The Real Exchange Rate and the Balance of Trade in US Tourism

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International Review of Economics and Finance (2012)

Abstract. This paper investigates the effects of the real exchange rate and income on US tourism export revenue and import spending with quarterly data for the floating exchange period from 1973 to 2010. Separate estimates of export revenue and import spending functions prove more revealing than estimates of the trade balance. Vector autoregressions capture dynamic adjustments to exchange rate and income shocks. Depreciation raises US tourism export revenue but does not affect import spending. US tourists going abroad respond to income while foreign tourists coming to the US do not.

Tourism is a growing component of the US trade balance in the international current account. The US has had a surplus in tourism since the 1990s with tourism receipts accounting for over 5% of export revenue in 2010. The US ranks first in tourism receipts and second in spending (UNWTO, 2011).

Following depreciation the trade balance may exhibit a J-curve, falling at first due to set contracts but rising over time. Empirical evidence on the J-curve is mixed. There are J-curve studies at the industrial trade level but the present is the first to explicitly examine tourism trade. Tourism might be more sensitive to exchange rates than other trade.

The present paper estimates US tourism export revenue and import spending separately with quarterly data from 1973 through 2010. The following section discusses the theoretical framework with export revenue and import spending functions of the real exchange rate and income. A review of the applied J-curve literature on disaggregated data follows. The third section presents the vector autoregressive model followed by a section on results.

2. Theoretical Framework

Socher (1986) makes the point that tourism had not been explicitly integrated into trade theory as has more recently been done by Hazari and Ng (1993), Hazari (1995), Hazari and Nowak (2003), and Hazari and Sgro (2004).

Vogt (2008) estimates US tourism export and import demands with annual data from 1973 to 2002 in partial adjustment models with error correction. Vogt finds that US tourists are more sensitive to the real exchange rate while foreign tourists to the US are more sensitive to real income. Results differ in the present study with quarterly data extended through 2010 and vector autoregressive methods, revealing foreign tourists to the US are more sensitive to the exchange rate while US tourists are more sensitive to income.

The present study adopts a two-country partial equilibrium model between the US and the rest of the world ROW. International and domestic tourism are imperfect substitutes especially for cultural and natural resource attractions. The present assumption of imperfect substitutes follows Rhomberg (1973), Magee (1975), Goldstein and Khan (1985), and Rose and Yellen (1989).

Dollar depreciation raises the price of foreign tourism for US tourists. Depreciation also lowers the foreign currency price for foreign tourists coming to the US. US demand for tourism abroad and foreign demand for tourism in the US are assumed to depend on respective incomes.

Various measures have been put forth to investigate the effects of depreciation on the trade balance. Goldstein and Khan (1978) and Rosenweig and Koch (1988) examine volume indices while Houthakker and Magee (1969), Senhadji (1998a), and Senhadji and Montenegro (1999) utilize real export revenue and import spending. Rose (1991) examines the difference between export revenue X and import spending M in BOT = X – M, and Demirden and Pastine (1995) and Senhadji (1998b) utilize the ratio of the trade balance to national income BOT/Y.

Haynes and Stone (1982) propose the ratio X/M as utilized by Bahmani-Oskoosee and Brooks (1999), Boyd, Caporale and Smith (2001), and Onafowora (2003). The present study similarly defines the tourism trade balance B as the ratio of export revenue X to import spending M. With lower case letters indicating natural logarithms, b = x – m. A rise in the real exchange rate R = EP*/P would lower the quantity of imports and raise the quantity of exports. In natural log form, the real exchange rate is r = e – p + p*.

Export revenue and import spending functions are specified as

$$x = a_0 + a_1 y^* + a_2 r + \varepsilon \qquad (1)$$

$$m = b_0 + b_1 y + b_2 r + \nu \qquad (2)$$

where y and y* are home and foreign incomes. The trade balance becomes

$$b = (a_0 - b_0) + a_1 y^* - b_1 y + (a_2 - b_2) r + (\varepsilon - \nu) \qquad (3)$$

The Marshall-Lerner coefficient $(a_2 - b_2)$ is the condition for depreciation to raise the trade balance. The sum of absolute values of elasticities of export and import demands must exceed unity, assuming balanced trade initially.

