmatrix}$

Premultiplication by $B^{-1}$ allows us to obtain the VAR model in standard form

$v_t = A_0 + A_1 v_{t-1} + \varepsilon_t$ (4)

In this paper, we estimate

$v_t = A_0 + A_1 v_{t-1} + A_2 v_{t-2} + ... + A_T v_{t-T} + \varepsilon_t$ (5)

where $v_t$ is defined as the vector of variables with first difference of natural logarithms, and $T$ is the total number of lags used in the model.

We test for the number of lags using Akaike’s Information Criterion (AIC) and Schwarz’s Information Criterion (SIC). The optimum lag length is twelve lags, which are necessary and sufficient to satisfy the requirement of independent and identical distribution in regression. In addition, a 12 month lag is enough to account for seasonal variations in trade. Therefore, we lose 13 observations for each data series by using 12 lags, so our final regressions are based on 208 observations. With the assumption of $\varepsilon_t$ and unrestricted VAR, we estimate the system of equations by ordinary least squares (OLS) equation by equation, which yields the same estimates as maximum likelihood method (Hamilton 1994). Briefly, six unrestricted VAR models were estimated with twelve lags of each variable and a constant term.

After estimating six VARs, we apply impulse response analysis to quantify and graphically depict the time path of the effects of typical shocks on imports and exports. In equation (5), a VAR can be written in the vector of Moving Average ($MA(\infty)$) form as

$v_t = \mu + \varepsilon_t + \Psi_1 \varepsilon_{t-1} + \Psi_2 \varepsilon_{t-2} + ...$ (6)

A plot of the row $i$, column $j$ element of $\Psi$,

$\frac{\partial v_{t+s}^i}{\partial \varepsilon_t^j}$ (7)
as a function of $s$ is called the impulse response function. It is a practical way to visually represent the behavior of each series in response to the various shocks. It describes the response of $y_{i,s}$ to a one-time impulse in $y_{j,t}$ with all other variables dated $t$ or earlier held constant including whether it converges back to its long run trend, and if so, whether it converges smoothly or with oscillation (Hamilton 1994).

**Empirical Results**

Our task is to observe the behavior of forest product trade in each category in response to the various shocks using VAR and its application. An impulse response function traces the effect of a one standard deviation shock to one of the innovations on current and future values of the endogenous variables. Therefore, we could determine the impact multiplier (short-run effect) and the long-run multiplier (long-run effect) as the dynamic patterns in each endogenous variable. Because the variables in the VAR are stationary, a shock in the system would cause variables differentiating (if any) from the initial level. We hypothesize that a shock in the exchange rate that suggests an increasing exchange rate (CAD/ 1 $U.S.$) from the initial level would discourage exports and encourage imports at least in the short-run, unless there are some factors more important than the effect of exchange rate to offset the response. The response of the exchange rate, exports, and imports to its own positive shock theoretically must be positive in the short-run.

This paper allows a shock in exports to affect imports and vice versa in order to observe the relationship between product transactions. Since the passage of NAFTA, international transactions between U.S.-Canada should be higher than in the past. Re-exporting behavior is expected in the short-run for some products. The notation of trade transaction variables includes the following: $DLB1 =$ the different import value of product 1 in natural logarithms; $DLS1 =$ the different export value of product 1 in natural logarithms; and $DLEX =$ the different value of exchange rate in natural logarithms.

We impose a one standard deviation shock in each variable, which directly affects its own variable and is also transmitted to all of the endogenous variables through the dynamic structure of the VAR. In this paper, we compute all dynamic patterns in the disaggregated forest product trade response to various shocks as impulse response functions.

A shock to the exchange rate (Figure 1) shows that there is a positive short-run effect about 1.2% in the first month and then the different dynamic patterns with oscillatory long-run effect before adjusting to the steady state after 22nd month.
In this study, we find that a shock in exchange rate has no effect on imports in the short-run in all observed markets. These results are consistent to Bolkesjø and Buongiorno (2006), who found no statistically significant difference from zero for the same product estimated in the short-run. In addition, a shock in exports affects nothing in the level of imports. It means that any export promotion policies would not reduce significantly in the imports amount. In contrast, a positive shock in imports does affect a positive change in exports, which explains the availability of re-export pattern in the forest products industries.

