Rensselaer

Working Papers in Economics

HOW FALLING EXCHANGE RATES 2000 - 2007 HAVE AFFECTEDTHE U.S. ECONOMY AND TRADE DEFICIT (EVALUATED USING THE FEDERAL RESERVE'S NOMINAL BROAD EXCHANGE RATE)

John J. Heim
Rensselaer Polytechnic Institute

Number 0802

January 2008

1

HOW FALLING EXCHANGE RATES HAVE AFFECTED
THE U.S. ECONOMY AND TRADE DEFICIT
(EVALUATED USING THE FEDERAL RESERVE'S NOMINAL BROAD EXCHANGE RATE)

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

ABSTRACT:

Falling exchange rates reduce the purchasing power of the dollar, increasing import prices. Higher import prices have two effects. (1) A *substitution* effect that shifts demand from imported to domestically produced goods. (2) An *income* effect that reduces the total amount of real income available for spending on domestic goods and foreign goods. Based on U.S. 1960 - 2000 data, this paper estimates an econometric model that finds that the income effects of falling exchange rates overwhelms the substitution effects, causing a net negative influence on the GDP and income. Results indicate demand for both imported *and* domestic consumer and investment goods is adversely affected because the income effect is so dominant.. For investment goods, there was a 2.52 billion substitution effect out of imported goods when import prices rose due to a one point drop in the nominal Broad exchange rate. Declining real income also caused decreased demand for domestically produced investment goods. For consumer goods, the substitution effect stimulated domestic demand, but was more than offset by the negative effect of declining income. The decrease in demand for domestic goods and services was 2.0 times as large as the decrease in demand for imports. Therefore, the trade deficit fell less in dollars ($198B) than the GDP ($321B) in real dollars. The study estimates that, other things equal, the trade deficit would fall from 4.3% to 2.3% of the GDP as a result of a large 16.1 percent drop in the nominal Broad exchange rate index, such as occurred 2000-07. Had the exchange rate not fallen during this period, we estimate the average annual growth rate of the U.S. economy would have been 3.2%, not the 2.7% it has actually averaged, assuming sufficient capital and labor availability to do so. Finally, we find that a falling trade deficit induced by falling exchange rates ($12.31B per point drop in the rate), reduces the size of the annual transfer of U.S. assets to foreigners needed to finance the deficit by the same amount, but does not result in an equally large change upward by the end of the period in U.S. ownership of assets, because about 2/3 of this gain is offset by an income – decline related drop in savings ($8.28B per point decline in the index) during the same period. JEL E00, F40, F43.

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

1. INTRODUCTION

When market forces and/or exchange rate policies result in a decline in the U.S. exchange rate (XR), where XR = the number of units of a foreign currency a dollar will buy, it reduces the number of units of foreign currency Americans can buy with each dollar they are willing to spend. It could make foreign goods more expensive compared to American goods, causing a shift in demand to American goods. Similarly, the decreased cost (in foreign currency) of a U.S. dollar might cause an increase in foreign purchases of American exports.

Are U.S. decisions to purchase domestic vs. foreign goods heavily affected by changes in the exchange rate between the United States and its major trading partners? Does a falling exchange rate mean a decline in import demand, accompanied by increasing demand for domestic goods? Or might it be that Americans purchase less domestic goods as well as less imported goods, because higher import prices are in part paid for by reducing domestic consumption? These are empirical questions, which this paper seeks to answer. To do so we will econometrically estimate the effect of exchange rate changes 1960-2000 on U.S. demand for both domestic and imported consumer and investment goods and services. Using these statistical results, we then estimate the impact on the U.S. GDP, and GDP growth rates, of the the 13.4% (16.1 index point) decline in the U.S. Federal Reserve's nominal "Broad" trade weighted exchange rate that occurred during the period 2000-2007.

Finally, we will examine how reductions in the trade deficit might reduce transfers of ownership of U.S. assets to other nations or their citizens, as is necessary to pay for trade deficits.

2. THE CONSUMER DEMAND MODEL:

To study the effect of exchange rate changes on consumption of domestically produced and imported consumer goods, we need a theory of consumer demand, so that in testing, we can control for changes in consumption causes by things other than the exchange rate. Essentially, this paper postulates a modified Keynesian theory of demand for consumer goods. 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.

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…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.

Heim (2007A) 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) $C = \beta_1 + \beta_2 (Y-T_G) + \beta_3(T_G - G) - \beta_4 (PR) + \beta_5 (DJ)_{-2} + \beta_6 (XR)_{AV0123}$

where

$(Y-T_G)$ = Total income minus taxes, defined as the GDP minus the portion of total government receipts used to finance government purchases of goods and services, i.e., total government receipts minus the portion used to finance government spending on transfer payments not included in the GDP definition of government spending.

$(T_G - G)$ = 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: $\beta_{3A} T_{G(0)}$ and $\beta_{3B} G$. because it has been found the effects of each on consumer spending differs, with the tax variable the more important. (Heim 2007A)

PR = 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} = A stock market wealth measure, the Dow Jones Composite Average, lagged two years

XR_{-i} = The trade - weighted exchange rate (XR), lagged "i" years. In our regressions, an average of the XR value for the current and past three years is used, denoted XR_{AV0123}. This is done to capture what preliminary studies showed was slow, multiyear process of adjustment to exchange rate changes (Heim, 2007c)

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:

$$\Delta C_0 = \beta_2 \Delta(Y-T_G)_0 + \beta_3 \Delta(T_G - G)_0 \qquad - \beta_4 \Delta(PR)_0 + \beta_5 \Delta(DJ)_{-2} + \beta_6 \Delta(XR)_{AV0123}$$

or

$$\Delta C_0 = \beta_2 \Delta(Y-T_G)_0 + \beta_{3A} \Delta(T)_{G(0)} - \beta_{3B} \Delta(G)_0 - \beta_4 \Delta(PR)_0 + \beta_5 \Delta(DJ)_{-2} + \beta_6 \Delta(XR)_{AV0123}$$

These last two equations are the same except that we have divided the crowd out variable into two variables. We will test these hypotheses, particularly the second one, using regression analysis further below, and use the results to calculate the effects of exchange rate change on consumer demand.

