DOES A STRONG DOLLAR INCREASE DEMAND FOR BOTH DOMESTIC AND IMPORTED GOODS?

John J. Heim, Rensselaer Polytechnic Institute, Troy, New York, USA

ABSTRACT

Rising exchange rates strengthen the dollar and lower prices on imported consumer goods. Lower import prices have two effects. (1) A substitution effect that shifts demand from domestically produced goods to imports. (2) An income effect that increases demand for imports even further. However, it also allows some income previously spent on imports, but no longer needed due to lower import prices, to be shifted to purchases of domestic goods. This paper finds that for the U.S., 1960 - 2000, the income effect overwhelmed the substitution effect. As a result, econometric results suggest declining import prices increased both import demand and demand for domestically produced consumer goods. The estimated increase in demand for domestically produced consumer goods and services was 3.4 times as large as the increase in demand for consumer imports. Also, because of the large increase in GDP resulting from growth in domestic demand, the trade deficit grew slower than domestic output of consumer goods. This finding suggests that while the trade deficit grows as a result of a strengthening dollar, the increase, as a percent of U.S. GDP, is small, about four tenths of a percent for a ten percent strengthening of the dollar.

Keywords: Macroeconomics, International Trade, Imports, Exports, Exchange Rate

1. INTRODUCTION

For years, much discussion in the United States has centered on whether the Chinese exchange rate is kept artificially high, thereby making it possible (and profitable!) for Americans to buy many Chinese Yuan for each dollar they are willing to exchange. This makes Chinese goods seem cheap compared to American counterparts and may cause a decline in purchases of American goods, and with it, a decline in American jobs. Similarly, the more Yuan it takes to buy a dollar, the less American export goods the Chinese are likely to buy. Similar concerns are raised about some other trading partners.

The question is, are American decisions to purchase domestic vs. foreign goods really that much affected by changes in the exchange rate? Does a rising exchange rate (stronger dollar) really mean rising imports and declining purchases of domestic goods? If so, is it a one-for-one trade off, or are rising imports only partially financed by declining purchases of domestic goods? Also, rising exchange rates lower import prices, which increases Americans’ real incomes and purchasing power through the “income effect”. Might it be that we purchase more domestic goods as well as more imported goods when a rising exchange rate creates a stronger dollar? These are empirical questions which this paper seeks to answer. To do so we will examine the effect of exchange rate changes 1960-2000 on demand for both domestic and imported consumer goods and services. We will especially look to see if a rise in one is offset by a decline in the other, or accompanied by a rise in the other because the “income effect” swamps the “substitution effect” resulting from the change in relative prices.

2. 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. Data Tables B2, B3, B7, B26, B54, B60, B73, B82, B90, B95, B104, B106 and B110. However, additional multilateral trade weighted value of the dollar, i.e., the foreign exchange rate data, is taken from Table B110 of the Economic Report of the President, 2001 and Table B108 of the 1997 Economic Report of the President, 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, we need a theory of consumer demand for consumer goods, so that in testing, we can control for changes in consumption causes by things other than the exchange rate, and thereby hopefully
increase the accuracy of our exchange rate effect estimates. Essentially, this paper postulates a modified Keynesian theory of demand for consumer goods (described below). It assumes that in general, the determinants of the demand for imported consumer goods are the same as those mentioned in Keynes (1936), with the addition of two other variables. First, a “crowd out” variable is added, similar to the one used in investment studies to control for periods of limited credit availability which may occur in response to government deficits. Second, we also add an exchange rate variable.

2.1. 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 credits) and a trade weighted 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, in Ruggles & Ruggles (1956, p.306) attempt to describe the Keynesian function in their classic text on national income accounting, 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. Of course, a declining APC means the function has a positive intercept, as is commonly shown in textbook presentations of the Keynesian consumption function.
TABLE 1
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>Disposable 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>3,000-5000</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)

In another study (Heim 2007A), it was 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.

