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The exchange rate and US tourism trade, 1973–2007

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This paper investigates exchange rate effects on US tourism trade in structural vector autoregressive models with quarterly data for the floating exchange rate from 1973 to 2007. Tourism export revenue and import spending are examined along with the tourism trade balance. Depreciation raises the US tourism trade balance with a unit elastic effect after six quarters with no evidence of J-curve behaviour. Only export revenue is marginally sensitive to the exchange rate. Foreign travel is a luxury good for US tourists, while travel to the USA is a normal good for foreign tourists.

Keywords: trade balance; US tourism; exchange rates

The trade balance may exhibit J-curve behaviour, falling with depreciation but rising over time as developed by Magee (1973) and Junz and Rhomberg (1973) and reviewed by Bahmani-Oskooee and Ratha (2004). This paper examines the effect of the exchange rate on the US tourism trade balance, export revenue and import spending with quarterly data for the floating exchange rate from 1973 to 2007. Structural vector autoregression SVAR models examine short and long term dynamics.

International tourism has grown over the last three decades to become a major source of income for a number of countries. The USA ranks first in tourism export revenue and second in import spending (World Tourism Organization, 2008). Tourism has assumed some importance in the US trade balance with a surplus since 1989 and with tourism receipts accounting for 5% of export revenue in 2007.

International tourism as a traded service has become integrated into trade theory by Socher (1986), Hazari and Ng (1993), Hazari (1995), Hazari and Nowak (2003) and Hazari and Sgro (2004). A distinguishing characteristic of tourism relative to other traded products is that importers must travel to the exporting country. Harrop (1973), Rosensweig (1988), Crouch (1994) and Song *et al* (2009) find that international tourism is a luxury good. Studies on the exchange rate and tourism include Tse (2001), Eilat and Einav (2004) and Saayman and Saayman (2008). Dupont *et al* (2008) present a long-term study of US tourism imports from 1820 to 2000.

There is a literature examining the effect of exchange rates on the trade balance at the industry level. Goldstein and Khan (1985) point out that aggregation across industries may in fact bias estimates and disguise more fundamental adjustments at the industry level. Meade (1988) finds no J-curve behaviour for US non-oil industrial supplies, capital goods (excluding automobiles) and consumer goods. Doroodian *et al* (1999) uncover J-curve behaviour for US agriculture but not for manufacturing. Yazici (2006) finds an S-curve for Turkish agriculture, the trade balance rising initially with depreciation before falling and then increasing. Ardalani and Bahmani-Oskooee (2007) find J-curve behaviour for only 6 of 66 US industries.

Houthakker and Magee (1969), Goldstein and Khan (1978), Rosensweig and Koch (1988), Senhadji (1998a) and Senhadji and Montenegro (1999) estimate price elasticities of import demand functions. The present approach focuses on trade balance adjustments as in Magee (1973), Rose and Yellen (1989) and Onafowora (2003).

Vogt (2008) examines US tourism export revenue and import spending in error correction models with annual data from 1973 to 2002. Vogt finds US tourists are more sensitive to a trade-weighted exchange rate, while foreign tourists to the US are more sensitive to real income. The present SVAR models quarterly data from 1973 through 2007 to uncover opposite results. Vogt deflates with a weighted consumer price index that may introduce bias.

The following section discusses the theoretical framework with tourism spending a function of income and the exchange rate. The third section presents the econometric model, followed by a section on the empirical results.

Theoretical framework for tourism trade

Rhomberg (1973), Magee (1975) Goldstein and Khan (1985) and Rose and Yellen (1989) develop the model of import substitution. International and domestic tourism are assumed imperfect substitutes owing to cultural and natural resource attractions. Consumers make the optimal choice between international and domestic tourism constrained by income. The present partial equilibrium model specifies the USA as the home country and a group of countries the foreign country.

Dollar depreciation raises the price of foreign tourism lowering the number of US tourists going abroad, and lowers the price for foreign tourists raising the number of foreign tourists. Domestic demand D_m for tourism abroad and foreign demand D_m^* for tourism in the USA also depend on respective incomes.

Home and foreign demand functions as general functions include the price of the imperfect substitute:

$$D_m = D_m(Y, p, Ep^*)$$

$$D_m^* = D_m^*(Y^*, p/E, p^*) \tag{1}$$

where Y is US income, Y^* is foreign income, E is the dollar price of foreign currency, p is the price of US tourism and p^* is the foreign currency price of foreign tourism. There are positive cross price effects if domestic and foreign tourism are imperfect substitutes. There are no data focused on the prices tourists pay, directing present attention to the exchange rate. Depreciation lowers US demand D_m for tourism abroad, and raises foreign demand D_m^* for US tourism.