**Sawn wood or chipped wood market**

In the sawn wood or chipped wood market, an own shock of imports or exports affects contemporaneously about 10% in the relative change for value of imports and about 8% for the value of exports. A positive shock in exchange rate would affect exports negatively about 1.2% in the short run. Impulse response functions present interesting information when we observe a shock in imports to exports and vice versa. In the short-run, there is no response from the imports to a shock in exports, while we observe about 4% change of exports response to a shock in imports. The pattern of re-export in this market confirms our hypothesis.

In the longer run, the effect to its own shock would be lower with no seasonal effects in the imports, but we observe seasonal effects in the exports even though they would be lower over time. The steady state could be reached after 30 months. The effects of the shock in exchange rate would take place in both trade transactions with different patterns. For the imports, we observe high fluctuation in the value for a year and the patterns will turn to the steady state after
18 months. We find slight oscillation patterns along the 30 months period response to a shock in exchange rate. For the cross shocks of imports and exports, there is a seasonal pattern for imports without the steady state trend, while a seasonal pattern for exports could be observed with diminishment in the relative change over time.

**Veneer sheets and sheets for plywood**

In the veneer sheets and sheets for plywood market, imports and exports response to its own shock is about 8% and 11% respectively. There is no short-run effect from the imports to a shock in exchange rate, while there is tiny short-run effect (less than 0.04%) from the exports to a shock in exchange rate. We observe no short-run effect from trade response to exchange rate in this market. A shock in imports shows the re-export patterns as the positive response to the shock of 2.7% however, imports did not respond to a shock in exports.

The long-run effects response to its own shock of imports and exports are quite similar, containing seasonal patterns and diminishing the effect over time. A shock in exchange rate would affect imports less than an oscillation of 1%, and there would be steady state (if any) beyond the 30 months period. For exports, the oscillation with seasonal effect could be observed and the effect would reduce over time with the expected steady state. The seasonal patterns would be lower after 24 months in the case of a shock in imports to exports, and there would be some fluctuation over time in the imports after a shock in the exports also.

**Particle board market**

In the particle board market, imports and exports respond to their own shock more than 12% in the short-run. A shock in exchange rate does not affect imports, but slightly decreases exports by about 0.3%. A shock in exports does not affect imports in the short-run, while a shock in imports supports a slight increase in the exports about 0.9%.

Imports and exports respond to their own shock. They all decrease below the initial level in the first 5 months before having oscillation patterns and tending to the steady state after 30 months. In the case of a shock in exchange rate, there would be some fluctuation in the imports and exports over time. The imports tend to reach a steady state after 30 months, and exports tend to reach a steady state after about 22 months. Both imports and exports respond to the cross shocks in the oscillation patterns, and tend to become steady after 30 months.

**Chemical wood pulp market**

There would be a positive response to an increase in various shocks, but there is no effect in the imports to a shock in exchange rate and exports. Each individual shock would increase imports and exports by more than 8% and 15% respectively. A shock in exchange rate would increase only exports by about 1%. A shock in imports again, confirms the re-export hypothesis with an increase of about 7.4% of exports.

Even though the response to its own shock of imports takes about 22 months to become steady, imports and exports, in general, tend to reach a steady state after 15 months responding to the
shocks. The dynamic patterns in this market are the shortest period among the markets in this study.

**Newsprint, in rolls or sheets market**

In this market, imports and exports respond contemporaneously to their own shock at about 5% for imports and almost 30% for exports. There is no effect in the short-run for imports if we impose either a shock in exchange rate or a shock in exports. We observe a negative short-run effect on exports when we impose a shock in exchange rate, but a positive short-run effect when we impose a shock in exports.

The dynamic patterns for an import’s response to its own shock contain lower seasonal effect over time and could reach a steady state after 30 months. The dynamic patterns for exports show no evidence of seasonal effect, and a steady state could be reached after 30 months. We observe the steady state in exports after a shock in exchange rate or a shock in imports. The effects from either shock last about 15 months. For imports, the long-run effect reaches a steady state after 30 months with different patterns. We find more oscillation patterns of import response to exports than response to exchange rate.

**Uncoated kraft paper and paper board, in rolls or sheets market**

In the kraft paper and paper board market of the study, imports and exports respond simultaneously to their own shock about 10% of the time. Imposing a shock in exchange rate or exports has no effect on imports in the short-run, but there is a positive effect in exports response to each shock of about 0.4% and 3% respectively. We observe the re-export pattern in this market.

