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DOES THE EXCHANGE RATE REALLY AFFECT CONSUMER SPENDING?

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Abstract: This paper examines the extent to which changes in imports or exports of U.S. consumer goods and services occurs in response to a change in the exchange rate, 1960 - 2000. The data used are taken from the Economic Report of the President, 2002. The findings indicate that an increase in the trade weighted exchange rate of about one percent is associated with an increase in imports of consumer goods of approximately $1 billion dollars the year after the change. The same level increase seems associated with a decline in consumer goods exports of about $0.75 billion dollars. JEL F00, F40, F43.

For years now, the rhetorical battle in the United States has raged over whether the Chinese exchange rate is kept artificially high, thereby making it possible for Americans to buy many Chinese Yuan for each dollar they are willing to spend. This makes foreign goods seem cheap compared to American counterparts. Similarly, the more Yuan it takes to buy a dollar, the less American goods (exports) the Chinese are able to buy.

The argument is also made that if only the Chinese would lower their managed exchange rate to some "reasonable", but usually undefined, level, trade would again be fair, and a large portion of the trade imbalance between the two countries would disappear. Similar arguments are sometimes made regarding the exchange rates with some other American trading partners, such as Japan.

The question is, are American purchasing decisions as between domestic and foreign goods really that much affected by changes in the exchange rate between the United States and its major trading partners? That is an empirical question, and the one which this paper seeks to explore. We will examine the affect of changes in the exchange rate 1960-2000 on consumer goods imported into the U.S., and on consumer goods exported from the U.S.

METHODOLOGY

All data used in the study is taken from the Council of Economic Advisors’ statistical appendix to the Economic Report of the President, 2002, Tables B2, B3, B7, B26, B54,

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1 John J. Heim is clinical associate professor of economics at Rensselaer Polytechnic Institute. He has benefited greatly from the intellectual stimulation provided by his colleagues in the economics department at R.P.I. All responsibility for errors, of course, remains his own.
B60, B73, B82, B90, B95, B104, B106 and B110. Additional data on multilateral trade weighted value of the dollar, i.e., the foreign exchange rate, is taken from Table B110 of the Economic Report, 2001 and Table B108 of the Economic Report, 1997. Exchange rate values 1960 - 1970 were assumed constant at 1970 levels, per the Bretton Woods protocols. All data are expressed in real 1996 dollars, or converted to same using the GDP deflator in Table B3.

To study the effect of exchange rate changes on consumption of domestically produced and imported consumer goods, it was necessary to adopt a theory of consumer demand for consumer goods. Essentially, this paper postulates a Keynesian theory of demand for consumer goods (described below) and assumes that in general, the determinants of the demand for imported consumer goods are the same as those mentioned in Keynes (1936) for domestically produced consumer goods, with the addition of two other variables: a “crowd out” variable to control for periods of limited consumer credit availability, and an exchange rate variable.

The Basic Keynesian Function:

Keynes argues in chapter 8 of the General Theory of Employment, Interest and Money (1936) that income, wealth, fiscal policy (taxes) and possibly the rate of interest might influence consumption. However, he felt

... income...is, as a rule, the principal variable upon which the consumption-constituent of the aggregate demand function will depend....(p.96)

though

...windfall changes in capital-values will be capable of changing the propensity to consume, and substantial changes in the rate of interest and in fiscal policy may make some difference (pp.95-96)...

where “fiscal policy” is a reference to tax levels. In chapter 9 he also notes other factors that might affect the level of consumption spending: precautionary saving (for unknown, but potential, future needs), saving for known future needs (like retirement), and saving to finance improvements in future standards of living.

Hence, we can sum up Keynes by saying his determinants of consumption spending included after tax income, wealth, and the interest rate, and a desire to save. To these, our consumption function below will add a crowd out factor as also being the result of fiscal policy (via government deficit effects on savings available to finance consumer or investment credits) and the exchange rate.

Keynes also argued (p. 97) that the proportion of total income saved would grow as income grew, resulting in falling average propensity to consume as income grew.