Supplies of US and foreign tourism are S_x and S_x^*. Supplies are assumed to be perfectly elastic due to excess capacity as seems likely in the present quarterly data. Any quantity of tourism, within relevant bounds at least, is supplied at the market price. Equilibrium quantities of tourism are determined in the two markets where:

$$D_m = S_x^*$$

$$D_m^* = S_x. \tag{2}$$

Export revenue is $X = pq_x$ for the home country where q_x is the market clearing quantity. In general functional form, export revenue reduces to a function of foreign income and the exchange rate:

$$X = X(Y^*, E). \tag{3}$$

Foreign income Y^* raises export revenue X for a given E. Dollar depreciation (an increase in E) lowers the price of tourism p/E and raises the quantity demanded $q_m^* = q_x$. Depreciation increases X given perfectly elastic export supply S_x.

Similarly, import spending by the home country $M = Ep^*q_m$ reduces to:

$$M = M(Y, E). \tag{4}$$

Import spending M is positively related to home income Y. Depreciation raises the price Ep^* of foreign tourism, lowering quantity q_m and import spending M.

The present paper specifies tourism export revenue and import spending as log linear functions:

$$\ln X = a_0 + a_1 \ln Y^* + a_2 \ln E + \varepsilon \tag{5}$$

$$\ln M = b_0 + b_1 \ln Y + b_2 \ln E + \nu \tag{6}$$

Assuming balanced trade initially, the Marshall–Lerner condition that depreciation raises the trade balance depends on coefficients a_2 and b_2.

There are various measures of the trade balance in the applied literature. Real export revenue and import spending are the focus of Houthakker and Magee (1969), Senhadji (1998a) and Senhadji and Montenegro (1999). Goldstein and Khan (1978) and Rosensweig and Koch (1988) examine volume indices. The difference between export revenue and import spending $B = X - M$ is examined by Rose (1991) and Bahmani-Oskoosee and Malixi (1992). The ratio of net exports to national income B/Y is examined by Demirden and Pastine (1995) and Senhadji (1998b).

Haynes and Stone (1982) propose the ratio X/M utilized by Bahmani-Oskoosee and Brooks (1999), Boyd *et al* (2001) and Onafowora (2003). The present paper adopts this ratio, $B \equiv X/M$. In natural logs, the specification is:

$$\ln B = \ln X - \ln M. \tag{7}$$

Substitute Equations (5) and (6) into (7) to find:

$$\ln B = (a_0 - b_0) + a_1 \ln Y^* - b_1 \ln Y + (a_2 - b_2) \ln E + (\varepsilon - \nu), \tag{8}$$

or more simply:

$$\ln B = c_0 + a_1 \ln Y^* - b_1 \ln Y + c_3 \ln E + \mu. \tag{9}$$

An increase in foreign income raises the trade balance while an increase in home income lowers it. The Marshall–Lerner condition holds if $c_3 > 0$.

A weakness of the ratio is that it could increase with various changes in X and M. For instance, Depreciation could raise X but lower B if M rises more than X. In the data, the simple correlation between X/M and the difference $X - M$ is 0.94.

SVAR model of the exchange rate and tourism trade

Consider the structural vector autoregressive SVAR process of integrated variables:

$$\mathbf{A}\mathbf{y}_t = \mathbf{B}(L)\mathbf{y}_{t-1} + \mathbf{u}_t, \tag{10}$$

where $\mathbf{A}$ is an m × m square matrix, $\mathbf{y}_t$ is an m × 1 vector of m difference stationary variables, $\mathbf{B}(L)$ is a matrix lag polynomial, and $\mathbf{u}_t$ is an m × 1 vector of m structural shocks. Shocks have zero means, unit variance, and are mutually independent:

$$E\mathbf{u}_t = \mathbf{0} \text{ and } E\mathbf{u}_t\mathbf{u}_t' = \mathbf{I}, \tag{11}$$

where $\mathbf{0}$ is an m × 1 null vector and $\mathbf{I}$ is an m × m identity matrix.