For its own shock, imports and exports oscillate positively and negatively at 2% of the initial level for 16 months before reaching the steady state. In the response to a shock in exchange rate/imports/exports, imports and exports would turn to a steady state faster than other markets, with the starting point at 15 months.

**U.S. trade balance**

To examine the dynamic effects of exchange rate changes on the U.S. trade balance, we can simplify equations (1)-(5) from 3 dimensions (e.g., a 3×3 matrix) into 2 dimensions (e.g., a 2×2 matrix). We define the U.S. trade balance as the ratio of imports to exports for each product group with Canada. Because the U.S. trade balance in each period informs us about a trade deficit, we observe the dynamic patterns between the trade deficit in each market and the exchange rate. Then, using a similar method of estimation, we can plot the IRFs for the trade balance in each product to the shock of exchange rate. With the VAR, we could observe contemporaneously and continuously the responses of trade deficit and exchange rate in each market. However, we do not know a priori that how much the trade surplus would be after a shock in the case that we have a positive relationship in the short-run for each VAR. We could observe only the direction of the responses not the quantified amount. All information is presented in Figure 2.
In the short-run, imposing a shock in exchange rate, we find that there contain positive and contemporaneous effects in every market. The observed positive direction means that a positive shock in exchange rate would deteriorate the trade deficit. On the other hand, depreciation policies would slow down the problem of trade balance deficits in some levels. However, these results could not guarantee the competitiveness of the industries under depreciation policies. Based on the previous computation, the improved short–run trade balance deficit came from the positive side of exports extension only. Therefore, there is no evidence that depreciation policies would improve the competitiveness in the forest product trade, but only reduce the trade deficit in the first five markets or increase some value of exports. In the long run, all dynamic patterns would alternate in sign and start turning to a steady state at 15 months, except for sawn wood at 30 months.

Figure 2. Impulse response functions of the U.S. trade balance

Implications

In this article, we consider the possibility that changes in exchange rate, imports, and exports affect trade transactions in forest product markets, not only contemporaneously but also over time. We present impulse response functions (IRFs) that describe the response of imports, exports, and trade balance deficits to exogenous shocks in exchange rate and related components. Because various categories of forest product trade may behave differently, analysis by category is important; aggregation may obscure significant responses within categories. We examined six forest product trades, sawnwood, veneer sheets, particle board, chemical pulp, newsprint, kraft paper, and paper board, under the Vector Autoregression (VAR) using the monthly data of U.S.-Canada bilateral trade.
We find that these data series are different stationary, suggesting that shocks to exchange rate or endogenous variables do not lead to permanent changes in the imports or exports. Our IRFs reveal significant dynamic responses to changes in exchange rate or trade components as those variables return to their initial levels following a shock. Furthermore, the effects persist for several years. These dynamic responses suggest that theoretical models of international trade or related policies may be incomplete if they cannot explain the dependence of current trade components on the history of past exchange rate as well as on past imports, exports, or the trade balance.

In the case of the imports and exports model, we find that exchange rate does not affect U.S. imports in the short run. This finding substantiates the results of Buongiorno et al. (1988) and Bolkesjø and Buongiorno (2006). In contrast, exchange rate affects U.S. exports in the short run. This information is consistent with Bolkesjø and Buongiorno (2006). In addition, we discover the latest information that exports do not affect imports in the short-run, while imports affect exports. It implies that there is re-exporting patterns in the U.S. forest product trade. For the trade balance, we find little positive effect of the U.S.–Canada trade in five forest products, which is in contrast to Baek (2007). This implies that, in the short-run, a change in the value of the U.S. dollar slightly influences the U.S. trade in forest products, but is not a major factor to improve trade balance or competitiveness. This study finds that the exchange rate plays an essential role in determining the long-run behavior of the U.S. trade in forest products. This result substantiates the results of Kaiser (1984), Adams et al. (1986), Sarker (1993), Bolkesjø and Buongiorno (2006), and Baek (2007). These results yield two conclusions: 1) past information or lag of forest product trade variables matters to predict current and future forest product trade variables, and 2) the dynamic patterns of these intertemporal patterns may assist policy makers and decision-makers in better understanding the future effects of current decisions especially for depreciation policies or trade protection policies.

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