The J-curve effect is the hypothesis that the balance of trade falls immediately following a depreciation due to previously arranged contracts but rises after an adjustment lag as developed by Magee (1973) and Junz and Rhomberg (1973) and reviewed by Bahmani-Oskooee and Ratha (2004). Empirical results are mixed but methodology has developed over the years.

Some studies investigate sector specific responses to depreciation. Meade (1988) finds no J-curve adjustment for non-oil industrial supplies, capital goods excluding automobiles, and consumer goods. Doroodian, Jung and Boyd (1999) report a J-curve effect for agriculture but not manufacturing. Yazici (2006) finds an S-curve for the balance of trade in Turkish agriculture, rising initially before falling and finally increasing. In export and import data for 66 US industries, Ardalani and Bahmani-Oskooee (2007) find the J-curve for only 6 industries in an error correction model. Goldstein and Khan (1985) point out that aggregation across different products may bias estimates and disguise different underlying adjustments.

The present paper estimates export revenue and import spending functions separately. Estimating the trade balance (4) directly in fact disguises the effects of the exchange rate and income on US tourists. The trade balance model cannot capture adjustment dynamics of export revenue and import spending functions. The present vector autoregressive (VAR) methods, impulse response functions, and variance decomposition analysis capture these dynamic adjustment processes.

3. Econometric Model

We employ three vector autoregressive VAR models. First, the export model is based on a tri-variate VAR(p) with the exchange rate $\mathrm{r_t}$, tourism export $\mathrm{x_t}$, and foreign income $\mathrm{y_t^*}$. Second, the import model is based on a tri-variate VAR(p) with the exchange rate, tourism import $\mathrm{m_t}$, and home income $\mathrm{y_t}$. Third, the tourism trade balance model is a quad-variate VAR(p) with the exchange rate, tourism trade balance $\mathrm{b_t = x_t - m_t}$, and a vector of the income variable, $\mathbf{y}_t = [\mathrm{y_t} \quad \mathrm{y_t^*}]'$. All variables are real and natural logarithms.

In all three models, $\mathrm{r_t}$ is placed the first assuming that the exchange rate is not contemporaneously affected by other variables during the quarter. The trade variables ($\mathrm{x_t}$, $\mathrm{m_t}$, $\mathrm{b_t}$) are ordered second in each model, prior to income, assuming tourism decisions are made in advance.

We propose the following VAR(p) model for these variables with deterministic trends,

$$\mathbf{x}_\mathrm{t} = \mathbf{A}\mathbf{d}_\mathbf{t} + \mathbf{B}(\mathrm{L})\mathbf{x}_{\mathrm{t}-1} + \mathbf{C}\mathbf{u}_{\mathrm{t},} \qquad (5)$$

where

$$\mathbf{d_t} = \begin{bmatrix} 1 \\ t \end{bmatrix}, \qquad \mathbf{x}_t = \begin{cases} [r_t \quad x_t \quad y_t^*]' & \text{(Exports)} \\ [r_t \quad m_t \quad y_t]' & \text{(Imports)} \\ [r_t \quad b_t \quad \mathbf{y}_t{}']' & \text{(Trade Balance)} \end{cases}$$

and $\mathbf{A}$ is a coefficient matrix for the deterministic terms, $\mathbf{B}(L)$ denotes the lag polynomial matrix, $\mathbf{u}_t$ is a vector of normalized underlying structural shocks, that is, $E\mathbf{u}_t\mathbf{u}_t' = \mathbf{I}$ where $\mathbf{I}$ is the identity matrix, and $\mathbf{C}$ is a matrix that describes the contemporaneous structural relationships among the endogenous variables. The term $E\mathbf{C}\mathbf{u}_t\mathbf{u}_t'\mathbf{C}' = \mathbf{\Sigma}$ is the variance-covariance matrix estimator from the reduced form VAR. The vector $\mathbf{x}_t$ is 3x1 for the export and import models and 4x1 for the trade balance model.