The structural form system of Equation (10) is represented by the following reduced form system of equations:

$$\mathbf{y}_t = \mathbf{C}(L)\mathbf{y}_{t-1} + \boldsymbol{\varepsilon}_t, \tag{12}$$

where:

$$\mathbf{C}(L) = \mathbf{DB}(L),\ \boldsymbol{\varepsilon}_t = \mathbf{Du}_t, \text{ and } \mathbf{D} = \mathbf{A}^{-1}. \tag{13}$$

Combining Equations (12) and (13):

$$E\boldsymbol{\varepsilon}_t\boldsymbol{\varepsilon}_t' = E\mathbf{Du}_t\mathbf{u}_t'\mathbf{D}' = \mathbf{DD}' = \boldsymbol{\Sigma} \tag{14}$$

where $\boldsymbol{\Sigma}$ is the variance covariance matrix from the reduced form VAR.

Just identifying the system requires $m(m-1)/2$ identifying assumptions. We employ the conventional approach of Sims (1980) and utilize the Choleski decomposition of $\boldsymbol{\Sigma}$ to find $\mathbf{D}$, an approach that can be useful given prior knowledge on short-term relations between variables of interest.

Restrictions in the SVAR model are based on prior knowledge. Tourism is perhaps a small enough share of international transactions to ignore its contemporaneous effect on the exchange rate. Though foreign income may affect the exchange rate, its short-term effect would be negligible since tourists plan ahead for international travel.

Given the least squares estimates $\mathbf{C}(L)$ and $\boldsymbol{\Sigma}$ from the reduced form, the structural form VAR is recovered with the identified contemporaneous matrix $\mathbf{D}$ followed by the impulse response analysis for structural shocks to the system.

Data and stationary pretests

Quarterly data from 1973 through to 2007 on tourism export revenue and import spending including travel expense are from the International Transactions Accounts of the Bureau of Economic Analysis. The exchange rate index is the Federal Reserve trade weighted major currencies index.

US income is GDP. Income for the rest of the world is the sum of GDP of the five major US tourist arrival countries: the UK, Canada, Japan, France and Germany. The exchange rate index includes these major currencies as well as the Swiss franc, Australian dollar and Swedish krona. All GDPs are from the *International Financial Statistics* of International Monetary Fund.

Variables are not deflated. Goldstein and Khan (1985) point out that biased estimates result from deflating variables in a regression. A real weighted exchange rate would also introduce confounding issues.

Figure 1 shows plots of all variables in natural logs. Tourism export revenue X has generally grown since 1974 before falling off after 2000, while import spending M has grown and accelerated during the dollar appreciation from the mid-1980s. The sharp drop due to the September 11 attacks is apparent. The tourism trade balance B was negative but improving to 1980, before falling (1980–1984) and then rising and becoming positive up to 1992. After that time B was steady up to 1996 before falling but remaining positive since 1996.

The exchange rate E had two periods of dollar depreciation, up to 1984 then during the late 1990s, and two periods of appreciation, from 1984 to 1996 and since 2000. US income Y has grown steadily at an increasing rate, while foreign income Y^* has been more variable with slower growth since 1996.