Typical tests in the late 30’s and early 40’s using cross-sectional data seem to verify this. For example, Ruggles & Ruggles (1956, p.306) attempt to describe the Keynesian function in their classic text on national income accounting. They use using the income and consumption patterns of almost 40 million U.S. families in 1935-36 to illustrate a declining average propensity to consume/increasing average propensity to save as
income increased. Their data are shown in Table C1. Note that about half of all personal saving was done by the top ½% of all income recipients – those families earning $15,000 or more, and that the bottom two income groups had negative savings, i.e., average propensity’s to consume greater than one. Data like this have provided our standard, though somewhat even if only slightly – oversimplified (no provision for wealth or interest rate effects), interpretations of the Keynesian consumption function.

Table C1
Consumers’ Income and Expenditure, by Income Group, 1935-36
(in millions, unless otherwise noted)

<table>
<thead>
<tr>
<th>Income Group (in dollars)</th>
<th># of Families (000)</th>
<th>Personal Income</th>
<th>Personal Taxes</th>
<th>Dispos. Income</th>
<th>Consumption Expenditures</th>
<th>Personal Saving</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under $780</td>
<td>13,153</td>
<td>$6,190</td>
<td>171</td>
<td>$6,019</td>
<td>$7,226</td>
<td>-1,207</td>
</tr>
<tr>
<td>780-1,450</td>
<td>13,153</td>
<td>14,154</td>
<td>616</td>
<td>13,638</td>
<td>13,890</td>
<td>-252</td>
</tr>
<tr>
<td>1,450-2,000</td>
<td>5,974</td>
<td>10,035</td>
<td>409</td>
<td>9,626</td>
<td>9,164</td>
<td>462</td>
</tr>
<tr>
<td>2,000-3,000</td>
<td>4,434</td>
<td>10,577</td>
<td>465</td>
<td>10,112</td>
<td>9,043</td>
<td>1,069</td>
</tr>
<tr>
<td>3,000-5,000</td>
<td>1,818</td>
<td>6,644</td>
<td>343</td>
<td>6,301</td>
<td>5,125</td>
<td>1,176</td>
</tr>
<tr>
<td>5,000-15,000</td>
<td>749</td>
<td>5,839</td>
<td>413</td>
<td>5,426</td>
<td>3,529</td>
<td>1,897</td>
</tr>
<tr>
<td>$15,000 &amp; Over</td>
<td>178</td>
<td>5,820</td>
<td>750</td>
<td>5,070</td>
<td>2,237</td>
<td>2,833</td>
</tr>
<tr>
<td>Total</td>
<td>39,458</td>
<td>$59,259</td>
<td>$3,067</td>
<td>$56,192</td>
<td>$50,214</td>
<td>$5,978</td>
</tr>
</tbody>
</table>

Source: Ruggles & Ruggles, (1956, p.306)

Of course, a declining APC means the function has a positive intercept, as is commonly shown in textbook presentations of the Keynesian consumption function.

In another study (Heim, 2007a), this author found that regression results on a modified Keynesian function of the following type explained about 90% of the variance in consumer spending in the 1960-2000 period:

(1) \[ C_0 = \beta_1 + \beta_2 (Y-T_G)_0 + \beta_3 (T_G - G)_0 - \beta_4 (PR)_0 + \beta_5 (DJ)_{-2} + \beta_6 (XR)_{-2} \]

where

\[(Y-T_G)_0 = \text{Total income minus taxes, defined as the GDP minus that portion of total government receipts used to finance government purchases of goods and services, i.e., total government receipts minus what's needed to finance transfer payments in the current period.}\]

\[(T_G - G)_0 = \text{The government deficit (interpreted as a restrictor of consumer credit. Usually we will disaggregate this into two separate variables in regressions: } \beta_{3A} T_G(0) \text{ and } \beta_{3B} G. \text{ because we found the effects of each on consumer spending to differ, with the tax variable the more important.}\]

\[PR_0 = \text{An interest rate measure, the Prime rate, for the current period. This rate is a base rate for much consumer credit.}\]

\[DJ_{-2} = \text{A stock market wealth measure, lagged two years}\]
The trade-weighted exchange rate, lagged 2 years. In some regressions, an average of the XR value for the past two years is used, denoted XR\textsubscript{AV12}.