3. THE INVESTMENT DEMAND MODEL

Demand for Investment goods may also decline when exchange rate changes raise import prices, lowering real business and personal income. All decreases in real disposable income should result in decreased purchases of imported and/or domestic consumer goods and services, and result in some decrease in savings. Reductions in disposable income will be distributed in accordance with marginal propensities to consume domestic (MPC_D) and imported (MPC_M) consumer goods and to save (MPS). (which, below, we find are 55%, 11%, and 34% respectively.) The decrease in savings should result in decreased investment. Both classical and Keynesian investment theory suggests that to the extent necessary, interest rates will increase to ensure that decreased savings translates into reduced demand for investment goods.

How much of the decreased demand will be for domestic versus imported investment goods will depend on the marginal propensities to invest (MPI_D or MPI_M) in response to a change in the economy's real growth rate (i.e., the "accelerator effect") caused by a declining exchange rate. A secondary decrease in Investment should also occur due to multiplier effects of the original income, reducing savings even further, causing increased crowd out effects. Any additional decreases in investment should be picked up by the coefficient on the exchange rate variable.

Hence, the effect on U.S.-produced investment goods may include a positive substitution effect resulting from higher import. The exchange rate coefficient should show the net of this positive effect and also a negative effect on investment of the decrease in savings generated by the exchange rate - induced decrease in real income Whether the positive substitution effect or negative income effect on domestic investment dominates is an empirical question. Other studies (Heim 2007b) have produced regression coefficients which suggest little or no substitution effect, and a decidedly negative effect of the decrease in savings on demand for domestic and foreign investment goods.

The investment model tested includes key variables traditionally thought to influence investment. See, for example, Jorgenson (1971). Imported investment goods are defined as imported capital goods plus imported industrial supplies and materials. The current period is denoted without a subscript; prior years are subscripted with a -1 or -2. Since the variables in each are the same, the tested equations all take the general form

$$\Delta I_D = (\Delta I - \Delta M_{ksm}) = \beta_{D1} \Delta ACC + \beta_{D2} \Delta DEP + \beta_{D3} \Delta CAP_{-1} + \beta_{D4} \Delta T_G - \beta_{D5} \Delta G - \beta_{D6} \Delta r_{-2} + \beta_{D7} \Delta DJ_{-2}$$
$$+ \beta_{DI8} \Delta PROF_{-2} + \beta_{D9} \Delta XR_{AV0123}$$

$$\Delta I_M = (\Delta M_{ksm}) = \beta_{M1} \Delta ACC + \beta_{M2} \Delta DEP + \beta_{M3} \Delta CAP_{-1} + \beta_{M4} \Delta T_G - \beta_{M5} \Delta G - \beta_{M6} \Delta r_{-2} + \beta_{MI7} \Delta DJ_{-2}$$
$$+ \beta_{M8} \Delta PROF_{-2} + \beta_{M9} \Delta XR_{AV0123}$$

The variables included in these equations are

ΔACC = An accelerator variable $\Delta(Y_t - Y_{t-1})$

ΔDEP = Depreciation, a measure of investment needed this year just to replace worn out plant and equipment

ΔCAP_{-1} = A measure of last year's capacity utilization

$\Delta PROF_{-2}$ = A measure of business profitability two years ago

The other variables have the same meanings they had in the consumption equations, with lags as noted.

4. 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.

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. Depending on the particular regression test and the number of lags used, our sample size was 36-38 observations from the 1960-2000 period. With this number of observations, 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 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 $\Delta(Y-T_{G})_0$ were used. The remaining right hand side variables were used as first stage regressors. Newey-West hetroskedasticity corrections were also made.

Generally, autocorrelation controls were not used, since, as shown further below, they tended to distort the estimates of marginal effects in equations where they were used. We estimated demand functions for total consumption (domestic and imported goods) and demand for imported consumer goods alone, using the same explanatory variables. Subtracting the import coefficients for each explanatory variable from coefficients for the same variables in the total consumption regression gave inferred coefficients for the same explanatory variables in the domestic consumption equation. They were identical to those that could be independently obtained by regressing these variables on domestic consumption. However, sometimes the imported goods equation would have a low Durbin-Watson statistic, indicating autocorrelation. When autocorrelation control variables were added to the equation, they changed the explanatory variable coefficients substantially, and no longer would subtracting these import coefficients from total consumption equation coefficients yield estimates of domestic consumption coefficients the same as one would obtain from regression (as they should). Hence, we declined to use autocorrelation controls.

Our initial set of findings establish a baseline model of consumption with all the variables discussed above except the exchange rate. In the 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. 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.

Following (Heim, 2007c), given the occasional ambiguities in the trade data as to how to classify imports, we then define as our best approximation of consumer goods and services imports the variable whose variance is best explained by the Keynesian consumption function discussed above, based on the theory that the demand for imported goods should be a function of the same variables as the demand for domestic goods, i.e., income, wealth, exchange rates, etc.

Since import statistics are not neatly broken into C, I and G categories in government data, the definitions of consumer and investment imports used is somewhat judgmental (e.g., what portion of imported foodstuffs or autos are for business use versus consumer use?). Our definitions are taken from Heim, (2007c). For consumer imports, the definition is

$M_{m\text{-ksm}}$ = Total Imports (M) – (Capital Goods Imports + Imported Industrial Supplies and Materials (M_{ksm}))

This definition appears to be a reasonable, if not exact, one, given the data available. Separate regressions were then run on total consumer demand, and demand for imported consumer goods alone. Results for the imports equation are then subtracted from the results for the total consumption (C) equation, to obtain estimates of the demand for domestically produced consumer goods. We found that the coefficients obtained in this manner on each of the determinants of consumption are exactly the same as those obtained from the regression of the variable (C-M) on our standard consumption determinants.

Preliminary testing, suggested that exchange rate changes have some lagged effects that go back as far as three years ago, so the exchange rate (XR_{Av0123}) was used. Individual variables for each year's effect were not used. High levels of multicollinearity between them made coefficient values for any one year change dramatically when another year's exchange rate variable was added or deleted. However, the coefficients on average exchange rate variables tended to precisely or approximately add up to the sum of the coefficients when separate exchange rate variables were used for each year. In addition, adding an additional year's lag to the average increased explained variance, up through the three year lag. This suggests that the full effects of exchange rate changes take that long to achieve. 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., machinery. 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.