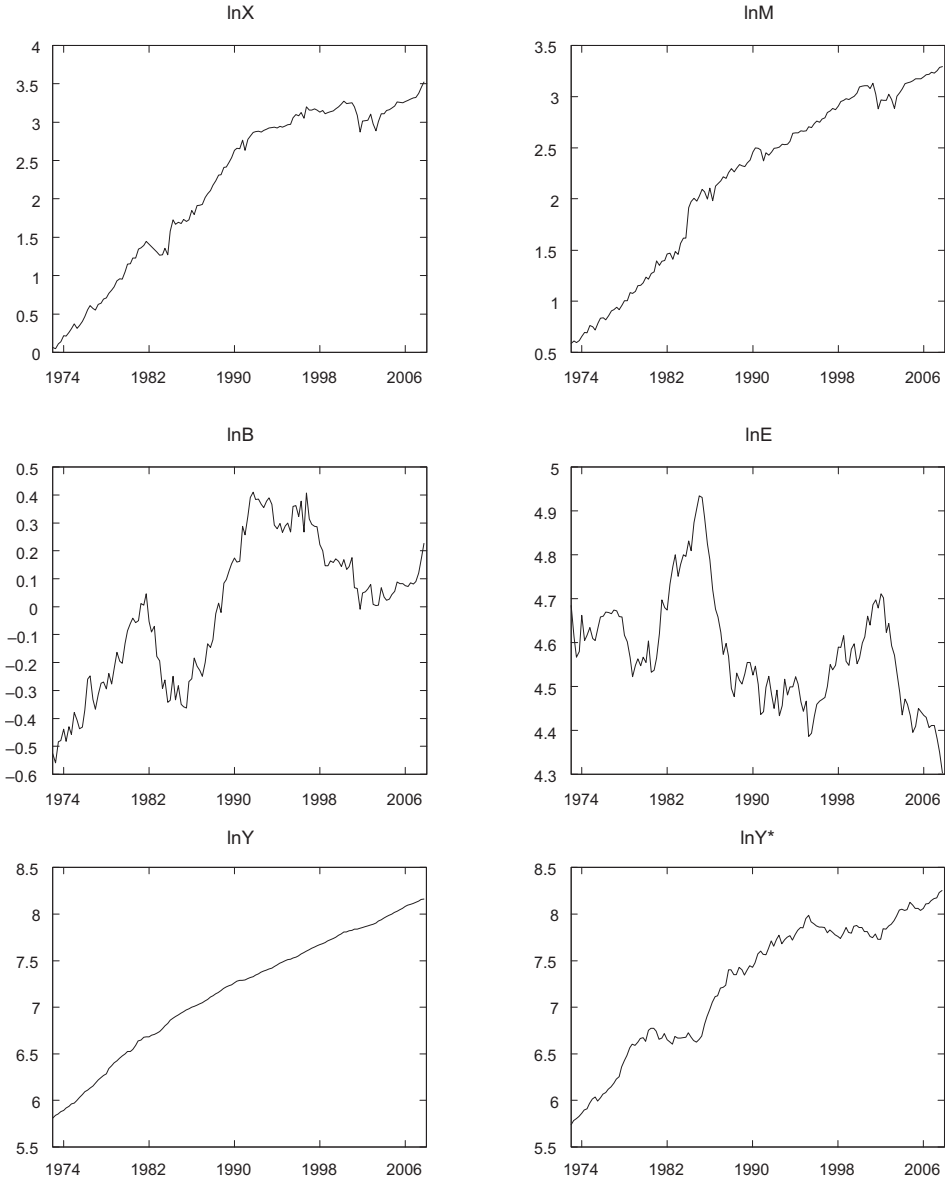

Figure 1. Variable series.

Stationary pretests check whether variables converge to steady state levels. Results of augmented Dickey–Fuller ADF unit root tests are in Table 1. The number of lags is chosen by the Schwarz information criterion (SIC).

The ADF test with an intercept fails to reject the null hypothesis of a unit root for all variables except US income *Y*. The ADF test does not reject the null hypothesis of a unit root for all variables with intercept and trend. With lags added to *Y* the ADF test fails to reject the unit root null hypothesis. The series does not appear stationary in Figure 1. ADF tests reject the unit root

Table 1. Unit root pretests of log variables.

Variable	Specification	ADF_c	$ADF_{c,t}$
X	Level	–2.16	–1.15
	Differenced	–12.80***	–13.22***
M	Level	–1.98	–0.91
	Differenced	–14.36***	–14.65***
B	Level	–2.02	–1.78
	Differenced	–14.12***	–14.25***
E	Level	–1.06	–1.86
	Differenced	–10.86***	–10.93***
Y	Level	–4.91***	–2.09
	Differenced	–4.88***	–9.28***
Y^*	Level	–2.12	–1.69
	Differenced	–5.30***	–5.48***

Notes: The number of lags is chosen by the Schwarz Information Criterion (BIC). ADF_c and $ADF_{c,t}$ refer to ADF-*t* statistics when an intercept is included and when an intercept and time trend are included. *, **, ***The null hypothesis of unit root is rejected at the 10%, 5% and 1% level, respectively. Asymptotic critical values are from Harris (1992).

null hypothesis for all differenced variables. All variables are integrated in the first order I(1).

Figure 2 shows the apparently stationary differences. An SVAR on differences of variables provides the present estimates.

Results for export revenue and import spending

Estimates derive contemporaneous relations of each innovation and the effects of one unit structural shocks. Diagonal estimates are normalized to one in the diagonal matrix $Eu_t\mu_t'$ with non unitary variances. Contemporaneous relations of each innovation and 1% structural shocks are derived. The estimated response functions to 1% structural shocks and confidence intervals are from 5% and 95% percentiles of 10,000 bootstrap simulations.

The order of export revenue of tourism $\mathbf{y}_t = [\Delta E_t\ \Delta X_t\ \Delta Y_t^*]'$ is chosen assuming the nominal exchange rate is not contemporaneously affected by shocks to tourism export revenue or foreign income. Tourism involves a small fraction of foreign exchange transactions. Any effect of foreign income on the nominal exchange rate would be seem to be very long term, years perhaps. Tourism export revenue is assumed not contemporaneously affected by foreign income as tourism would seem to be decided at least a quarter in advance. That is, if foreign tourists decide to travel to the USA at least one quarter in advance, their income during the quarter of travel is not relevant.