Assuming the system is invertible (5) can be rewritten as the following infinite order vector moving average representation[1]

$$\tilde{\mathbf{x}}_t = \mathbf{D}(L)\mathbf{C}\mathbf{u}_t = \sum_{s=0}^{\infty} \mathbf{D}_s\mathbf{C}\mathbf{u}_{t-s} \qquad (6)$$

where $\tilde{\mathbf{x}}_t$ is a vector of demeaned and detrended variables, $\mathbf{D}(L) = (\mathbf{I} - \mathbf{B}(L))^{-1}$, $\mathbf{D_0} = \mathbf{I}$, and $\mathbf{D}(L)\mathbf{C}$ is the matrix of moving average polynomials providing impulse-response functions.

Note that (6) enters the variance decomposition analysis. For example, the one-period ahead forecast error is $\boldsymbol{\eta}_{t+1} = \tilde{\mathbf{x}}_{t+1} - E_t\tilde{\mathbf{x}}_{t+1} = \mathbf{D}_0\mathbf{C}\mathbf{u}_{t+1} = \mathbf{C}\mathbf{u}_{t+1}$ so that the one-period ahead forecast variance becomes $\boldsymbol{\upsilon}_{t+1} = E_t\boldsymbol{\eta}_{t+1}\boldsymbol{\eta}_{t+1}' = \mathbf{C}\mathbf{C}'$. Likewise, the k-period ahead forecast error $\boldsymbol{\eta}_{t+k} = \tilde{\mathbf{x}}_{t+k} - E_t\tilde{\mathbf{x}}_{t+k} = \sum_{j=0}^{k-1} \mathbf{D_j}\mathbf{C}\mathbf{u}_{t+k-j}$ yields forecast error variance $\boldsymbol{\upsilon}_{t+k} = E_t\boldsymbol{\eta}_{t+k}\boldsymbol{\eta}_{t+k}' = \sum_{j=0}^{k-1} \mathbf{D}_j\mathbf{C}\,\mathbf{C}'\mathbf{D}_j'$. Note that, for instance, the relative contribution of the innovation in r_t for $E_t x_{t+k}$ in the export model can be obtained by $\boldsymbol{\upsilon}_{t+k}^{2,1}/(\boldsymbol{\upsilon}_{t+k}^{2,1} + \boldsymbol{\upsilon}_{t+k}^{2,2} + \boldsymbol{\upsilon}_{t+k}^{2,3})$, where $\boldsymbol{\upsilon}_{t+k}^{i,j}$ is the $(i,j)^{th}$ element of $\boldsymbol{\upsilon}_{t+k}$.

4. Empirical Results

The source of tourism data that include travel and air fares is the International Transactions Accounts of the Bureau of Economic Analysis. Export revenue and import spending are deflated by the

[1] The system is invertible and thus can be represented as a moving average process when all eigenvalues of the companion matrix of (5) are less than one in norm. See Hamilton (1994) for details.

US GDP deflator. The real exchange rate index is the Federal Reserve price adjusted major currencies index that includes the euro, Canadian dollar, yen, pound, Swiss franc, Australian dollar, and Swedish krona.

Real income for ROW is the sum of the real GDP of the five major tourist arrival countries, the UK, Canada, Japan, France, and Germany. These are essentially the countries in the currencies index. Their nominal GDPs are from the International Financial Statistics of International Monetary Fund. Nominal GDPs are deflated by their GDP deflators. US income is real GDP. All the quarterly series run from 1973 through 2010.

Stationarity of the system in (5) is first checked. The Akaike Information Criteria selects the number of lags as four quarters. All eigenvalues from the state space representation companion matrix are strictly less than one in norm, leading to the conclusion that all three models are jointly stationary with deterministic trend.

From the reduced-form estimation of (5), the contemporaneous matrix $\mathbf{C}$ is obtained by the Choleski decomposition factor in Table 1. Standard errors are obtained nonparametrically by 5,000 bootstrap simulations with empirical distributions of residuals. A depreciation of the dollar in a positive r_t shock may have a small negative effect on export revenue x_t initially, not significant at the 90% level. However, the impulse-response function estimate in Figure 1 indicates the shock seems to have substantial intermediate to long-term effect on US tourism export revenue at the 90% level. A foreign income shock has virtually no effect on x_t except for a weak transitory effect during the first quarter.