First difference versions of this modified Keynesian function (1) were used to reduce the distorting effects of multicollinearity and non-stationarity inherent in most time series models:

\begin{align*}
\Delta C_0 &= \beta_2 \Delta(Y - T_G)_0 + \beta_3 \Delta(T_G - G)_0 - \beta_4 \Delta(PR)_0 + \beta_5 \Delta(DJ)_{-2} + \beta_6 \Delta(XR)_{-2} \\
\text{or} \\
\Delta C_0 &= \beta_2 \Delta(Y - T_G)_0 + \beta_{3A} \Delta(T_G(0)) - \beta_{3B} \Delta(G)_0 - \beta_4 \Delta(PR)_0 + \beta_5 \Delta(DJ)_{-2} + \beta_6 \Delta(XR)_{-2}
\end{align*}

We will test these hypotheses using regression analysis using different levels of lag in the exchange rate variable from no lag (current year value) to -3 lag (the exchange rate value 3 years ago, and we will estimate the regression using the average exchange rate value for the past two years (average of -1 and -2 lags).

Each regression below shows the estimated marginal effect (regression coefficient) for the explanatory variables, the t statistic associated with it, the percent of variance explained and the Durbin Watson autocorrelation statistic. Throughout the remainder of the paper, marginal effects with a t-statistic of 1.8 are significant at the 8% level, 2.0 are significant at the 5% level and t-statistics of 2.7 are significant at the 1% level.

Because of the simultaneity between C (or its component part, M) and Y inherent in these equations, two stage least squares estimates of \(\Delta(Y - T_G)_0\) were also developed, using the last five right hand side variables as regressors. Newey-West heteroskedasticity corrections were also made. Testing for autocorrelation was also done. Where the autocorrelation variable’s coefficient was found significant at the 5% level, it was included; otherwise no correction was made.

**FINDINGS**

Early tests on total consumption indicated that only the two year lag and average of one and two year lagged values of the exchange rate were most systematically related to consumption. Nonetheless, we also present below the results obtained using the current exchange rate, the one and the three year lagged versions of this variable.

Baseline findings for the model, absent only the exchange rate variable, are also given. They allow us to determine the amount of additional variance explained by adding the exchange rate variable. The extent to which adding the exchange rate variable increases explained variance need to be evaluated with care, since order of entry in an equation can affect how much additional variance is explained. This is a major problem when there is significant multicollinearity between the last variable entered and the explanatory variables already in the model. One important sign of success in avoiding this problem is finding little or no change in the estimated marginal effects (regression coefficients) of the variables already in the regression when the exchange rate is added.
Our first set of statistical analyses examine the effect of the exchange rate on total consumption, i.e., consumption of both domestic and imported consumer goods (C) as "C" is used in the GDP identity,

\[ Y = C + I + G + (X-M) \]

Results are shown below for the baseline consumption function without the exchange rate variable, and for the additional equations adding the exchange rate (with from 0 to 3 year lagged values).

\[
\Delta C_0 = .66 \, \Delta(Y-T_G)_0 + .52 \, \Delta T_{G(0)} + .10 \, \Delta G_0 - 7.23 \, \Delta PR_{0.} + .42 \, \Delta DJ_{2} \quad R^2 = 88\%
\]

(26.6) (5.2) (0.5) (-3.0) (2.2) D.W.= 1.8

\[
\Delta C_0 = .66 \, \Delta(Y-T_G)_0 + .52 \, \Delta T_{G(0)} + .09 \, \Delta G_0 - 7.25 \, \Delta PR_{0.} + .43 \, \Delta DJ_{2} - .15 \, \Delta XR_0 \quad R^2 = 88\%
\]

(26.8) (5.0) (0.5) (-3.1) (2.1) (-0.3) D.W.= 1.8

\[
\Delta C_0 = .66 \, \Delta(Y-T_G)_0 + .53 \, \Delta T_{G(0)} + .07 \, \Delta G_0 - 6.77 \, \Delta PR_{0.} + .40 \, \Delta DJ_{2} + .70 \, \Delta X_{R,1} \quad R^2 = 89\%
\]

(25.4) (5.7) (0.5) (-2.7) (2.2) (1.4) D.W.= 1.9

\[
\Delta C_0 = .67 \, \Delta(Y-T_G)_0 + .49 \, \Delta T_{G(0)} + .04 \, \Delta G_0 - 7.07 \, \Delta PR_{0.} + .44 \, \Delta DJ_{2} + 1.14 \, \Delta XR_{2} \quad R^2 = 89\%
\]

(28.4) (4.8) (0.3) (-2.6) (2.6) (2.1) D.W.= 2.0

\[
\Delta C_0 = .67 \, \Delta(Y-T_G)_0 + .52 \, \Delta T_{G(0)} + .05 \, \Delta G_0 - 6.67 \, \Delta PR_{0.} + .41 \, \Delta DJ_{2} + .76 \, \Delta XR_{AV,12} \quad R^2 = 89\%
\]