From estimates of **D** these contemporaneous relations of each innovation and structural shock are derived:

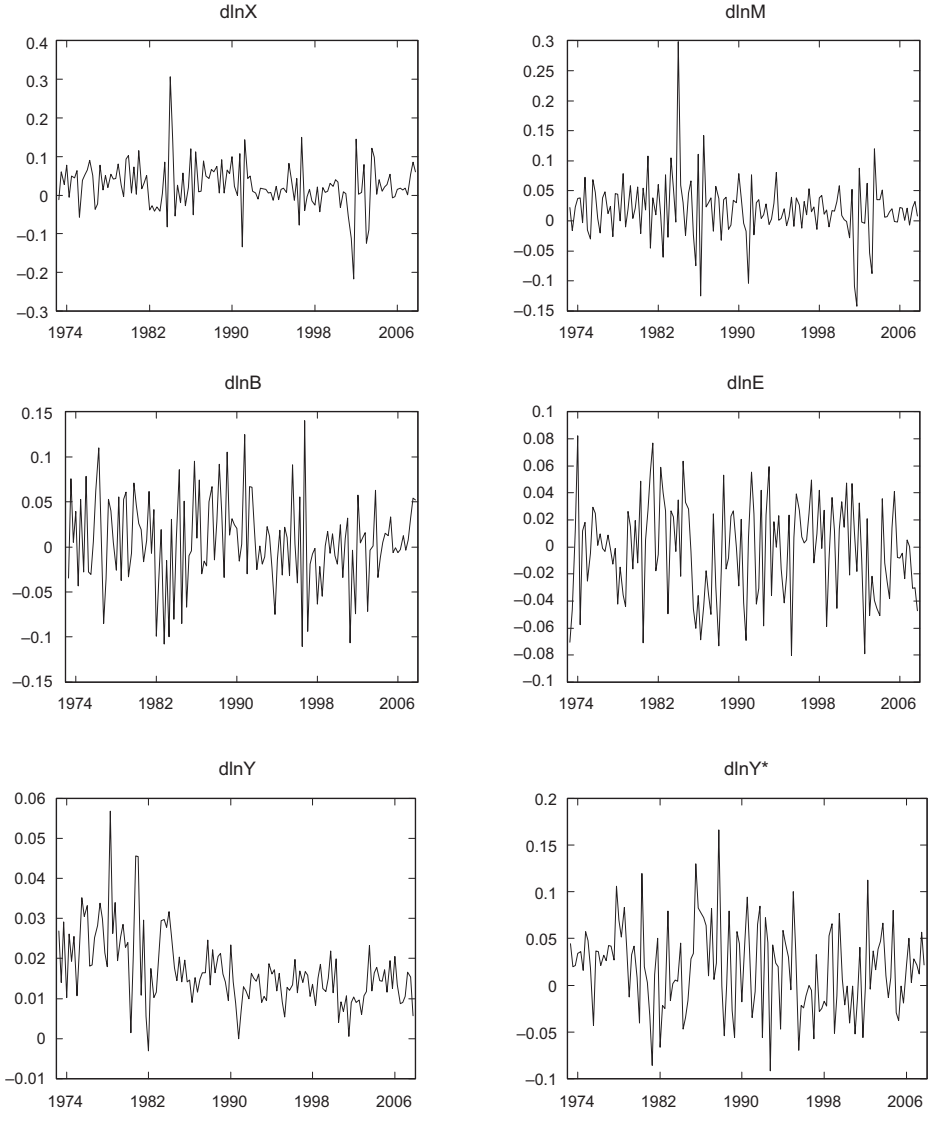

Figure 2. Variable differences.

$$\varepsilon_t^E = \underset{(0.0008)}{0.0146} u_t^E$$

$$\varepsilon_t^X = \underset{(0.0044)}{0.0030} u_t^E + \underset{(0.0056)}{0.0558} u_t^X$$

$$\varepsilon_t^{Y*} = \underset{(0.0038)}{-0.0162} u_t^E + \underset{(0.0029)}{0.0034} u_t^X + \underset{(0.0022)}{0.0381} u_t^{Y*}$$

with standard errors from 10,000 nonparametric bootstrap simulations. The choice of $k = 4$ is determined by the Akaike information criterion (AIC).