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

where

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

\[
(T_G - G)_0 = \text{The government deficit (interpreted as a restrictor of consumer as well as investment credit. Usually we will disaggregate this into two separate variables in regressions: } \beta_{3A} T_G(0) \text{ and } \beta_{3B} G. \text{ because we found the effects of each on consumer spending to differ, with the tax variable the more important. (Heim 2007)}
\]

\[
PR_0 = \text{An interest rate measure, the Prime rate, for the current period. This rate is a base rate for much consumer credit. It is deflated to get the “real” rate using the average of the past two year's CPI inflation rate.}
\]

\[
DJ_{-2} = \text{A stock market wealth measure, the Dow Jones Composite Average, lagged two years}
\]

\[
XR^{-i} = \text{The trade-weighted exchange rate, lagged “i” years. In some regressions, an average of the XR value for the current and prior year is used (XR}_{AV01}.)}
\]

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 econometric models:

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

or, separately estimating the effects of each of the components of the deficit:
\[
\Delta C_0 = \beta_2 \Delta(Y-TG)_0 + \beta_{3A} \Delta(T)G(0) - \beta_{3B} \Delta(G)_0 - \beta_{4} \Delta(PR)_0 + \beta_{5} \Delta(DJ)-2 + \beta_{6} \Delta(XR)-1
\]

We will test these hypotheses using regression analysis using two levels of lag in the exchange rate variable: 0 lag (current year value) and -1 lag (the exchange rate value for the prior year). We will estimate the regression using one lag, or multiple lags separately in the same equation. We will also test the average exchange rate values for these two years. An average rate may be an alternate way to capture any current year incompleteness in the adjustment to a change in the exchange rate.

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.  Our sample size was only 38 of the 40 observations from the 1960-2000 period, due to use of lags.  With 38 observations, throughout the remainder of the paper, marginal effects with a t-statistic of 1.8 are significant at the 8% level.  t-statistics of 2.0 and 2.7 are significant at the 5% and 1% level respectively.

2.2. OTHER METHODOLOGICAL ISSUES

Because of the simultaneity between the consumption variable (C) in the GDP accounts or its component part, consumer imports, and income (Y) inherent in these equations, two stage least squares estimates of disposable income \(\Delta(Y-TG)_0\) were used.  The remaining right hand side variables were used as first stage regressors.  Newey-West hetroskedasticity 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.

Baseline findings for each model, absent only the exchange rate variable, are also presented.  They are shown to give an idea of the amount of additional variance in consumer spending the exchange rate explains.  Though useful, the extent to which entering the exchange rate variable changes the percent of variance explained needs to be interpreted with care, since order of entry in an equation can affect how much additional variance appears to be explained.  This is a problem when there is significant multicollinearity between the last variable entered and the other explanatory variables.  One important sign of success in avoiding this problem is finding little or no change in the estimated marginal effects of the variables already in the regression when adding the exchange rate.  Therefore, we show results for how all consumption function coefficients change when entering an exchange rate variable, compared to their values in the baseline model.

In the baseline model, equations for total consumption (C) are presented, i.e., consumption of both domestic and imported consumer goods as “C” is used in the GDP identity

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

There is some difficulty unambiguously separating consumer imports out of total imports in the CEA’s data Appendix to the Economic Report of the President, 2002, Table B-104.  It is not clear from that table, for example, how much of the value of motor vehicle imports or petroleum imports are for business inventory investment vs. consumer use.  In addition, data on imported services (Table B-106 in the CEA data appendix) does not distinguish between business and consumer services imports or extend back beyond 1974, so no deduction from total imports for business services imports could be made in calculating consumer imports.

Ultimately, we took as a reasonable definition of consumer goods imports, given the data available, “total imports minus imports of capital goods and industrial supplies and materials”, to be denoted (M_{m-ksm}).