(26.4) (5.5) (0.4) (-2.5) (2.4) (1.8) D.W.= 2.0

\[
\Delta C_0 = .66 \, \Delta(Y-T_G)_0 + .53 \, \Delta T_{G(0)} + .10 \, \Delta G_0 - 7.82 \, \Delta PR_{0.} + .38 \, \Delta DJ_{2} + .45 \, \Delta XR_{3} \quad R^2 = 88\%
\]

(27.0) (5.2) (0.6) (-2.9) (2.0) (1.0) D.W.= 1.9

Using the (T-G) form of the deficit causes marginal, but not fundamental changes to parameter estimates, suggesting that first differencing has been helpful in removing instability of estimates due to multicollinearity effects. Notice however, that because the two components of the deficit seem to have different marginal effects on credit availability, consolidating them into one variable with one estimated average marginal effect reduces explained variance a bit.

\[
\Delta C_0 = .73 \, \Delta(Y-T_G)_0 + .47 \, \Delta(T_G-G)_{(0)} + 6.25 \, \Delta PR_{0.} + .52 \, \Delta DJ_{2} + .95 \, \Delta XR_{AV,12} \quad R^2 = 85\%
\]

(25.4) (4.6) (-2.0) (3.0) (2.0) D.W.= 1.9

Our results using the two year lag or average one & two year lags is consistent with the notion that a one-point increases in the trade weighted exchange rate (then), making imports cheaper, increase current year demand for consumer goods by an estimated $0.76 - $1.14 billion dollars.

At this point, we cannot tell if this represents an increase in demand for imported goods only, without decreasing demand for domestic goods. It might also be a net increase resulting from a larger increase in imports demand, partially offset in "C" by a substitution-effect decline in demand for domestically produced consumer goods. However, regression models below dealing with just the demand for imports indicates that exchange rate increases are correlated with an increased demand for imports of
roughly the same magnitude. These findings seem to imply, somewhat surprisingly, that while demand for imports may increase with increases in the prior year or two year ago exchange rate, demand for domestically produced consumer goods may not fall much due to substitution effects when those rates change.

The two stage least squares/heteroskedasticity/autocorrelation correction process left results on all variables essentially unchanged compared to traditional, single stage least squares results (not shown here), except to markedly strengthen the t-statistic on the income variable and weaken slightly the average exchange rate for the past two years as a systematic influence on total consumption compared to the 2-year ago exchange rate. Note that the most systematic impact of the exchange rate on total consumption appears to occur when we use the 2-year ago version alone, or perhaps the average exchange rate for the past two years.

We might hypothesize that the reason for this delay in consumer reaction to a change in the exchange rate is a delay in the process of adjusting product prices to changes in the exchange rate. This might occur because orders for many consumer goods, e.g., cars, parts provided by car parts suppliers or woods for furniture, are made well in advance of payment, pursuant to multi-year price contracts. However, this is merely a hypothesis. Determining the reason for the two year or past two year average exchange rate being the most consistent with the theory that exchange rates systematically affect consumption is beyond the scope of this paper.

Above, we used both the \((T_0-G)\) and the disaggregated form of the government deficit \((T, G\) separately) (in addition to the Prime interest rate) to assess the impact of scarcity of consumer credit on consumer demand. The need for additional variable(s) beside the Prime rate to capture the total effect of credit scarcity ("crowd out") is not surprising. In another study currently underway (Heim 2007b) compelling evidence is found that the prime rate, a base rate for much consumer credit, is institutionally adjusted by the banking community to reflect changes in the federal funds rate. Therefore, used alone, it is not as fully indicative of credit availability as a supply and demand driven interest rate might be.