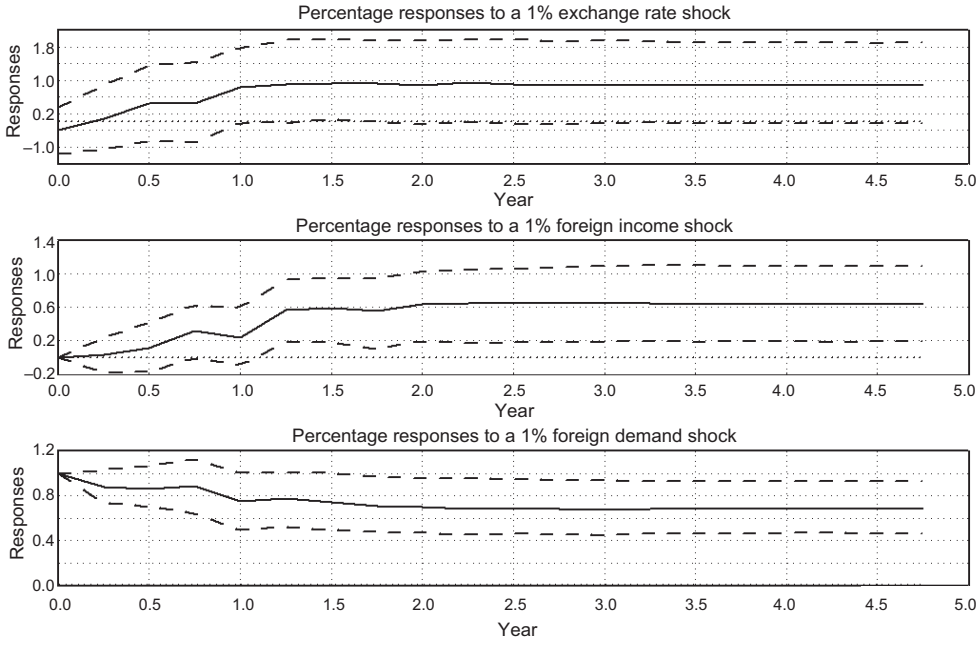

Figure 3. Impulse response function estimates of export revenue.
Note: 90% confidence intervals are obtained by taking 5% and 95% percentiles from 10,000 bootstrap simulations.

Matrix **D** is estimated with the diagonal normalized to one to find contemporaneous innovations to 1% structural shocks. Estimated export revenue response functions are reported in Figure 3.

In the first panel of Figure 3 a 1% depreciation shock may decrease tourism export revenue contemporaneously followed by an increase after one quarter, converging to equilibrium after six quarters. The short-term exchange rate elasticity is insignificant while the long-term elasticity is marginally insignificant.

In the second panel of Figure 3, tourism export revenue exhibits a robust positive response to foreign income shocks converging to equilibrium after six quarters. Tourism export revenue also responds strongly to its own shocks, diminishing somewhat over two years.

The order of the import spending model $\mathbf{y}_t = [\Delta E_t\ \Delta X_t\ \Delta Y_t]'$ is justified in a similar manner. Both AIC and BIC choose $k = 1$ but to remove any remaining serial correlation $k = 4$ is utilized similar to export revenue.

From the **D** estimate, these relations follow:

$$\varepsilon_t^E = \underset{(0.0017)}{0.0319} u_t^E$$

$$\varepsilon_t^M = \underset{(0.0035)}{0.0032} u_t^E + \underset{(0.0053)}{0.0442} u_t^M$$

$$\varepsilon_t^Y = \underset{(0.0006)}{0.0002u_t^E} + \underset{(0.0005)}{0.0016u_t^M} + \underset{(0.0008)}{0.0068u_t^Y}$$

Estimated import spending response functions are in Figure 4.

The insignificant response of import spending to a depreciation shock of 1% decreases contemporaneously, increasing after 4 quarters and converging to equilibrium after 10 quarters. Import tourism spending exhibits a robust positive elastic response to home income, converging to a value of 2 after two years. Import tourism spending also responds positively to its own shocks, diminishing to its long-term equilibrium after two years.

Consolidating results on export revenue and import spending, the trade balance may deteriorate initially following a depreciation shock, improve after a quarter and converge to the steady state after 10 quarters. The short-term deterioration, however, is insignificant. Long-term improvement of the trade balance is marginally insignificant through the effect on export revenue.