We then subtract the regression coefficients for each variable in this imports equation from our total imports and domestic consumption (C) regression results for the same variables to obtain estimates of how those same consumption determinants affect demand for domestically produced consumer goods.  We find that the coefficients obtained this way are precisely the same as those obtained by regressing the variable (C - M_{m-ksm}) on our standard consumption determinants.
After estimating the baseline model (no exchange rate variable included), we then estimated a model that includes a current year \((XR_0)\) and prior year \((XR_1)\) exchange rate as separate variables, because preliminary testing indicated there also seemed to be lagged effects on consumer demand of a change in exchange rates, probably because of lags in import price and export demand adjustments to rate changes. Finally, we then estimated a model in which the exchange rate variable is an average of the current year and prior year rate \((XR_{AV01})\).

We include multiple years’ separate rates, or multiple year average rates, on the theory it may take more than one period for spending to fully adjust to a change in exchange rates, as noted earlier in this paper. Therefore, not only this year’s exchange rate change but prior years’ changes may affect current period consumption. For example, peoples’ demand may be conditioned on what they recall price has been in the recent past as well as what it is today. It may also be that there are long lead times required for delivery of some items, e.g., furniture, automobiles. If so, this year’s actual purchases may have been the result of a prior year’s decision to purchase, based on a prior year’s price determined in part by that year’s exchange rate.

3. FINDINGS

3.1 THE BASELINE MODEL - NO EXCHANGE RATE:

This model is presented so that we can assess how much additional explanatory power the model has when we do later add an exchange rate variable. Though results are presented for all the other variables thought to influence consumer spending, these are not our focus in this study. They are presented simply to allow comparisons with results on the same variables in later models containing the exchange rate. To the extent these regression coefficients stay about the same when an exchange rate variable is added to the model, it reduces the chances that the exchange rate variable’s estimated effect is distorted by its ability to pick up variance attributable other variables in the equation, because it is correlated with them.

Note that here, and in subsequent models, we most often use the disaggregated version of the crowd out variable, because their seems to be different effects on consumer credit availability that result from changing the government deficit by changing taxes compared to changing government spending levels. This we hypothesize may be due to a tendency of the monetary authorities to accommodate increases in the deficit caused government spending by increasing the money supply, than to do so when the deficit increase is the result tax cuts.

Each model’s findings will be presented in the form of three equations. The first presents our findings on how well our hypothesized determinants of consumption actually explain total consumption demand \((C)\), the second presents our findings on how well our hypothesis can explain demand for imported consumer goods and services \((M_{m-ksm})\), and the third equation presents our findings on how well our hypothesis explains demand for domestically produced consumer goods and services \((C-M_{m-ksm})\). The “no exchange rate” baseline model results are as follows:

\[
\Delta C_0 = .65 \Delta (Y-TG)_0 + .48 \Delta TG(0) + .07 \Delta G_0 - .72 \Delta PR0. + .72 \Delta DJ-2
\]

\(R^2 = 91\%\)

\(t\) \( (31.8) \) \( (4.8) \) \( (0.4) \) \( (-3.9) \) \( (5.1) \) \( D.W. = 1.8 \)

Minus

\[
\Delta (M_{m-ksm})_0 = .10 \Delta (Y-TG)_0 + .29 \Delta TG(0) - .16 \Delta G_0 - .83 \Delta PR0. + .44 \Delta DJ-2
\]

\(R^2 = 77\%\)

\(t\) \( (4.4) \) \( (4.1) \) \( (-2.1) \) \( (-2.5) \) \( (3.7) \) \( D.W. = 1.4 \)

Equals:

\[
\Delta (C - M_{m-ksm})_0 = .55 \Delta (Y-TG)_0 + .19 \Delta TG(0) + .22 \Delta G_0 - 1.90 \Delta PR0. + .28 \Delta DJ-2
\]

\(R^2 = 74\%\)

\(t\) \( (16.2) \) \( (1.5) \) \( (1.4) \) \( (-0.6) \) \( (2.0) \) \( D.W. = 1.8 \)
Notice that the regression coefficients in the last regression are precisely (except for rounding) those you would obtain subtracting the coefficients in the second equation from those in the first! Our confidence in each of the regression’s findings is strengthened by being able to correctly predict the results of either the first, second or third regression from the results obtained in the other two.