Table 1. Contemporary Matrix Estimation

Export Model

	r_t	*s.e.*	x_t	*s.e.*	y_t^*	*s.e.*
r_t	0.018	(0.001)	-		-	
x_t	-0.006	(0.005)	0.055	(0.005)	-	
y_t^*	0.057	(0.015)	0.027	(0.014)	0.182	(0.010)

Import Model

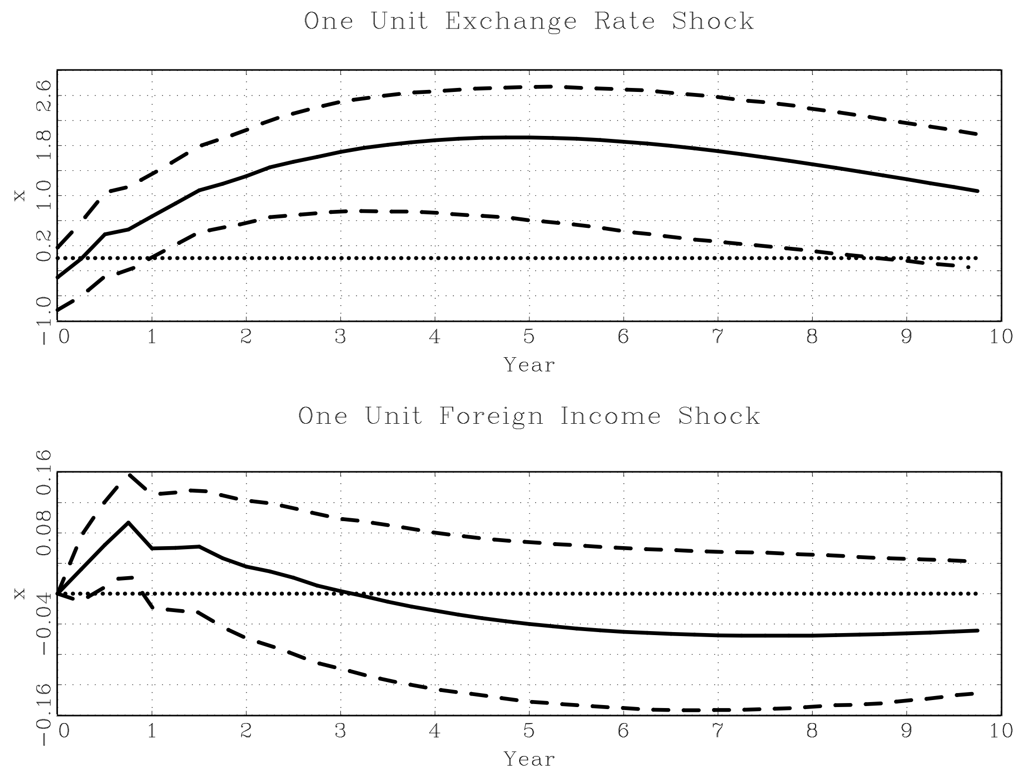
	r_t	*s.e.*	m_t	*s.e.*	y_t	*s.e.*
r_t	0.034	(0.002)	-		-	
m_t	-0.002	(0.003)	0.043	(0.004)	-	
y_t	0.001	(0.001)	0.002	(0.000)	0.007	(0.001)

Trade Balance Model

	r_t	*s.e.*	b_t	*s.e.*	y_t	*s.e.*	y_t^*	*s.e.*
r_t	0.017	(0.001)	-		-		-	
b_t	0.004	(0.004)	0.041	(0.002)	-		-	
y_t	0.001	(0.001)	-0.001	(0.001)	0.007	(0.001)	-	
y_t^*	0.070	(0.014)	0.000	(0.013)	0.005	(0.016)	0.170	(0.009)

Note: The contemporaneous matrix is estimated by the Cholesky Decomposition without normalization. Standard errors (*s.e.*) are obtained from 5,000 nonparametric bootstrap simulations.