Next, we will look at how total U.S. imports vary with changes in the determinants of consumer demand. Again we start with the baseline model, which does not include the exchange rate, and observe how adding the exchange rate augments our results:

$$
\Delta M_0 = 0.15 \Delta(Y-T_0) + 0.21 \Delta T_{G(0)} - 0.07 \Delta G_0 - 0.08 \Delta PR_0 + 0.06 \Delta DJ - 0.06 \Delta XR + 0.71 \Delta R(1) + 0.48 \Delta R(2)
$$

\(t\) \(4.8\) \(3.4\) \(-0.6\) \(-0.7\) \(0.3\) \(4.9\) \(3.0\)

\(R^2=87\%\) \(D.W.=1.9\)

$$
\Delta M_0 = 0.15 \Delta(Y-T_0) + 0.30 \Delta T_{G(0)} - 0.22 \Delta G_0 - 2.27 \Delta PR_0 + 0.84 \Delta DJ - 0.63 \Delta XR - 0.63 \Delta XR
$$

\(t\) \(5.8\) \(6.7\) \(-2.6\) \(-1.8\) \(7.3\) \(2.5\)

\(R^2=85\%\) \(D.W.=1.5\)

$$
\Delta M_0 = 0.15 \Delta(Y-T_0) + 0.31 \Delta T_{G(0)} - 0.28 \Delta G_0 - 1.66 \Delta PR_0 + 0.84 \Delta DJ - 1.06 \Delta XR
$$

\(t\) \(6.5\) \(6.7\) \(-3.8\) \(-1.4\) \(6.7\) \(5.6\)

\(R^2=87\%\) \(D.W.=1.8\)

$$
\Delta M_0 = 0.16 \Delta(Y-T_0) + 0.27 \Delta T_{G(0)} - 0.29 \Delta G_0 - 2.22 \Delta PR_0 + 0.89 \Delta DJ + 0.94 \Delta XR
$$

\(t\) \(6.1\) \(6.1\) \(-3.0\) \(-2.0\) \(7.2\) \(5.0\)

\(R^2=86\%\) \(D.W.=1.7\)
\[
\Delta M_0 = 0.16 \Delta (Y - T_G)_0 + 0.30 \Delta T_{G(0)} - 0.30 \Delta G_0 - 1.68 \Delta PR_0. + 0.85 \Delta DJ_{-2} + 0.92 \Delta XR_{AV12} \quad R^2 = 88% \\
(t) \quad (6.8) \quad (7.4) \quad (3.6) \quad (-1.5) \quad (6.7) \quad (7.7) \quad D.W. = 1.8
\]

and using the (T-G) form of the deficit leaves most estimates virtually unchanged:

\[
\Delta M_0 = 0.16 \Delta (Y - T_G)_0 + 0.30 \Delta (T_{G(0)} - G_0) - 1.68 \Delta PR_0. + 0.85 \Delta DJ_{-2} + 0.92 \Delta XR_{AV12} \quad R^2 = 88% \\
(t) \quad (8.1) \quad (7.5) \quad (-1.6) \quad (6.8) \quad (8.2) \quad D.W. = 1.8
\]

Here again, our results are consistent with the theory that the demand for imports is significantly and positively affected by the exchange rate. During the 1960-2000 period, the exchange rate varied between 84 and 143, with a mean value of 107 (1973 = 100 for this index). An average increase in consumer imports of about $0.92 - 1.06 billion is found to accompany a one index point (or about 1%) strengthening of the dollar, i.e., increase in the exchange rate.

Even changes in the rate during the current year show some correlation with changes in total imports, though not as much as changes for the prior year or two. In this and subsequent analyses, we interpret the lesser change found when using the current year value of the exchange rate as akin to an errors-in-variables problem. That is, we viewing the current year rate as an imperfect substitute for the prior year or prior two years’ rates, which seem more systematically related to consumption, biasing the current year coefficient downward.

Our next analyses will attempt to separate consumer imports out of total imports. The data available in Table B104 of the statistical appendix to the *Economic Report of the President, 2002* breaks down all U.S goods imports into only the following categories:

- **Total Imports**
- Petroleum & Petroleum Products
- Industrial Supplies and Materials
- Capital Goods, Except Automotive
- Automotive
- Other

(No comparable breakdown of services is provided in the various appendix tables.)

Some of these clearly are not consumer goods categories. For other categories, such as automotive, petroleum and “other”, some portion (not clearly identified) are consumer goods. We will try several alternative definitions of consumer imports, defining them as total imports minus either

- (only) the capital goods category,
- the capital goods category and the industrial supplies and materials category, or
- capital goods, industrial supplies and materials and half of the value of the petroleum products.