5. THE CONSUMER DEMAND MODEL (USING THE NOMINAL BROAD XR INDEX)

Using this exchange rate change definition, the government deficit variables, and the Keynesian variables, our regression results for consumer demand are as follows:

$\Delta(C)_0$ $= .63\Delta(Y\text{-}T_G)_0$ $+ .47\Delta T_{G(0)}$ $+ .06\Delta G_0$ $- 6.22\ \Delta PR_0.$ $+ .60\ \Delta DJ_{-2}$ $+ 2.69\ \Delta XR_{AV0123}$ $R^2 = 91\%$
(t) (18.2) (4.3) (0.5) (-3.4) (4.0) (1.5) D.W.= 1.7

$\Delta(M_{m\text{-ksm}})_0$ $= .06\Delta(Y\text{-}T_G)_0$ $+ .27\Delta T_{G(0)}$ $- .18\ \Delta G_0$ $- 3.94\ \Delta PR_0.$ $+ .26\ \Delta DJ_{-2}$ $+ 4.33\ \Delta XR_{AV0123}$ $R^2 = 83\%$
(t) (2.8) (4.6) (-1.9) (-2.6) (1.8) (2.9) D.W.= 1.5

$\Delta(C\text{-}M_{m\text{-ksm}})_0$ $= .57\Delta(Y\text{-}T_G)_0$ $+ .20\Delta T_{G(0)}$ $+ .24\ \Delta G_0$ $- 2.28\ \Delta PR_0.$ $+ .34\Delta DJ_{-2}$ $- 1.64\ \Delta XR_{AV0123}$ $R^2 = 74\%$
(t) (16.0) (1.6) (1.3) (-0.7) (2.8) (-1.0) D.W.= 1.8

Though not presented here, the same models without the exchange rate variable had R^2 of 91, 77 and 74% respectively. The exchange rate appears to have a major influence on import demand, adding 6%-points to explanatory power, but seems to have a minimal effect on domestic demand for consumer goods. These coefficients will be used below in estimating the total impact on the economy of declines in the exchange rate.

6. THE INVESTMENT DEMAND MODEL (USING THE NOMINAL BROAD XR INDEX)

Our purpose here is not to analyze definitively the components of the investment function, but just to provide estimates of the effect of the exchange rate on investment that have been obtained while controlling for as least some of the other variables that might affect investment, and whose influences might otherwise be picked up by the exchange rate variable due to intercorrelation.

Econometric estimates of the parameters in the investment model described earlier, show the following:

ΔI $= .28\Delta ACC +$ $.95\Delta DEP +$ $1.48\Delta CAP_{-1} + .52\ \Delta T_G\ -.63\Delta G\ - 6.40\Delta r_{-2} -.20\ \Delta DJ_{-2}\ +.16\ \Delta PROF_{-2} + 6.92\ \Delta XR_{AV0123}$ $R^2 = .89$
t= (7.9) (3.2) (1.0) (5.6) (-2.9) (-3.8) (-0.8) (0.9) (3.8) DW =1.9

$\Delta(M_{ksm}) = .04\Delta ACC +$ $.38\Delta DEP +$ $1.52\Delta CAP_{-1} +.07\ \Delta T_G\ -.22\Delta G\ + 1.54\Delta r_{-2} +.19\Delta DJ_{-2}\ - .10\ \Delta PROF_{-2} + 2.52\ \Delta XR_{AV0123}$ $R^2 = .70$
t= (1.8) (4.1) (2.2) (2.5) (-2.1) (1.3) (2.6) (-1.1) (-2.1) DW =2.4

$\Delta(I-M_{ksm}) = .24\Delta ACC +$ $.57\Delta DEP -$ $.04\Delta CAP_{-1} +.44\ \Delta T_G\ -.41\Delta G\ - 8.00\Delta r_{-2} -.38\ \Delta DJ_{-2} +.26\ \Delta PROF_{-2} + 4.39\ \Delta XR_{AV0123}$ $R^2 = .85$
t= (8.7) (1.9) (-0.0) (5.4) (-2.0) (-4.9) (-1.5) (1.5) (1.8) DW =1.6

The results for the MPI_D and MPI_M indicate that the accelerator effect of a decline in current year real income on investment is principally on domestically produced investment goods, with demand decreasing $ 0.24 billion for every billion decrease in the size of the change in current year GDP. Demand for imported goods on the other hand only decreases .04 billion. There appears to be a $4.39 billion decrease in demand for domestically produced investment goods for every single - point (~ 0.8%) decline in the trade weighted nominal Broad exchange rate from 2000 levels. We hypothesize that this reflects the effect on investment due to the drop in real savings caused by declining real income associated with the exchange rate decline. This income effect seems to swamp the substitution effect to cheaper domestic goods we would expect to see here. Unlike our findings with the real Broad exchange rate, the steep decline in income may does not cause some shifting to (still cheaper?) imports.

7. THE EXPORTS DEMAND MODE (USING THE NOMINAL BROAD XR INDEX)

There is also an <u>increase</u> in income that occurs because of the increase in exports associated with the decline of the exchange rate. A rough estimate of this effect can be obtained by regressing exports on the 4-year average exchange rate above and the growth in the American GDP over the 1960-2000 period. The income variable serves as a proxy for the growth in our major trading partners' incomes over this period, which has a major effect on 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 hetroskedasticity controls are as follows:

$\Delta X_0 = .05\ \Delta(Y)_0 - 2.43\ \Delta XR_{AV0123} + .55\ \Delta AR(1)\ + .\ 45\ \Delta AR(3)$ $R^2 = 49\%$
(t) (2.1) (-2.5) (2.4) (2.5) D.W.= 1.8