In all three equations we find all the Keynesian - postulated determinants of consumption significant at least the 5% (t=2.0) level. We also find the (non-Keynesian) tax variable in the (disaggregated) government deficit (crowd out) expression highly significant in two of the three, but not necessarily the government spending variable. Above, we noted that this difference in results between these two components might be anticipated.

Running our regressions in first differences of the variables instead of in levels provides somewhat smaller levels of explained variance. This is to be expected when using time series data, since regressions in levels tend to overstate explained variance. But first differences is generally considered a technique that strengthens the credibility of the rest of the parameter estimates. Even using first differences and without yet adding the exchange rate variable, the baseline model explains most of the variance in consumer spending, particularly for total consumption of domestic and imported goods (91%), and much of it for imported consumer goods (77%). 74% of the variation in domestically produced goods and services is explained.

If we entered the government deficit variables as one variable \( \Delta(T_G - G) \), we see in a way we are more used to visualizing, how systematically the government deficit seems to be related to consumer spending. In the earlier Heim (2007) study: it is the second most powerful explainer of consumer demand, after income. Below, to illustrate, we have used one deficit variable in the total consumption equation. Because it masks the differential effects of its two components, and by doing so, somewhat reduces explained variance, hereafter we will only show results for the two variable version of the deficit.

\[
\Delta C_0 = .71 \Delta(Y - T_G)_0 + .43 \Delta(T_G - G)_0 - 6.45 \Delta PR_0 + .86 \Delta DJ - 2 \quad R^2 = 87\%
\]

As we noted, the regression coefficients in the regression above for domestic consumption are precisely (except for rounding) those you would obtain subtracting the imports consumption equation from the first regression, i.e., for the total consumption regression. This finding holds for both one stage least squares and two stage least squares (2SLS), as well as for either of these accompanied by hetroskedasticity adjustments.

It is only approximately true when different methods are used for different equations in the model or when autocorrelation corrections are made to equations. For example, in the model above we found 1st order autocorrelation in the imports equation, but not in the \( C \) or \( (C - M_{m-k}) \) equations. Below we show how the autocorrelation controls change the import equation coefficients (and standard errors, \( R^2 \), and Durbin Watson statistics).

\[
\Delta(M_{m-k})_0 = .09 \Delta(Y - T_G)_0 + .20 \Delta T_G(0) + .03 \Delta G_0 - 2.09 \Delta PR_0 - .17 \Delta DJ - 2 + .96 AR(1) \quad R^2 = 82\%
\]

Autocorrelation is often a sign of a missing explanatory variable. When we add the exchange rate to the model, we will find the autocorrelation variable becomes insignificant and the government spending and wealth variables return to something close to their original values.
3.2 ADDING THE EXCHANGE RATE TO THE BASELINE MODEL

In our second model, we add the current year exchange rate to the baseline model. The effect on our three equations is as follows:

\[
\begin{align*}
\Delta C_0 &= .66 \Delta (Y-T_G)_0 + .48 \Delta T_G(0) + .05 \Delta G_0 - 6.75 \Delta PR_0 + .76 \Delta DJ_2 - .45 \Delta XR_0 \\
(\text{t}) &= (31.7) (4.5) (0.3) (4.5) (5.6) (-1.0) \\
R^2 &= 91\% \\
\text{D.W.} &= 1.7
\end{align*}
\]

\[
\begin{align*}
\Delta (M_{m-ksm})_0 &= .10 \Delta (Y-T_G)_0 + .29 \Delta T_G(0) - .13 \Delta G_0 - 4.79 \Delta PR_0 + .38 \Delta DJ_2 + .64 \Delta XR_0 \\
(\text{t}) &= (5.2) (4.9) (-1.9) (-3.0) (3.0) (3.0) \\
R^2 &= 80\% \\
\text{D.W.} &= 1.7
\end{align*}
\]

\[
\begin{align*}
\Delta (C- M_{m-ksm})_0 &= .55 \Delta (Y-T_G)_0 + .18 \Delta T_G(0) + .17 \Delta G_0 - 1.95 \Delta PR_0 + .38 \Delta DJ_2 - 1.09 \Delta XR_0 \\
(\text{t}) &= (18.9) (1.4) (1.0) (-0.8) (2.6) (2.4) \\
R^2 &= 77\% \\
\text{D.W.} &= 1.9
\end{align*}
\]