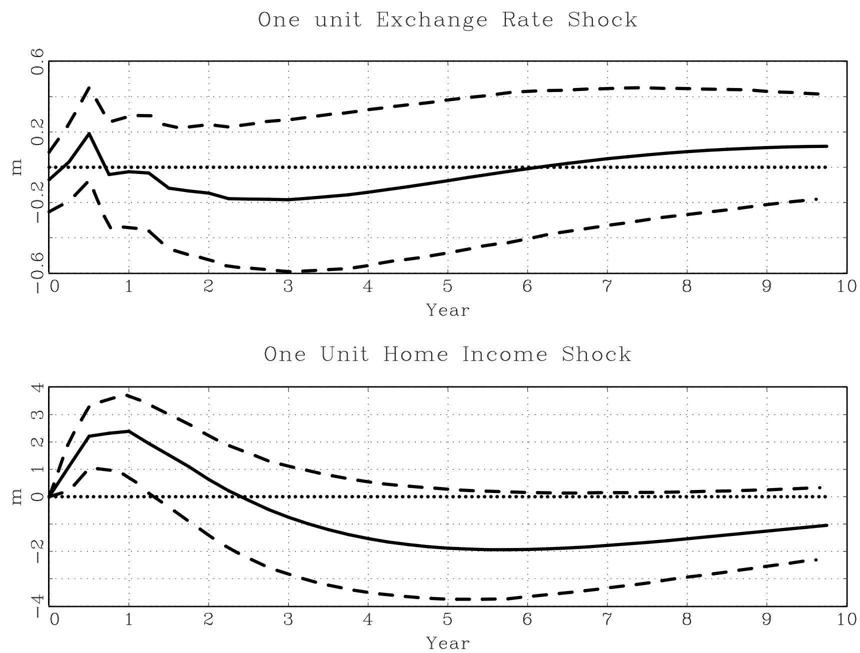
Figure 1. Impulse-Response Function Estimates: Export Model



Note: Response functions are obtained from a tri-variate vector autoregressive model with the foreign exchange rate is ordered first, while the foreign income variable is placed last. The 90% confidence bands (dashed lines) are obtained by taking 5% and 95% percentiles from 5,000 nonparametric bootstrap simulations.

The first panel of Figure 2 demonstrates a negligible effect of exchange rate shocks on US tourism import spending m_t. However, the income shocks seem to have a positive short term effect on the purchase of foreign tourism by the US.