8. THE TAX GROWTH MODEL

Part of tax growth is exogenous, i.e., varies with legislative changes in tax rates. However, part is endogenous, ie, tied to and dependent on income growth from year to year. Below we estimate the effect of a change in total income (GDP) on part of taxes government revenues - the part raised to finance purchases goods and services. The results of this regression, using first differences in the data to reduce multicollinearity and stationarity problems, as well as 2SLS and heteroskedasticity controls are as follows:

$\Delta T_G = .26\ \Delta(Y)$ $R^2 = 47\%$
(t) (7.7) D.W.= 1.4

Since both the consumption and investment equations above show a positive effect on demand of an increase in tax revenues, presumably by reducing crowd out caused by government deficits, in calculating the full effects of a rise in real income due to exchange rate changes, it is important to also measure the

secondary boost to income resulting from additional taxes collected as income grows. We might also define tax changes that are government - enacted, ie, exogenous, as approximately ΔT_{EX} , where

$$\Delta T_{EX} = \Delta T_G - .26\,\Delta Y \quad (or) \quad \Delta T_G = .26\,\Delta(Y) + \Delta T_{EX}$$

We say "approximately, because T_{EX} also contains the regression error term.

9. A MODEL FOR CALCULATING MULTIPLIER, ACCELERATOR AND CROWDOUT EFFECTS OF EXCHANGE RATE CHANGES

Some readers may be unfamiliar with notation commonly used by economists to denote different parts of the economy, or with commonly used economic terms like "multiplier" or "accelerator". To illustrate how these terms are used, the following definitions and derivations of the multiplier and accelerator are presented, using simplified versions of our above consumption and investment equations for ease of exposition:

The GDP (Y) is comprised of consumer goods (C), investment goods (I), government goods and services (G) and net exports (X-M):

(1) $Y = C + I + G + (X-M)$

In a simple model of the economy, demand for consumer goods might be defined as follows

(2) $C = c_0 + (c_1 + m_{c1})(Y-T_G) + (c_2 + m_{c2})\,T_G + (c_3 + m_{c3})\,G$

where $(Y- T_G)$ is total income generated producing the GDP minus total taxes; $c_1 + m_{c1}$ are the marginal propensities to consume domestic and imported goods, $c_2\,T_G + c_3\,G$ represent the consumer credit crowd out variables resulting from government deficits. The disaggregated form of the deficit is used instead of just $c_2\,(T_G - G)$ because testing above indicates that the effects of the two variables on crowd out are different.

Demand for investment goods in a simple model of the economy might be described as

(3) $I = I_0 + (I_1 + m_{I1})\,\Delta Y - (I_2 + m_{I2})\,r + (I_3 + m_{I3})\,T_G + (I_4 + m_{I4})\,G$

where ΔY is an "accelerator" variable, indicating I grows (accelerates) in response to the general growth in the economy, r is the real interest rate, $(I_1 + m_{I1})$ are the marginal propensities to purchase domestically produced or imported investment goods   in response to a change in the GDP,. $(I_2 + m_{I2})$ are the marginal propensities to invest in these goods when interest rates change. $I_3\,T_G + I_4\,G$ represent the investment credit crowd out variables, again disaggregated.

Import demand might be expressed as

(4) $M = M_C + M_I = m_0 + m_{c1}\,(Y-T) + m_{I1}\,\Delta Y - m_{I2}\,r + (m_{c2} + m_{I3})\,T_G + (m_{c3} + m_{I4})\,G$

i.e., the demand for imported consumer or investment goods is driven by the same variables as is domestic demand.

Substituting (2), (3) and (4) into equation (1) gives

(5) $Y = (c_0 + I_0 - m_0) + c_1\,(Y- T_G) + I_1\,\Delta Y - I_2\,r + G + X + (c_2 + I_3)\,T_G + (c_3 + I_4)\,G$

i.e., the domestic GDP is a function of the demand for domestic C,I,G and X goods, as modified by crowd out problems

Collecting only the Y terms, we get

(6) $Y = \left[\dfrac{1}{(1-c_1)} \right] [(c_0 + I_0 - m_0) - c_1 T_G + I_1 \Delta Y - I_2 r + G + X + (c_2 + I_3) T_G + (c_3 + I_4) G]$

where $\dfrac{1}{(1-c_1)}$ is the standard consumption multiplier cited in textbooks and would equal $\dfrac{1}{(1-.57)} = 2.33$

using the marginal propensity to consume domestically produced goods from the regressions above.

However, if we separate $I_1 \Delta Y$ into its separate components, $I_1 Y$ and $- I_1 Y_{-1}$, and recollect our current year Y terms, we get a modified multiplier (or multiplier/accelerator) coefficient that combines traditional multiplier and accelerator effects:

(7) $Y = \left[\dfrac{1}{(1 - c_1 - I_1)} \right] [(c_0 + I_0 - m_0) - c_1 T_G - I_1 Y_{-1} - I_2 r + G + X + (c_2 + I_3) T_G + (c_3 + I_4) G]$

where the numerical value the accelerator/multiplier coefficient is $\dfrac{1}{(1 - .57 - .24)} = 5.26$

again using our regression results above. We can further augment this function by noting that the tax component (T_G) of the "crowd out" variables in both the consumption and investment equation grows as income grows, as shown in our tax growth model above. Also, our consumption and investment regressions above suggest that a rise in taxes depresses consumption spending by decreasing disposable income -\$.57B for each billion increase in T_G, but that the same rise in taxes stimulates consumer spending by +\$.20B and investment spending by +\$.44B, more than offsetting the negative impact of taxes on disposable income, for a net effect of +\$.09B. Hence,

$(-c_1 + c_2 + I_3) T_G = (-.57 + .20 + .44) T_G = (.07) T_G = (.07)(.26 Y + T_{EX}) = .02 Y + .07 T_{EX}$

Using this formulation and recombining the Y terms gives a further modified multiplier we will call the Multiplier/Accelerator/Crowd Out (M/A/C) multiplier:

(8) $Y = \left[\dfrac{1}{(1 - c_1 - I_1 - [-c_1 + c_2 + I_3][.26])} \right] [(c_0 + I_0 - m_0) - c_1 T_{EX} - I_1 Y_{-1} - I_2 r + G + X + (c_2 + I_3) T_{EX} + (c_3 + I_4) G]$

Expressed in first differences, which we used for econometric testing above, this becomes

(9) $\Delta Y = \left[\dfrac{1}{(1 - c_1 - I_1 - [-c_1 + c_2 + I_3][.26])} \right] [- c_1 \Delta T_{EX} - I_1 \Delta Y_{-1} - I_2 \Delta r + \Delta G + \Delta X + (c_2 + I_3) \Delta T_{EX} + (c_3 + I_4) \Delta G]$

where the numerical value of M/A/C multiplier becomes $\dfrac{1}{(1 - .57 - .24 - .02)} = 5.88$

This is the multiplier we will use below to calculate the total effect of a change in the exchange rate on U.S. real income.