Notice that the exchange rate here is statistically significant in both the import and domestic consumption equations, and adds about 3% to the explained variance levels in these equations. Since the effect of these two equations is to offset almost 60% the reduction in domestic purchases with increases in imports, it is not surprising that in the total consumption equation, where the exchange rate variable shows only the smaller net negative effect, we do not find the exchange rate statistically significant. But this should not be misinterpreted as meaning the exchange rate does not matter.

The coefficients on our baseline model variables are virtually unchanged by adding the exchange rate variable. This is a good sign that neither they, nor the exchange rate variable's coefficient, are being distorted by an ability to explain part of each other's variance because their movements over time are correlated.

For our third model, we add both the current and immediate past year exchange rates to the baseline model as one way of hypothesizing that it may take more than one period for exchange rate changes to result in increased purchases, perhaps because of long production lead times required after orders are placed, or multiyear price contracts. Our results are

\[
\begin{align*}
\Delta (C)_0 &= .65 \Delta (Y-T_G)_0 + .48 \Delta T_G(0) + .00 \Delta G_0 - 6.08 \Delta PR_0 + .77 \Delta DJ_2 - .82 \Delta XR_0 + .99 \Delta XR_1 \\
(\text{t}) &= (30.6) (5.0) (0.0) (-3.8) (6.8) (-2.3) (1.9) \\
R^2 &= 92\% \\
\text{D.W.} &= 2.0
\end{align*}
\]

\[
\begin{align*}
\Delta (M_{m-ksm})_0 &= .10 \Delta (Y-T_G)_0 + .30 \Delta T_G(0) - .18 \Delta G_0 - 4.10 \Delta PR_0 + .39 \Delta DJ_2 + .26 \Delta XR_0 + 1.02 \Delta XR_1 \\
(\text{t}) &= (6.2) (5.1) (-3.5) (-2.9) (4.5) (1.0) (3.7) \\
R^2 &= 86\% \\
\text{D.W.} &= 2.1
\end{align*}
\]

\[
\begin{align*}
\Delta (C- M_{m-ksm})_0 &= .55 \Delta (Y-T_G)_0 + .18 \Delta T_G(0) + .17 \Delta G_0 - 1.97 \Delta PR_0 + .38 \Delta DJ_2 - 1.08 \Delta XR_0 - .03 \Delta XR_1 \\
(\text{t}) &= (18.7) (1.4) (1.1) (-0.8) (2.5) (-2.4) (-0.1) \\
R^2 &= 77\% \\
\text{D.W.} &= 1.9
\end{align*}
\]

Adding the prior year exchange rate adds substantially (6%) to explained variance in imports compared to using only the current year rate, and adds slightly to total consumption (1%). The prior year exchange rate is highly significant in the import equation, and the current year rate is significant in the domestic consumption equation. Since the partial offsets to these effects are small (-.03 or +.26), the total consumption estimates largely reflect them, and are also statistically significant. Also notice that the estimated effect of current year changes in the exchange rate change substantially in the total and imports demand equations, when the prior year rate is added to the equation. The correlation between the two rates is .35, suggesting multicollinearity is the source of the problem, and that perhaps the specific year estimates of the exchange rate’s effect are not to be trusted.
3.3 USING AVERAGE EXCHANGE RATES

Analysis elsewhere (Heim, 2007B) indicated that use of an average of the current year and prior year exchange rates (XR\text{AV01}), or using them as separate variables in the regression provided the most statistically significant exchange rate coefficients and/or explained more variance than using either the current and prior year rates separately in the regression, compared to using either the current year rate or the prior year rate alone.