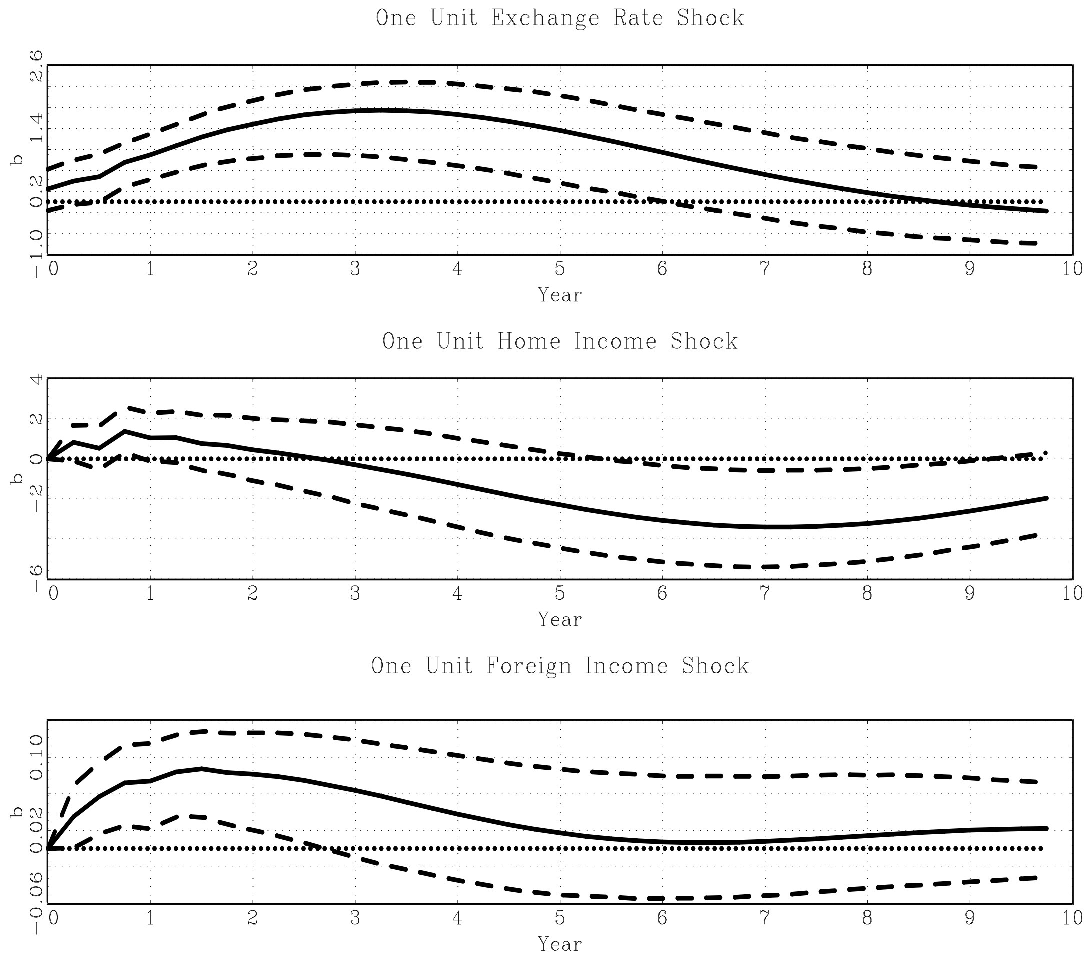
Figure 2. Impulse-Response Function Estimates: Import Model



Note: Response functions are obtained from a tri-variate vector autoregressive model with the foreign exchange rate is ordered first, while the home income variable is placed last. The 90% confidence bands (dashed lines) are obtained by taking 5% and 95% percentiles from 5,000 nonparametric bootstrap simulations.

A dollar depreciation shock seems to have a positive effect on export revenue x_t but virtually no effect on import spending m_t. Note the consistent impulse-response function of the US tourism trade balance $(x_t - m_t)$ to an exchange rate shock in Figure 3. Movement of the trade balance function resembles movement of the export revenue function. No evidence of a J-curve is observed in any model. Note also that, by construction, the home income shock affects only import spending in the import model, while the foreign income shock influences only export revenue in the export model. Impulse-response functions from our unrestricted trade balance model demonstrate consistent movements with response functions from the previous two restricted models. In other words, separate estimates of the responses of export revenue and import spending to these shocks unveil important information that may not be obtained by the trade balance model.

Figure 3. Impulse-Response Function Estimates: Trade Balance Model



Note: Response functions are obtained from a quad-variate vector autoregressive model with ordering of the foreign exchange rate, the trade balance, the home income, and the foreign income. The 90% confidence bands (dashed lines) are obtained by taking 5% and 95% percentiles from 5,000 nonparametric bootstrap simulations.

There are similar findings from the variance decomposition analysis. In Table 2 about 20% of the variation in three year ahead US tourism export revenue is explained by exchange rate innovations, while foreign income plays a negligible role.

Table 2. Export Variance Decomposition Analysis

k	r_t	$s.e.$	x_t	$s.e.$	y_t^*	$s.e.$
1	0.010	(0.022)	0.990	(0.022)	0.000	(0.000)
2	0.006	(0.020)	0.987	(0.023)	0.006	(0.012)
3	0.011	(0.024)	0.966	(0.036)	0.023	(0.027)
4	0.015	(0.032)	0.938	(0.054)	0.047	(0.044)
8	0.086	(0.081)	0.860	(0.101)	0.054	(0.063)
12	0.197	(0.124)	0.759	(0.133)	0.044	(0.066)
20	0.407	(0.163)	0.559	(0.159)	0.033	(0.067)
40	0.582	(0.174)	0.364	(0.163)	0.053	(0.091)

Note: Variance decomposition analysis is implemented from a tri-variate vector autoregressive model with the real exchange rate is ordered first, while the foreign income is placed last. *k* denotes the forecast horizon in quarters. Standard errors ($s.e.$) are obtained from 5,000 nonparametric bootstrap simulations.