10. INCOME AND SUBSTITUTION EFFECTS OF A DECLINING EXCHANGE RATE: CHANGES IN DEMAND FOR DOMESTIC AND IMPORTED GOODS

How much will the demand for imports decline when the trade weighted exchange rate drops one index point, or about 8/10 of 1%, from year 2000 values? Economic theory suggests both the income and the substitution effects should be negative for imports, each causing increased purchases of imported consumer and investment goods. Economic theory also suggests that the income and substitution effects

for domestically produced goods should work in opposite directions: substitution effects caused by higher import prices increasing domestic demand, income effects decreasing it.

Our statistical results above are consistent with this theory. The <u>initial</u> income effect of a declining exchange rate - induced $1 billion decline in disposable income reduces demand for domestic consumer goods by $0.57 billion and imports by $0.06 billion, and reduces savings by $0.37 billion (MPS = .37 = 1-MPC_D-MPC_M). Multiplier effects of these changes increase these estimates, as we will show in the next section. In addition, the direct substitution effect, as measured by the coefficients on the exchange rate variable, reduces consumer imports by $4.33 billion and increases domestic demand for consumer goods by $1.64 billion, for each single point decline in the exchange rate.

In the regressions for investment goods, the income effect is shown by the coefficient on the accelerator variable. The accelerator measures the GDP (income) growth in the current year. The income effect caused by a $1 billion decline in the amount of economic growth in the current year causes a small decline in demand for imported investment goods ($0.04 billion), and a substantially larger decline in the demand for domestically produced investment goods ($0.24 billion). Using the exchange rate coefficient as a measure of substitution effects, the coefficient on this variable in the imported investment goods equation, shows a positive sign, indicating that consistent with substitution effect theory, declining exchange rates decrease demand for imports $2.52B per point the rate declines, because the change increase import prices. The demand for domestic investment goods also is found to decline markedly ($4.39B), with a one point decline in the exchange rate. In this case the negative effect is counter to (substitution effect) theory and we hypothesize it indicates overwhelming dominance of negative income effects on investment, particularly through the decline in domestic savings, not completely captured by accelerator variable in the equation. The domestic investment exchange rate coefficient, in other words, may be dominated by the spillover of negative income effects associated with a declining exchange rate, effects which appear to swamp substitution effects.

In the consumption model, only the regression coefficient on the exchange rate variable in the consumer imports equations is statistically significant, and this coefficient is important in our analysis below. The coefficients on the variables in the domestic consumption and total consumption equations are not statistically significant. However, they are the same as that obtained by subtraction of the statistically significant estimatefor imports from either the total consumption or domestic consumption coefficients. Hence, these coefficients may be reasonable for use in estimating how exchange rate changes affect the demand for consumer goods. For the 3 investment equations, again, 2 of the 3 exchange rate coefficients are significant at the 5% level or better: total investment and imports investment. The exchange rate coefficient for domestic investment goods is statistically significant only at the 10% level, but its value is exactly the same as is obtained by subtraction of the two significant estimates. Hence, we feel reasonably confident in all three of our point estimates.

A one point decrease the trade-weighted exchange rate index (which would represent an eight tenths of one percent decrease from the index's 119.45 level in the year 2000) could increase import prices by 0.8% percent, if the exchange rate change was passed entirely through to the consumer. However, recent evaluation by Federal Reserve staff of the "pass through" of exchange rate changes to import prices 1985 -2005 suggests that import prices only change about half as much as the exchange rate change, and not less than that as some others have recently claimed (Hellerstein, Daly & Marsh, 2006). This is the estimated pass through rate we will use. In the year 2000, U.S. total real imports (1996 dollars) were $1,532 billion. A 0.8% decrease in the exchange rate, then, would be expected to increase import costs by 0.4%, or $6.13 billion, decreasing real incomes in the U.S. by the same amount. Real disposable income also decreases the same amount, since there is no tax effect: nominal (i.e., taxable) income is the same; real income has decreased only because prices have increased.

11. THREE METHODS FOR CALCULATING THE IMPACT ON THE GDP OF A CHANGE IN THE EXCHANGE RATE

Three separate methods, all yielding the same results, are used to compute the effect of a change in the exchange rate on the GDP (Y):

Method 1: Use marginal effects estimates from the above investment and consumption regressions to estimate the initial drop in real income resulting from a one index point drop in the trade weighted exchange rate. Apply the M/A/C multiplier (5.88) to the result

Method 2: Use the method favored in many large scale econometric models of the economy (Fair 2003, Pindyck & Rubinfeld 1991). This involves separately estimating ΔC_D, ΔI_D, ΔG and ΔX (using the equations above), and simply summing the results to get ΔY

Method 3: Formally Construct a Keynesian IS curve, and predict ΔY from its determinants and the multiplier implied by the function. It is a slightly more formal presentation of Method 1.

Each of the methods can serve as a partial check on the estimates obtained from the others.