Results for the tourism trade balance

In the trade balance model $\mathbf{y}_t[\Delta E_t\ \Delta B_t\ \Delta Y_t\ \Delta Y_t^*]'$ the order of $\mathbf{y}_t$ is chosen assuming the exchange rate is not contemporaneously affected by trade balance or income shocks, and the trade balance is not contemporaneously affected by

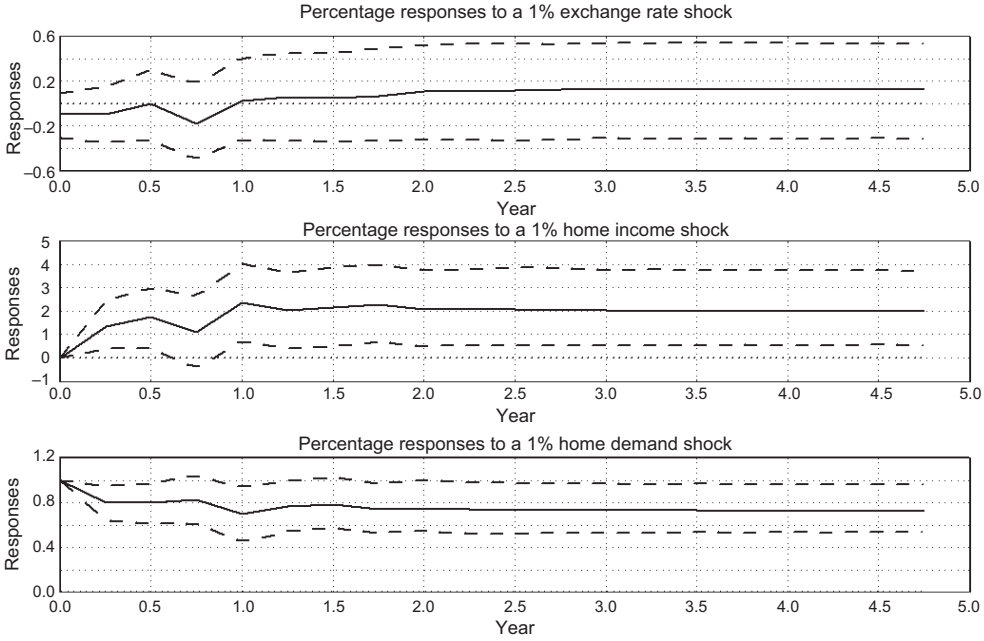

Figure 4. Impulse response function estimates of import spending.
Note: 90% confidence intervals are obtained by taking 5% and 95% percentiles from 10,000 bootstrap simulations.

income shocks. Also, home income is assumed not contemporaneously affected by foreign income. Higher foreign income may lead to export demand and perhaps home income growth but the effect after a few quarters would seem to be negligible.

From the **D** estimate the following relations are derived:

$$\varepsilon_t^E = \underset{(0.0008)}{0.0147} u_t^E$$

$$\varepsilon_t^B = \underset{(0.0041)}{0.0008} u_t^E + \underset{(0.0026)}{0.0418} u_t^B$$

$$\varepsilon_t^Y = \underset{(0.0036)}{0.0169} u_t^E + \underset{(0.0032)}{0.0012} u_t^B + \underset{(0.0020)}{0.0383} u_t^Y$$

$$\varepsilon_t^{Y*} = \underset{(0.0006)}{-0.0002} u_t^E - \underset{(0.0005)}{0.0010} u_t^B + \underset{(0.0006)}{0.0000} u_t^Y + \underset{(0.0007)}{0.0066} u_t^{Y*}$$

The choice of $k = 4$ is determined by the AIC. Matrix **D** with diagonal element normalized to one is estimated. Trade balance response functions are in Figure 5.