The results of these analyses are shown below.
The first analysis defines consumer goods imports as total imports minus capital goods imports (M_{m-k}):

\[
\Delta M_{m-k} = .11 \Delta (Y-T_G)_0 + .27 \Delta T_{G(0)} - .08 \Delta G_0 - 2.30 \Delta PR_0 + .51 \Delta DJ - .45 \ AR(1) \quad \text{R}^2 = 86\% \\
(t) \quad (4.7) \quad (4.2) \quad (-0.8) \quad (-2.2) \quad (6.8) \quad (2.6) \quad \text{D.W.} = 1.7
\]

\[
\Delta M_{m-k} = .11 \Delta (Y-T_G)_0 + .28 \Delta T_{G(0)} - .16 \Delta G_0 - 3.00 \Delta PR_0 + .59 \Delta DJ + .67 \Delta X R_0 \quad \text{R}^2 = 87\% \\
(t) \quad (5.9) \quad (6.2) \quad (-2.5) \quad (-2.9) \quad (8.6) \quad (3.8) \quad \text{D.W.} = 1.5
\]

\[
\Delta M_{m-k} = .11 \Delta (Y-T_G)_0 + .29 \Delta T_{G(0)} - .23 \Delta G_0 - 2.39 \Delta PR_0 + .59 \Delta DJ + 1.05 \Delta X R_{-1} \quad \text{R}^2 = 90\% \\
(t) \quad (7.3) \quad (6.3) \quad (-4.1) \quad (-2.4) \quad (8.0) \quad (6.3) \quad \text{D.W.} = 2.1
\]

\[
\Delta M_{m-k} = .12 \Delta (Y-T_G)_0 + .25 \Delta T_{G(0)} - .24 \Delta G_0 - 2.96 \Delta PR_0 + .64 \Delta DJ + .89 \Delta X R_{-2} \quad \text{R}^2 = 88\% \\
(t) \quad (7.7) \quad (5.7) \quad (-3.2) \quad (-3.0) \quad (8.9) \quad (4.6) \quad \text{D.W.} = 1.8
\]

\[
\Delta M_{m-k} = .12 \Delta (Y-T_G)_0 + .28 \Delta T_{G(0)} - .25 \Delta G_0 - 2.42 \Delta PR_0 + .61 \Delta DJ + .91 \Delta X R_{AV12} \quad \text{R}^2 = 91\% \\
(t) \quad (9.1) \quad (7.0) \quad (3.8) \quad (-2.7) \quad (8.0) \quad (8.4) \quad \text{D.W.} = 2.1
\]

Using the (T – G) form of the deficit leaves the estimates virtually unchanged:

\[
\Delta M_{m-k} = .12 \Delta (Y-T_G)_0 + .27 \Delta (T_G-G)_0 - 2.40 \Delta PR_0 + .61 \Delta DJ + .92 \Delta X R_{AV12} \quad \text{R}^2 = 91\% \\
(t) \quad (11.0) \quad (7.3) \quad (-2.8) \quad (8.3) \quad (9.0) \quad \text{D.W.} = 2.2
\]

Here again we find a highly systematic, positive relationship between the changes in the exchange rate and changes in (this definition of) consumer goods and services imports. Again, lagged values of the exchange rate seem to be the ones driving current demand for imports, with the one year and two past year average lag most systematically related. Again the results suggest about a $1 billion increase in consumer imports accompanies a 1 index point increase in the trade weighted exchange rate.

Next, we try approximating the value of imported consumer goods as total imports minus imported capital goods and industrial supplies and materials. Doing so, we get :

\[
\Delta M_{m-kSm} = .08 \Delta (Y-T_G)_0 + .25 \Delta T_{G(0)} - .02 \Delta G_0 - 3.61 \Delta PR_0 + .46 \Delta DJ + .50 \ AR(1) \quad \text{R}^2 = 86\% \\
(t) \quad (4.9) \quad (5.5) \quad (-0.3) \quad (-3.8) \quad (5.5) \quad (4.6) \quad \text{D.W.} = 1.7
\]

\[
\Delta M_{m-kSm} = .08 \Delta (Y-T_G)_0 + .21 \Delta T_{G(0)} - .06 \Delta G_0 - 3.21 \Delta PR_0 + .59 \Delta DJ + .73 \Delta X R_0 + .44 \ AR(1) - .38 \ AR(2) \quad \text{R}^2 = 89\% \\
(t) \quad (6.3) \quad (5.4) \quad (-1.0) \quad (-3.6) \quad (11.3) \quad (3.8) \quad (2.7) \quad (-2.2) \quad \text{D.W.} = 1.9
\]