11.1 METHOD 1

$ 3.39B   Initial Decline in Real U.S. Income from: $ - 6.13B (M price increase induced decline in Y)
+ .37B (.06 MPC_M x -6.13 Initial $\Delta(Y-T_G)$
=Portion of 6.13 not spent on U.S. goods)
- 4.39B (I_D: Decrease in domestic investment)
+ 1.64B (C_D: Direct Sub. effect increase in C_D)
+ 2.69B (C_D Effect Due to upward ΔMPC_D
4.33 decline C_M – 1.64 Direct Substitution to C_D)
$ + 2.43B (X: - Increase in exports)
$ - 3.39B

x   5.88   Multiplier/Accel/Crowd Out (M/A/C)Effect
$ 19.93B   Decline in Real Income (Y) after Multiplier/Accel/Crowd Out (MAC)Effects
- 3.68B ΔTaxes due to M/A/C Effect @ Historic .26 Rate = .26(19.93 – (5.76=6.13-.37))
where 5.76 is the portion of the initial non-taxable 6.13 decrease in
real income affecting domestic demand =(MPC_D + MPI_D)(6.13) = (.57 + .37)(6.13)
where we assume the MPS = MPI_D
$ 16.25B $\Delta(Y-T_G)$ = Decline in disposable income
($19.93-$16.25 = $3.68 Reduction in Tax Collections)

Let

- 0.74B = ΔC_D Due to Crowd Out Effect Caused By Decreased Taxes = (.20)($-3.68B)
- 0.99B = ΔC_M Due to Crowd Out Effect Caused By Decreased Taxes = (.27)($-3.68B)
+/- 4.33B = ΔC_{DorM} Due to +/-1.64B Direct Sub. Effect & +/-2.69 Indirect Sub. Effect Due to ΔMPC_D

With this information we can summarize the changes in consumption and saving resulting from the increase in disposable income of $24.47 as follows:

$ -16.25B $\Delta(Y-T_G)$ -16.25B B $\Delta(Y-T_G)$ $ -16.25B B $\Delta(Y-T_G)$
x   .57 MPC_D x   .06 MPC_M x   .37   MPS
$- 9.26B ΔC_D (Inc. Effect) $ - 0.98B ΔC_M (Inc. Effect) $ - 6.01B Δ Savings (Reduction
- 0.74B Crowd Out Effect   - 0.99B Crowd Out Effect   in Domestic Funds Available
+ 4.33B Substitution Effect   - 4.33B Substitution Effect   to Fund Investment)
$- 5.67B Total ΔC_D $ - 6.30B Total ΔC_M

11.2 METHOD 2:

We repeat the above investment and consumption regression equations above for easy reference as we calculate using Method 2:

$$\Delta C_D = \Delta(C\text{-}M_{m\text{-}ksm})_0 = .57\Delta(Y\text{-}T_G)_0 + .20\Delta T_{G(0)} + .24\ \Delta G_0 - 2.28\ \Delta PR_0 + .34\Delta DJ_{-2} - 1.64\ \Delta XR_{AV0123}$$
$$\Delta C_M = \Delta(M_{m\text{-}ksm})_0 = .06\Delta(Y\text{-}T_G)_0 + .27\Delta T_{G(0)} - .18\ \Delta G_0 - 3.94\ \Delta PR_0 + .26\ \Delta DJ_{-2} + 4.33\ \Delta XR_{AV0123}$$

$$\Delta I_D = \Delta(I\text{-}M_{ksm}) = .24\Delta ACC + .57\Delta DEP - .04\Delta CAP_{-1} + .44\ \Delta T_G - .41\Delta G - 8.00\Delta r_{-2} - .38\ \Delta DJ_{-2} + .26\ \Delta PROF_{-2} + 4.39\ \Delta XR_{AV0123}$$
$$\Delta I_M = \Delta(M_{ksm}) = .04\Delta ACC + .38\Delta DEP + 1.52\Delta CAP_{-1} + .07\ \Delta T_G - .22\Delta G + 1.54\Delta r_{-2} + .19\Delta DJ_{-2} - .10\ \Delta PROF_{-2} + 2.52\ \Delta XR_{AV0123}$$

From these equations, we see three variables through which investment is affected by changes in the exchange rate:

1. the decrease in the accelerator income variable in the investment equation, or the disposable income variable in the consumption equation, due to the decrease in gross real income caused by the one - point **ΔXR_{AV0123}**
2. the decline in tax collections because of the decline in real income, all of which was taxable, except the initial decrease caused by the 0.4%% increase in import prices, and
3. through the one - point change in the exchange rate variable

In this case then, the estimated decline in domestic investment will be

$$
\begin{aligned}
\Delta I_D = \Delta(I\text{-}M_{ksm}) \quad &= .24\ \Delta ACC &&+ .44\ \Delta T_G &&+ 4.39\ \Delta XR_{AV0123} \\
&= (.24)(\$\text{-}19.93B) &&+ (.44)(\$\text{-}3.68B) &&+ (4.39B)(-1) \\
&= -4.78 &&- 1.62 &&- 4.39 \\
&= \$\text{-}10.79B
\end{aligned}
$$

where the change in taxes ΔT_G is the difference between the change in gross income(ΔY)and the change in disposable income $\Delta(Y\text{-}\Delta T_G)$ given above.

We can also estimate the decrease in demand for imported investment goods as

$$
\begin{aligned}
\Delta I_M = \Delta(M_{ksm}) \quad &= .04\ \Delta ACC &&+ .07\ \Delta T_G &&+ 2.52\ \Delta XR_{AV0123} \\
&= (.04)(\$\text{-}19.93B) &&+ (.07)(\$\text{-}3.68) &&+ (2.52)(-1) \\
&= \$ - 0.80 &&- \$\ 0.26 &&- 2.52 \\
&= \$ - 3.58B
\end{aligned}
$$

By similar reasoning, we see that the changes in the demand for domestic and imported consumer goods are as follows

$$
\begin{aligned}
\Delta C_D = \Delta(C\text{-}M_{m\text{-}ksm}) \quad &= .57\ \Delta(Y\text{-}T_G) &&+ .20\ \Delta T_G &&- (1.64+2.69)\ \Delta XR_{AV0123} \\
&= (.57)(\$\text{-}16.25B) &&+ (.20)(\$\text{-}3.68B) &&- 4.33(-1) \\
&= -9.26 &&- 0.74 &&+ 4.33 \\
&= \$\text{-}5.67B \text{ (same result as method 1)}
\end{aligned}
$$

and

$$
\begin{aligned}
\Delta C_M = \Delta(M_{m\text{-}ksm}) \quad &= .06\ \Delta(Y\text{-}T_G) &&+ .27\ \Delta T_G &&+ 4.33\ \Delta XR_{AV0123} \\
&= (.06)(\$\text{-}16.25B) &&+ (.27)(\$\text{-}3.68B) &&+ 4.33(-1) \\
&= -0.98 &&- 0.99 &&- 4.33 \\
&= \$\text{-}6.30B \text{ (same result as method 1)}
\end{aligned}
$$