In our next model, the average of current and past year exchange rates is used to see if this better describes the multiyear effects on consumption of a change in exchange rates. Our results are as follows:

\[\Delta (C)_0 = 0.65 \Delta (Y-T_G)_0 + 0.48 \Delta T_G(0) + 0.07 \Delta G_0 - 6.66 \Delta PR_0 + 0.71 \Delta DJ-2 + 0.17 \Delta XR\text{AV01} \quad R^2 = 91\% \]

\[(t) \quad (30.6) \quad (4.9) \quad (0.4) \quad (-3.8) \quad (5.2) \quad (0.3) \quad D.W. = 1.8 \]

\[\Delta (M_{m-ksm})_0 = 0.10 \Delta (Y-T_G)_0 + 0.30 \Delta T_G(0) - 1.15 \Delta G_0 - 4.35 \Delta PR_0 + 0.37 \Delta DJ-2 + 1.29 \Delta XR\text{AV01} \quad R^2 = 85\% \]

\[(t) \quad (6.2) \quad (5.3) \quad (-2.4) \quad (-3.2) \quad (3.6) \quad (5.8) \quad D.W. = 2.0 \]

\[\Delta (C- M_{m-ksm})_0 = 0.55 \Delta (Y-T_G)_0 + 0.18 \Delta T_G(0) + 0.22 \Delta G_0 - 2.31 \Delta PR_0 + 0.34 \Delta DJ-2 - 1.11 \Delta XR\text{AV01} \quad R^2 = 76\% \]

\[(t) \quad (19.2) \quad (1.4) \quad (1.2) \quad (-0.9) \quad (2.5) \quad (-2.0) \quad D.W. = 1.8 \]

Note that the coefficients on this average exchange rate variable are identical (except for rounding) to the sums of the coefficients on the separate current year and past year exchange rate variables used in the model further above. This suggests we can profitably use a multiyear average exchange rate to capture the effects of a current year rate change whose full impact takes place over several years. It also avoids the problem of multicollinearity possibly confounding the reliability of the separate year effects estimates, yet at the same time telling us the total effect over two years. The only loss in using the average is that explained variance is 1% lower in all three equations, compared to when the two exchange rates entered separately.

3.4. THE EFFECT ON DEMAND FOR DOMESTICALLY PRODUCED AND IMPORTED CONSUMER GOODS OF A 1% EXCHANGE RATE CHANGE

Next, the regression equations above will be used to estimate how much the demand for both imported and domestically produced consumer goods will increase (due to both income and substitution effects) when the trade weighted exchange rate rises one index point, or about 1%, from year 2000 values. Economic theory suggests both the income and the substitution effects for imports should be positive, each causing increased purchases of imported consumer goods.

The findings above will also be used to evaluate what is likely to happen to demand for domestically produced consumer goods. A negative substitution effect would be expected, as Americans reduce purchases of domestic consumer goods to buy cheaper imports. But lower import prices also increase Americans’ real incomes. This income effect should result in increased purchases of domestic consumer goods. Will the income effect dominate the substitution effect, so that there is a net increase in demand for domestic goods? This is an empirical question, to be examined in the remainder of this paper.

We will use the exchange rate variable coefficients discussed above to calculate the impact of a one index point (~1%) change in the exchange rate on purchases of domestically produced and imported consumer goods. In the calculations below, we have used the last set of regression results, which use the current and prior year average as the exchange rate variable, to make some key projections.

A one point increase the trade-weighted exchange rate index (roughly a 1% increase at 2000 index levels) could reduce import prices about one percent, if the change was passed entirely through to the
consumer. We assume it is, at least over a period of years. In the year 2000, U.S. total real imports (1996 dollars) were $1,532 billion. A one percent saving reduces their cost by $15.32 billion, increasing real incomes in the U.S. by the same amount. Real disposable income also increases the same amount, since there is no tax effect: nominal (taxable) income is the same; real income has increased only because prices have dropped.