\[
\Delta M_{m-kSm} = .08 \Delta (Y-T_G)_0 + .26 \Delta T_{G(0)} - .16 \Delta G_0 - 3.54 \Delta PR_0 + .54 \Delta DJ + 1.07 \Delta X R_{-1} \quad \text{R}^2 = 91\% \\
(t) \quad (5.6) \quad (6.0) \quad (-3.5) \quad (-4.0) \quad (9.7) \quad (6.1) \quad \text{D.W.} = 2.3
\]

\[
\Delta M_{m-kSm} = .09 \Delta (Y-T_G)_0 + .20 \Delta T_{G(0)} - .17 \Delta G_0 - 3.96 \Delta PR_0 + .66 \Delta DJ + 1.11 \Delta X R_{-2} - .42AR(2) \quad \text{R}^2 = 90\% \\
(t) \quad (9.2) \quad (4.3) \quad (-2.6) \quad (-3.4) \quad (12.6) \quad (5.7) \quad (-2.1) \quad \text{D.W.} = 1.9
\]

\[
\Delta M_{m-kSm} = .09 \Delta (Y-T_G)_0 + .25 \Delta T_{G(0)} - .18 \Delta G_0 - 3.57 \Delta PR_0 + .55 \Delta DJ + .92 \Delta X R_{AV12} \quad \text{R}^2 = 93% \\
(t) \quad (10.0) \quad (6.7) \quad (3.6) \quad (-4.6) \quad (9.3) \quad (9.1) \quad \text{D.W.} = 2.3
\]

Using the (T – G) form of the deficit leaves the estimates virtually unchanged:
\[ \Delta M_{\text{m-ksmp}} = .10 \Delta (Y-T)_{0} + .24 \Delta (T_G-G_0) - 3.52 \Delta PR_{0,1} + .56 \Delta DJ_{2} + .94 \Delta XR_{AV12} \quad R^2 = 92\% \]

\[
\begin{array}{ccccccc}
\text{(t)} & (11.4) & (7.5) & (-5.0) & (10.3) & (9.5) & \text{D.W.} = 2.3 \\
\end{array}
\]

Again we find that adding the exchange rate variable adds as much as 6% to the variance explained, showing a significant influence of the rate on consumer import spending, by this definition of consumer imports. An average increase in consumer imports of about $0.92 - 1.11 billion is found to accompany a one index point (or about 1%) strengthening of the dollar, i.e., increase in the exchange rate. We again interpret the lesser change found when using the current year value of the exchange rate as akin to an errors-in-variables problem, viewing the current year rate as an imperfect substitute for the prior year or prior two years’ rates, biasing the result downward.

Next, we try approximating domestically produced consumer goods from the data available to us as total C minus imported capital goods, imported industrial supplies and materials, and \( \frac{1}{2} \) of all imported petroleum:

\[ \Delta M_{\text{m-ksmp}} = .08 \Delta (Y-T)_{0} + .23 \Delta T_{G(0)} - .07 \Delta G_0 - 4.21 \Delta PR_{0} + .49 \Delta DJ_{2} + .71 \text{AR}(1) - .36 \text{AR}(2) \quad R^2 = 86\% \]

\[
\begin{array}{ccccccc}
\text{(t)} & (6.2) & (4.8) & (-0.8) & (-3.8) & (5.2) & (4.9) & (-2.0) & \text{D.W.} = 2.0 \\
\end{array}
\]

\[ \Delta M_{\text{m-ksmp}} = .08 \Delta (Y-T)_{0} + .21 \Delta T_{G(0)} - .07 \Delta G_0 - 4.22 \Delta PR_{0} + .53 \Delta DJ_{2} + .61 \Delta XR_{0} + .61 \text{AR}(1) - .37 \text{AR}(2) \quad R^2 = 87\% \]

\[
\begin{array}{ccccccc}
\text{(t)} & (6.7) & (4.2) & (-0.7) & (-3.8) & (8.1) & (4.6) & (4.6) & (-2.2) & \text{D.W.} = 2.0 \\
\end{array}
\]

\[ \Delta M_{\text{m-ksmp}} = .08 \Delta (Y-T)_{0} + .28 \Delta T_{G(0)} - .17 \Delta G_0 - 4.56 \Delta PR_{0} + .49 \Delta DJ_{2} + 1.33 \Delta XR_{1} \quad R^2 = 91\% \]