So, by Method 2 we have

$$\Delta Y = \Delta C_D + \Delta I_D + \Delta G + \Delta X \text{ (+ Exogenous } \Delta XR \text{ rate effects on real income due to price decreases}$$
$$\text{i.e., } (5.76 = (MPC_D + MPI_D)(6.13) = 3.49 + 2.27)$$
$$= -5.67 - 10.79 + 0 + 2.43 - 5.76$$
$$= -9.16 - 13.06 +) + 2.43$$
$$= \$ - 19.79 \text{ (Same result as Method 1 (\$-19.93) , except for rounding)}$$

11.3 METHOD 3:

Using the formal Keynesian "IS" curve method for calculating the GDP shown in Section 9 above:

ΔY = ΔC_D + ΔI_D + ΔG + ΔX **(plus exogenous change -5.46)**
    $=(.57\Delta(Y-T_G) +.20\Delta T_G - (4.33)\Delta XR_{AV0123})+(.24\ \Delta ACC +.44\ \Delta T_G + 4.39\Delta XR_{AV0123})+ \Delta G + \Delta X - 5.76$
        $= (5.88) (+4.33 - 4.39 + 2.43 -5.76)$
        $= (5.88) (-3.39)$
        $= \$-19.93$ (Same result as by Methods 1 and 2)

12. EXCHANGE RATE EFFECTS ON THE TRADE DEFICIT

The estimated decline in the trade deficit of a one index -point decline in the U.S. exchange rate is the sum of the resulting decrease in purchases of imports and the increase in purchases of U.S. exports

$\$$ 6.30B - Decline in C_M
   3.58B - Decline in I_M $\$$ 2.27B - Initial Δ Savings = (.37 MPS)(-6.13 Initial ΔY)
. 2.43B - Increase in X   6.01B - MAC Induced Subsequent Δ Savings $=.37\Delta(Y-T_G)$
$\$$12.31B - <u>Decrease in the Trade Deficit</u> $\$$ 8.28B - <u>Decrease In Domestically Owned Wealth</u>
           <u>Associated with a 1 Point</u>
           <u>Drop in the Exchange Rate</u>

Our savings calculations are reasoned as follows: The initial decline in real savings ($2.27B) stemming from the exchange rate drop forces a comparable decrease in investment (traditional investment theory tells us that a left shift in the savings curve drives up interest rates sufficiently to cause a comparable decline in investment). This initial decrease in domestic investment and the initial decline in domestic consumption (2.27) & (.57)($6.13) =$5.76, and other effects noted in Method 1, generate a subsequent decline in disposable income of $16.25 of which 37% = 6.01 was a subsequent decline in savings. Hence the savings decline totaled $8.28.

The estimated decrease in <u>what would have been the growth in domestic assets had the exchange rate not dropped</u> (i.e., the savings decline of $8.28B) is appreciably less than the estimated decrease in the trade deficit ($12.31). Hence, if one looks at declining trade deficits as a means reversing the trend toward declining U.S. ownership of U.S. assets, there is some success. An exchange rate induced <u>growth</u> in trade deficits appears to be 2/3s self financed by the associated economic growth, and an exchange rate induced decline in the trade deficit may reduce the usual level of growth of US owned assets via new investment by about as 2/3, reducing the net effect of the trade deficit reduction on U.S. ownership of assets by 2/3s. Our reasoning is as follows:

Every U.S. trade deficit is financed by a transfer of ownership of U.S. assets (including money), or claims to assets to other countries or their citizens. This is how the money is raised that allows one country to buy more trade goods from a second country, than the second is buying from the first. A decline in the deficit reduces the amount of U.S. assets that have to be transferred to foreign ownership to finance the deficit. Hence, the decline in the amount of U.S. capital assets (or claims thereto) that have to be transferred to foreigners to pay for the trade deficit is simultaneously 2/3 offset by a decline in savings stemming from the GDP (income) decline that also occurs when the exchange rate (and trade deficit) drops!. Hence, ceteris paribus, the decline in the trade deficit only leads to an increase in U.S. owned domestic assets about 1/3 as large as the declining trade deficit might at first blush suggest.

(Conversely, a <u>rise</u> in the U.S. exchange rate of one point would give exactly the same results as above, but with the opposite sign. Income would increase $19.93B, disposable income by $16.25, the trade deficit and savings would rise by $12.31B and $8.28 respectively, etc. In this case though, the increase in the trade deficit would be 2/3s financed by increasing U.S. assets generated by the new savings resulting from the associated growth in the economy. The very increase in the exchange rate which causes this, also causes growth in U.S. income and assets due to its stimulus of domestic saving and

investment. In the case of a rising exchange rate, the increased trade deficit caused by a strengthening of the dollar would be 2/3s self financing!

13. CONCLUSIONS

There are six major conclusions that seem supported by the above analysis: The analysis suggests that when the trade - weighted exchange rate falls by one point, the result is

1. a. a decrease in demand for_imported consumer and investment goods and services estimated at $9.88B (6.30B C_M, + 3.58B I_M).

    b. a decrease in demand for_domestically produced consumer and investment goods and services of an estimated $19.93B , or 2.02 times as much as the decreased demand for imports. Our study is too macroeconomic in nature to be able to say which specific industries will be helped or hurt.

2. a decrease in demand for domestic investment, estimated at $13.06B. The decline in investment should be matched by a decline in world savings used in the U.S. Of this, $8.28 would be associated with the U.S. decline in saving, the rest would be a decline in the U.S. use of foreign savings.

3. The trade deficit would likely decrease an estimated $12.31 billion, due to the $9.88B reduction in imported consumer and investment goods and services, and $2.43B increase in exports.