Using this as a starting point, we will use simple Keynesian multiplier analysis to determine the total growth in income resulting from the initial $15.32B increase due to lower import prices.

However, part of this income gain would be offset by income losses due to substitution effects causing decline in domestic consumption. Our domestic goods consumption regression suggests a direct decline in purchases of domestically produced consumer goods of $1.11 billion. But our regression results also indicate an increase in import purchases (substitution effect) due to the exchange rate change, *income held constant*, of $1.29 billion. This suggests that part of the substitution effect resulting from overall lower import prices is a shift in the marginal propensity to consume toward imports and away from domestic goods in the years after the exchange rate change, increasing import purchases out of existing income another $0.18 Billion ($1.29 B - $1.11B) by the end of the year after the exchange rate change.

In addition, there is another reduction in income that occurs because of the decline in exports associated with the change in the exchange rate. A rough estimate of this effect can be obtained by regressing exports on the current and prior year average exchange rate used above and the growth in the American GDP over the 1960-2000 period. The income variable serves as a rough control for the growth in our major trading partners’ incomes over this period, which also affects the demand for our exports. The results of this regression, using first differences in the data to reduce multicollinearity and stationarity problems, as well as 2SLS, autocorrelation and heteroskedasticity controls are as follows:

\[
\Delta X_0 = 0.04 \Delta (Y)_0 - 1.32 \Delta XR_{AV0123} + 0.42 AR(1) + 0.55 \Delta AR(3) \quad R^2 = 51%
\]

\(t\) | (2.0) | (-4.3) | (1.7) | (3.3) | D.W. = 2.0

The net increase in income ($15.32B price effect minus $1.11B substitution and $1.32 exports effects) will then be evaluated in terms of its impact on consumer demand, using the marginal propensities to consume domestic (.55) and imported goods (.10) estimates in the above equations. These MPCs will be used to determine the changes in demand for domestic and imported goods due to the income effect, and this result will be adjusted for substitution effects.

In calculating the effects of exchange rate changes on demand for imported and domestic consumer goods, we need to include multiplier effects. Using the marginal propensity to consume domestic goods (MPCD = .55) given in the domestic consumption equation above, we get a consumption multiplier of \(1/(1-0.55) = 2.22\). In the calculations below, we will also make use of the fact that taxes levied (\(T_c\)) to purchase government goods and services (G) averaged 20% of real income (Y) during the 1960-2000 period.

Are the statistical results immediately above consistent with what we would expect to happen to demand for imported and domestic consumer goods as a result of the one point (~1%) change in the trade-weighted exchange rate? The answer is, they are. There is strong evidence of both income and substitution effects, in the right directions, as shown immediately below.
3.41. CALCULATION OF EXCHANGE RATE EFFECTS ON CONSUMPTION

$12.89B Initial Change in Real Income = $15.32B - Import (M) price drop
   - 1.11B - Substitution effect drop in CD
   - 1.32B - Drop in exports (X)
$12.89B

x 2.22 Multiplier
$28.62B Total Change in Real Income (Real GDP) after multiplier effects

$13.37B Initial Change in Disposable Real Income = $15.32B (Import price drop - 0% tax)
   - 0.89B (1.11B CD - 20% Tax)
   - 1.06B (1.32B X - 20% Tax)
$13.37B

x 2.22 Multiplier
$29.68B (= $13.37 Disposable Income plus 16.31 multiplier - generated pre-tax income)
- 3.26B (20% Tax on $16.31 multiplier generated pre-tax income)
$26.42B Total change in Disposable Income $Y-T_G after multiplier effects

$26.42B Δ(Y-T_G) x .55 MPC_D $26.42B Δ(Y-T_G) x .10 MPC_M
$14.53B ΔCD (Inc. Effect) $2.64B ΔCM (Inc. Effect)
-1.29B Substitution Effect +1.29B Substitution Effect
. & MPC Shift . & MPC Shift
$13.24B Total ΔCD $3.93B Total ΔCM

Clearly, because the MPC_D is so much greater than the MPC_M, the real income change causes a far greater growth in demand for domestically produced consumer goods & services than imports.