\[
\begin{array}{ccccccc}
\text{(t)} & (6.5) & (5.0) & (-2.8) & (-4.6) & (7.9) & (5.1) & \text{D.W.} = 2.0 \\
\end{array}
\]

\[ \Delta M_{\text{m-ksmp}} = .08 \Delta (Y-T)_{0} + .16 \Delta T_{G(0)} - .12 \Delta G_0 - 4.36 \Delta PR_{0} + .66 \Delta DJ_{2} + 1.23 \Delta XR_{2} + .31 \text{AR}(1) - .53 \text{AR}(2) \quad R^2 = 90\% \]

\[
\begin{array}{ccccccc}
\text{(t)} & (7.1) & (3.3) & (1.6) & (-2.9) & (12.1) & (4.9) & (2.2) & (-3.6) & \text{D.W.} = 1.9 \\
\end{array}
\]

\[ \Delta M_{\text{m-ksmp}} = .08 \Delta (Y-T)_{0} + .25 \Delta T_{G(0)} - .19 \Delta G_0 - 4.57 \Delta PR_{0} + .51 \Delta DJ_{2} + 1.12 \Delta XR_{AV12} \quad R^2 = 93\% \]

\[
\begin{array}{ccccccc}
\text{(t)} & (11.0) & (6.2) & (3.5) & (-5.3) & (8.2) & (7.0) & \text{D.W.} = 1.8 \\
\end{array}
\]

Again, using the \((T - G)\) form of the deficit leaves the estimates virtually unchanged:

\[ \Delta M_{\text{m-ksmp}} = .09 \Delta (Y-T)_{0} + .25 \Delta (T_G-G_0) - 4.53 \Delta PR_{0} + .51 \Delta DJ_{2} + 1.14 \Delta XR_{AV12} \quad R^2 = 93\% \]

\[
\begin{array}{ccccccc}
\text{(t)} & (11.9) & (6.5) & (-5.6) & (8.8) & (7.2) & \text{D.W.} = 1.9 \\
\end{array}
\]

Again, using this definition of consumer imports, our results are about the same, and adding the exchange rate variable to the demand for imports equation adds about 7% - points to explained variance. A one index point change in the exchange rate is associated with a rise in imported consumer goods and services of $1.12 - $1.33 billion.

Graph 1 below plots the closeness of the fit between the level of consumer imports and the explanatory variables in the equation second above. The right scale measures, in billions of 1996 dollars, the predicted ("fitted") value (green line) compared to the actual value (red line) of the change in imports each year 1962 - 2000. The left scale measures, in billions, the difference between the estimated and actual values for each
year. The blue line at the bottom of the graph shows this enlarged view of the gap shown in the upper curves."

Graph 1

\[ \Delta M_{m-kmp} = 0.08\Delta(Y-T_G)_{t-1} + 0.25\Delta T_G - 0.19 \Delta G_{t-1} - 4.57\Delta PR_{t-1} + 0.51 \Delta DJ_{t-2} + 1.12 \Delta XR_{AV_{12}} \]

\( R^2 = 93\% \)

Impact of Exchange Rate on U.S. Exports in Consumer Goods:

A simpler model was also run to determine the extent to which changes in total exports were determined by changes in the U.S. trade weighted exchange rate. The model is extremely simple, testing how systematically, and in what direction, total exports (and imports) moved as the exchange rate changed, controlling only for the sizable differences in the size of the economy between 1960 and 2000 (using the disposable income variable used previously in this study). Similar analyses were done for just consumer goods and services exports and imports.

Below we have shown the model used and the resulting sign, magnitude and statistical significance of the exchange rate variable: Two stage least squares, heteroskedasticity and autocorrelation controls were used, as in earlier statistical tests.
Overall, then it does seem as though the exchange rate has an important influence on both U.S. exports of consumer goods and U.S imports of consumer goods, and in the theoretically expected way. On average, our results suggest approximately a $1 billion dollar change in current year imports will occur for each one point change in the trade weighted exchange rate during the past year or two. Our findings also suggest a likely change in current consumer goods exports of about ¾ billion for the same size change a year earlier in the exchange rate.

Left for further study is the issue of how domestically produced consumption varies with the exchange rate, which is only slightly, and inferentially dealt with here, with somewhat
surprising results. Also left for further study is the question of why import demand seems to lag exchange rate changes by one or two years.

BIBLIOGRAPHY