Similarly in Table 3 innovations in home income explain about 10% of the variation in one year ahead US tourism import spending, while the exchange rate has negligible effects.

Table 3. Import Variance Decomposition Analysis

k	r_t	$s.e.$	m_t	$s.e.$	y_t	$s.e.$
1	0.003	(0.011)	0.997	(0.011)	0.000	(0.000)
2	0.007	(0.013)	0.977	(0.026)	0.020	(0.022)
3	0.011	(0.024)	0.919	(0.052)	0.069	(0.046)
4	0.009	(0.023)	0.894	(0.065)	0.097	(0.061)
8	0.009	(0.036)	0.875	(0.091)	0.116	(0.086)
12	0.017	(0.057)	0.894	(0.092)	0.089	(0.076)
20	0.023	(0.082)	0.870	(0.111)	0.107	(0.086)
40	0.024	(0.098)	0.778	(0.140)	0.198	(0.119)

Note: Variance decomposition analysis is implemented from a tri-variate vector autoregressive model with the real exchange rate is ordered first, while the home income is placed last. *k* denotes the forecast horizon in quarters. Standard errors ($s.e.$) are obtained from 5,000 nonparametric bootstrap simulations.

In Table 4 the overall explanatory power of exchange rate shocks on tourism trade explains about 39% of variation in the three year ahead tourism trade balance. The home income shock hardly explains tourism trade balance, while foreign income has a fairly substantial effect accounting for 14% of the variation in the three year ahead tourism trade balance. Variance decomposition analysis corroborates advantages of estimating the export revenue and import spending separately.

Table 4. Trade Balance Variance Decomposition Analysis

k	r_t	$s.e.$	b_t	$s.e.$	y_t	$s.e.$	y_t^*	$s.e.$
1	0.010	(0.023)	0.990	(0.023)	0.000	(0.000)	0.000	(0.000)
2	0.025	(0.036)	0.949	(0.043)	0.012	(0.017)	0.014	(0.018)
3	0.039	(0.046)	0.909	(0.058)	0.013	(0.022)	0.039	(0.032)
4	0.071	(0.057)	0.830	(0.077)	0.030	(0.036)	0.068	(0.045)
8	0.233	(0.100)	0.597	(0.109)	0.034	(0.052)	0.136	(0.073)
12	0.389	(0.124)	0.447	(0.118)	0.023	(0.051)	0.141	(0.083)
20	0.542	(0.139)	0.307	(0.117)	0.043	(0.066)	0.108	(0.080)
40	0.441	(0.131)	0.211	(0.113)	0.273	(0.133)	0.075	(0.074)

Note: Variance decomposition analysis is implemented from a quad-variate vector autoregressive model with an ordering, the real exchange rate, the trade balance ($x_t - m_t$), the home and the foreign real income. k denotes the forecast horizon in quarters. Standard errors ($s.e.$) are obtained from 5,000 nonparametric bootstrap simulations.5.

Conclusion

This paper investigates the effects of the real exchange rate and income on US tourism export revenue and import spending with vector autoregressions for quarterly data during the floating dollar era from 1973 to 2010. Separate estimates of export and import functions better capture these dynamic adjustment processes, providing information on the channels of each shock. The trade balance estimate fails to unveil these responses.

Depreciation raises export revenue implying tourism demand facing the US is price elastic. Foreign visitors to the US are sensitive to the exchange rate. Depreciation does not, however, affect US tourism import spending, perhaps due to inelastic tourism demand or pricing to market by host countries. There is no evidence of a J-curve. US tourists are sensitive to income but foreign tourists to the US are not, suggesting foreign US tourists rely on income while tourists spend wealth.

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