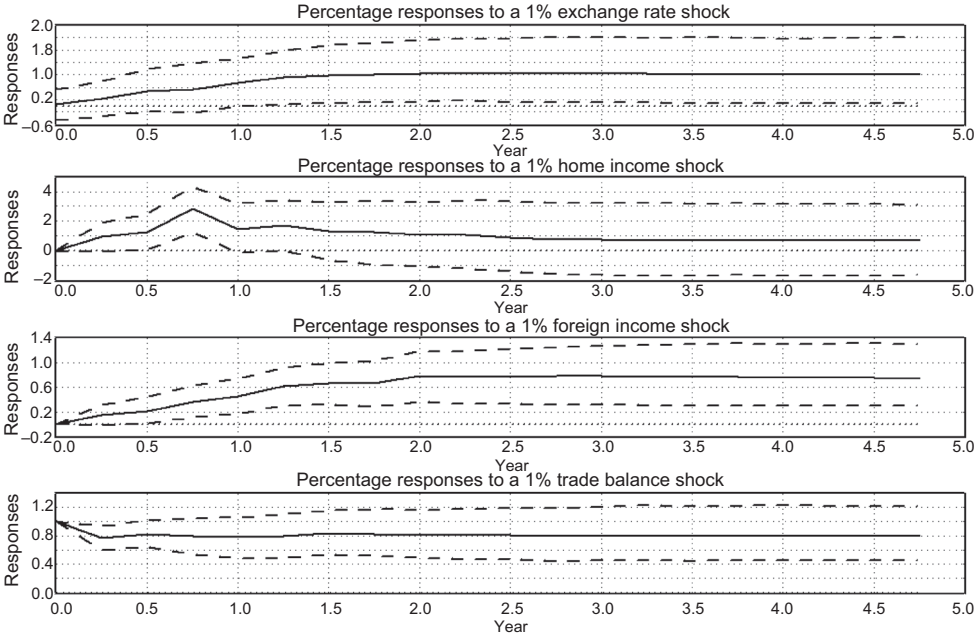

Figure 5. Impulse response function estimates of the trade balance.
Note: 90% confidence intervals are obtained by taking 5% and 95% percentiles from 10,000 bootstrap simulations.

The trade balance in the top panel of Figure 5 appears to increase contemporaneously with a 1% depreciation shock but this initial response is insignificant. The response becomes significant after four quarters and converges to the steady state after six quarters. There is no evidence of J-curve behaviour.

In the second panel, the trade balance exhibits a robust positive response to a home income shock that becomes insignificant after four quarters. Home income is expected, however, to lower the trade balance.

In the third panel, the trade balance exhibits a robust nearly elastic positive response to foreign income shocks that takes two years to converge to the steady state. The trade balance also exhibits a strong positive response to its own shocks that converges to the steady state within a quarter.

Tourism trade elasticities

Table 2 presents estimated tourism trade elasticities. Short term elasticities are insignificant. The long term export revenue elasticity $a_2 = 0.88$ is marginally insignificant. Combining a_2 with the import spending elasticity $b_2 = 0.12$ the Marshall–Lerner condition would seem to be satisfied, $a_2 - b_2 = 0.76 > 0$. There is no evidence of J-curve behaviour.

For the trade balance in the last column, depreciation has no short term effect but does have a near unit elastic effect in the long term. Every 1% depreciation raises the tourism trade balance by 1.01%, a noticeable effect following quarters of substantial depreciation or appreciation. For instance, the maximum depreciation and appreciation in the sample of about 8% would have similar percentage effects on the tourism trade balance.

US tourists are about three times as sensitive to income as foreign tourists in the separate estimates of export revenue and import spending. The 1.99 income elasticity of import spending in the second column of Table 2 implies every 1% income increase induces US tourists to spend nearly double that percentage more on foreign tourism, a luxury good for US tourists.

Table 2. Short-term and long-term exchange rate and income elasticities.

Elasticities	Export revenue X	Import spending M	Trade balance $B = (X/M)$
E short term	–0.20	–0.10	0.05
90% CI	[–0.77, 0.35]	[–0.31, 0.09]	[–0.45, 0.52]
E long term	0.88	0.12	1.01*
90% CI	[–0.04, 1.90]	[–0.32, 0.53]	[0.09, 2.21]
Y long term	–	1.99*	0.71
90% CI		[0.55, 3.73]	[–1.64, 3.13]
Y^* long term	0.63*	–	0.75*
90% CI	[0.19, 1.09]		[0.31, 1.29]

Notes: 90% confidence intervals (CI) are obtained by taking 5% and 95% percentiles from 10,000 bootstrap simulations. * represents the coefficients are significant within 90% confidence intervals.

The inelastic foreign income elasticity of US tourism export revenue is 0.63. This inelastic effect may be explained by foreign tourists having other options for international tourism, specifically visiting each other or other countries not in the sample. It may also be that foreign tourists spend wealth or borrow rather than relying on current income.

Estimates on the trade balance *B* in the last column of Table 2 reveal a positive effect of depreciation but disguise the income effect of US tourists. Conversely, the separate estimates provide more detailed response dynamics but fail to reveal the effect of depreciation on the trade balance. These results illustrate the advantages of separate modelling the trade balance, export revenue and import spending.

Conclusion

The present structural vector autoregressive estimates uncover a long-term unit elastic effect of the exchange rate on the US tourism trade balance with no evidence of J-curve behaviour. For tourism trade, there are limited contracts that would lead to a short-term negative impact of depreciation. Separate estimates of export revenue and import spending show export revenue is more sensitive to the exchange rate. US tourism is a normal good for foreign tourists, while foreign travel is a luxury good for US tourists.

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