We can now calculate the effect of a 1% increase in the exchange rate on the trade deficit;

Change in Trade Deficit: $3.93B - ΔCM + 1.32B - ΔX $5.25B - Change in trade deficit due to a ~1% Change in the Trade-Weighted U.S. Exchange Rate

4. CONCLUSIONS

There are three major conclusions to be drawn from the above analysis:

1. A rising exchange rate strengthens the dollar, raising real income by making imports cheaper. The rising income increases demand for imported consumer goods and services. It also increases overall demand for domestically produced consumer goods and services by a much larger amount. Our estimate of the domestic consumer demand increase is ($13.24/$3.93) = 3.4 times as much as the increase in import demand. Our study is too macroeconomic in nature to be able to say which specific industries will be helped. And of course this implies many more jobs will be created in consumer goods industries than lost due to the reduction in import prices.

2. A one percent change in the trade weighted exchange rate, through its effect on demand for consumer goods and services, would likely result in about a $5.25 billion increase in the
consumer goods and services portion of the trade deficit.

3. The increase in domestic demand is so much greater than the increase in demand for imports that the trade deficit, though it grows when the dollar is strengthened, barely increases as a percent of GDP. Using the numbers above and real GDP, exports and imports data for the year 2000, we see only four hundredths of one percent increase in the trade deficit as a percent of GDP:

<table>
<thead>
<tr>
<th>GDP</th>
<th>Imports</th>
<th>Exports</th>
<th>Trade Deficit (% of GDP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual 2000 Data</td>
<td>$9224.00</td>
<td>$1532.0</td>
<td>$1132.0</td>
</tr>
</tbody>
</table>

Add 1% \( \Delta XR \)

\[ 9252.62 \quad 1535.9 \quad 1130.7 \quad 4.38\% \]

This suggests that even a fairly large, say 10%, strengthening of the exchange rate would only increase the trade deficit, as a percent of GDP, by four tenths of a percent, from 4.34 to 4.74% had it occurred in the year 2000.

There may also be additional impacts on investment through the accelerator and exchange rate effects, and growing income may reduce crowd out for both consumers and investors. Evaluation of these effects however are beyond the scope of this paper.

5. FINAL NOTE ON ECONOMETRIC METHODS:

Earlier we noted that entry of more than one lagged exchange rate variable, as an additional and separate variable in the regression, caused the regression coefficient on a previously entered lag to change, compared to their values in earlier regressions. This is essentially a multicollinearity question and to address it we present below the simple correlation coefficients of the several possible exchange rate variables. As we noted earlier, some of these coefficients indicate that even modest levels of intercorrelation between explanatory variables can sometimes lead to major distortions in marginal effect estimates.

**TABLE 2**

EXCHANGE RATE CORRELATION COEFFICIENTS

<table>
<thead>
<tr>
<th>XR(_0)</th>
<th>XR(_{-1})</th>
<th>XR(_{-2})</th>
<th>XR(_{-3})</th>
</tr>
</thead>
<tbody>
<tr>
<td>XR(_0)</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>XR(_{-1})</td>
<td>.35</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>XR(_{-2})</td>
<td>.05</td>
<td>.35</td>
<td>1.00</td>
</tr>
<tr>
<td>XR(_{-3})</td>
<td>-.22</td>
<td>-.06</td>
<td>.35</td>
</tr>
</tbody>
</table>

6. BIBLIOGRAPHY


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6. AUTHOR PROFILE

John J. Heim has an MPA from Harvard University and a Ph. D. in Political Economy from SUNY Albany. He is currently Associate Professor of Economics at Rensselaer Polytechnic Institute, Troy, NY. A latecomer to academia, Professor Heim previously served as Commissioner of Administration and Finance for the city of Buffalo, NY, Director of Fiscal and Budget Research for the minority party in the NYS Senate, and was President of Heim Industries, a software development firm.