4. Because the decrease in domestic demand is 1.67 times greater than the decrease in demand for imports, it causes a substantial drop in the GDP. The associated trade deficit, though it declines in dollars, barely declines as a percent of GDP. Using baseline measures of the real GDP, exports and Imports data for the year 2000, we see only about one tenth of one percent decrease in the trade deficit as a percent of GDP when the trade weighted exchange rate index falls one point:

	Real GDP	Imports	Exports	. Trade Deficit . Dollars (% of GDP)	
Actual 2000 Data	$9224.00	$1532.00	$1132.0	$400	4.3%
Effect of 1Pt. Drop XR	9204.07	1522.12	1134.43	$387.7	4.2%.
Effect of 10Pt DropXR	9024.70	1433.20	1156.3	$276.9	3.1%
Effect of 16.1Pt Dr.XR	8903.13	1372.90	1171.1	$201.8	2.3%

5. This suggests that even a fairly large, say 10%, drop in the exchange rate would decrease the trade deficit as a percent of GDP moderately, by 1.2 percent, from 4.3 to 3.1%, or about $123B, had it occurred in the year 2000. This decrease in the trade deficit would be accompanied by a 2.2% decrease in the GDP or $199.3B in year 2000 dollars. Using the numbers from Method 2, multiplied by 10, we have:

$$\Delta Y \quad = \quad \Delta C_D \quad + \Delta I_D \quad + \Delta G + \quad \Delta X$$
$$\$\text{-}199 \quad = \quad \text{-} \$92B \quad \text{-} \$131B \quad + \quad 0 \quad + \$24B$$

However, in the period 2000 – 2007, The U.S. exchange rate dropped even more significantly. The Nominal Broad Index dropped 16.1 points (13.4%), from 119.5 to 103.4, and the Real Broad Index dropped 12.5 points (12%) from 104.7 to 92.2.

Using the 16.1 point drop in the Nominal Broad Index during the 2000-07 period, suggests that this would have been associated with a decrease in the trade deficit as a percent of GDP by two percentage points, from 4.3% to 2.3%, or about $198B, had other factors affecting the deficit, like U.S. income and wealth growth for all other reasons remained constant at 2000 levels. This decrease in the trade deficit would have been accompanied by a 3.5% decrease

in the GDP or $321B in year 2000 dollars over the seven years (again, other things equal), or an average of $45.9B a year over the seven years. Using the numbers from Method 2, multiplied by 16.10, we have:

$$\Delta Y \; = \; \Delta C_D \; + \; \Delta I_D \; + \; \Delta G + \; \Delta X$$
$$\$\text{-}320 \; \sim= \; \text{-} \$149B \; \text{-} \$210B + \; 0 \; + \$39B \quad (\text{not} = \$321 \text{ due to rounding in Method 2})$$

The $321B decline in GDP associated with the estimated 16.1 point (or 13.4%) 2000-07 decline in exchange rates, would have represented a 3.5% drop in 2000 - level real GDP, had it (for all other reasons except the exchange rate induced change) remained constant during the 2000-07 period. However, Bureau of Economic Analysis data indicated the real GDP grew 18.7% during this period. Presumably, had the exchange rate decline not occurred, it would have grown an additional 3.5% to 22.2%, increasing the average growth rate during the period from 2.7 to 3.2%. This suggests the actual growth rate was about 16% below what it might have been, had the decline in exchange rates not occurred.

6. The $12.31 decline in the U.S. Trade deficit associated with a one point drop in the nominal Broad exchange rate index reduces the need for annual transfers of U.S. financial or real assets (including dollars) to foreign ownership. Some transfers are still needed to pay for the remaining trade deficit. The deficit reduction reduces the rate at which ownership of U.S. assets is transferred to the rest of the world. However, U.S. capital assets growth during the same period simultaneously falls by 2/3of this amount due to the decline in domestic saving (8.28B). Total investment, financed by both domestic and foreign savings, may decrease by $13.06, or about 106% as much as the decrease in the trade deficit.

14. BIBLIOGRAPHY

_____. *Economic Report of the President*. Washington. U.S. Government Printing Office. 2002 (also 2001 and 1997 reports)

Fair, R. *Estimating How the Macroeconomy Works, Appendix A: U.S. Model*. 2004 Available at http://fairmodel.econ.yale.edu/rayfair/pdf/2003A.PDF

Heim, J.J. "The Consumption Function", Rensselaer Polytechnic Institute, Department of Economics Working Paper. 2007a

Heim, J.J. "The Investment Function", Rensselaer Polytechnic Institute, Department of Economics Working Paper. 2007b

Heim, J. J. "Does A Strong Dollar Increase Demand for Both Domestic and Imported Goods?", *Journal of International Business and Economics*, Gale Group/Thomson Publishing, Vol. VII (3) Oct. 2007c., or the more comprehensive study from which it was developed: "Do Falling Import Prices Increase Market Demand for Domestically Produced Consumer Goods? RPI Working Papers in Economics, No. 707, Department of Economics, Rensselaer Polytechnic Institute, July 2007

Hellerstein, R., Daly, D. and Marsh, C. "Have U.S. Import Prices Become Less Responsive to Changes in the Dollar?" *Current Issues in Economics and Finance*, Federal Reserve Bank of New York, Vol.12, No. 6, September 2006.

Jorgenson, D. "Econometric Studies of Investment Behavior: A Survey", *Journal of Economic Literature*, 9(4), Dec. 1971, pp. 1111-47.

Keynes, J.M. *The General Theory of Employment, Interest and Money*. New York. Harcourt, Brace and World, Inc. 1964

Pyndick, R. & Rubinfeld, D. *Econometric Models & Economic Forecasts*. New York.: McGraw – Hill, Inc. 1991

Samuelson, P. "Interactions Between the Multiplier Analysis and the Principle of Acceleration", *Review of Economics and Statistics*, Vol. 21, No. 2, Aug. 1939, pp. 75-78.

AUTHOR PROFILE

Dr. 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. He previously served as an education finance analyst for a NY State governor, Director of Fiscal and Budget Research for the minority party in the NY State Senate, Commissioner of Administration and Finance for the city of Buffalo, NY. and President of Heim Industries, Inc., a statistical software firm.