The Value of The Dollar, And Other Factors Affecting The U.S. Manufacturing Sector: The Situation in The Mid-1980s

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Abstract

The purpose of this paper is to examine the major variables which affect the level of manufacturing output for each of 20 2-digit SIC industries, and for the U.S. manufacturing sector as a whole, as well as to estimate the sizes of these effects. By focusing on the situation in 1985, one is able to estimate the effect of the then strong dollar on the level of U.S. manufacturing output.

Introduction

In recent years, there has been much concern about the health of the U.S. manufacturing sector. This concern was especially great in 1985 when the exchange rate value of the U.S. dollar reached high levels, making foreign manufactured goods cheaper relative to those produced in the United States. Many economists concluded that this was a major cause of the slumping U.S. manufacturing sector.

Since there are many variables which affect the performance of the U.S. manufacturing sector, the purpose of this paper is to explain the variance of industrial production at the industry level, and at an aggregate level. This is done in order to determine which major variables affect U.S. manufacturing output and to estimate the sizes of these effects. In this way, we will be able to isolate the effect of the exchange rate value of the dollar.

The basic equation that is utilized in the empirical estimations is the following:

$$(1) \qquad \ln (IP_i) = \alpha + \beta \ln (EXVUS) + \gamma \ln (GNP/GNP^*) + \delta \ln (GNP^*) + \varsigma \ln (PPI_i/PY) + \eta \ln (PPI_i/PPIF) + \theta \ln (GNPF) + \epsilon_i$$

ϵ_i = a disturbance term

The variable definitions are contained in Table 1. The variable EXVUS is included to capture the effect of the exchange rate value of the dollar. A high dollar value has two basic effects. First, it makes U.S. goods more expensive to foreign buyers, who must convert their own currencies to dollars before making purchases. The greater the demand for dollars relative to the supply, as a result of this effect, the higher will be the equilibrium value of the dollar relative to the value of other currencies. Second, it makes foreign-made products cheaper, and hence more attractive, for U.S. consumers. A falling dollar, which characterizes the situation on the whole since 1985, has opposite effects. The sign of the coefficient of EXVUS in Equation 1 is expected to be negative.

GNP/GNP* is a proxy for short-term effects of the business cycle on the variance of U.S. manufacturing output. It has been demonstrated empirically that at an aggregate level cyclical swings in the U.S. economy tend to be more important to manufacturing industries than to the rest of the economy. This serves to justify the inclusion of GNP/GNP* as an independent variable in Equation 1. We will see later that when we examine the variance of manufacturing output on a micro level, some industries are more cyclical than others for various reasons.

TABLE 1
DEFINITIONS OF VARIABLES USED IN THE REGRESSION EQUATIONS

Variable	Definition	Expected Sign and Value
IP_i	Industrial Production Index for industry i.	1977 = 100, values as reported from the Federal Reserve Board.
EXVUS	Trade-weighted exchange value of the U.S. dollar, FRB index of group of 10 countries plus Switzerland.	Negative values between -0.00 and -0.99 show inverse relationship between industrial production and the exchange rate.
GNP/GNP*	Real gross national product divided by potential GNP, representing the position of the economy over the business cycle.	All values are expected to be positive. Cyclical industries should register a value of greater than 1; non-cyclical industries should be less than 1.
GNP*	Potential GNP as estimated historically by the Council of Economic Advisers and extended using CBO assumptions, measuring the long-term trend of the industry in combination with the cyclical variable.	Value should reflect the changing share of industry output in the economy, positive and greater than 1 where industry share is growing; and negative where industry share and output are declining.
PPI_i/PY	The Producer Price Index for industry i divided by the GNP deflator. This essentially represents relative real price changes for the industry.	Negative values, representing inverse relationship between price and output in demand.
$PPI_i/PPIF$	The Producer Price Index for industry i divided by a trade-weighted average of foreign producer price indexes.	Negative values representing inverse relationship between price and output in demand.
GNPF	Foreign GNP, trade-weighted for five major U.S. trading partners.	No prior expectation. Positive if foreign income pulls U.S. production through increased exports; negative if foreign growth displaces U.S. products.
RHO	Estimate of the autoregressive parameter produced under the Cochrane-Orcutt procedure.	Positive, between 0 and 1.

GNP* is an estimate of potential GNP, and captures the long-term trend in the overall level of economic activity. At the aggregate level, the coefficient of this variable indicates the share of total output made up of manufacturing output over the long-run. At the industry level, the coefficient of GNP* can be used to indicate whether certain manufacturing industries are experiencing a secular rise or a secular decline.

The price variables include the real price of domestic manufactured products (PPIi/PY) and the price of U.S. goods relative to foreign ones (PPIi/PPIF). These price terms show the cost movements of U.S. manufactured goods relative to all other U.S. products, and to similar foreign goods respectively. The signs of these two price variables are expected to be negative.

GNPF is a proxy for foreign GNP. Its sign is expected to be positive. The higher this value, the greater will be the demand for our exports, ceteris paribus. This effect is expected to be limited since exports and imports are a small percentage of GNP. In 1982, U.S.-manufactured exports accounted for only 9.1% of all manufacturing shipments; imports provided 8.5% of new supply of manufactured goods (domestic shipments plus imports).

Empirical Study

Equation 1 is essentially a reduced-form equation that is assumed to be demand driven in the short-run -- that is, lagged cyclical and potential domestic GNP are assumed to be important determinants of current-period industrial production. Similarly, the last period's foreign income level affects current-period production. As domestic and foreign income variables change, they presumably influence the demand for industrial output, quite apart from relative domestic or foreign prices or the exchange rate. It is in this sense that the model is "demand driven." In order to take account of potential nonlinearities, the equation is estimated in double-log form. Coefficient estimates can be interpreted as elasticities, ceteris paribus. Quarterly data from 1973:3 to 1985:1 are used in the empirical estimates. All explanatory variables are lagged one quarter.

In the presence of first-order serial correlation among the error terms, a phenomenon common in time series estimates such as this one, the Cochrane-Orcutt estimation procedure is preferable to ordinary least-squares, and is used in the various estimations of Equation (1). The following guide is presented by Pindyck and Rubinfeld (1981): "As a general rule, the presence of serial correlation will not affect the unbiasedness or consistency of the ordinary least-squares regression estimators, but it does affect their efficiency."

The Cochrane-Orcutt procedure is an efficient iterative solution technique that relies upon successively estimating new values of the serial correlation coefficient. This procedure is described in greater detail in Pindyck and Rubinfeld (1981), and in Hanushek and Jackson (1977), among others.

Equation 1 is estimated for the manufacturing sector as a whole. In addition, this same equation is estimated for 20 2-digit SIC industries. The empirical results are contained in Table 2.

The variable GNP/GNP* captures the economy's position in the business cycle and is generally positive and significant across the 2-digit SIC industries and at the aggregate level. Its size differs depending upon the industry in question. The empirical results demonstrate that nondurable products that need continual replacement, such as food, oil, and textiles, are less sensitive to changes in the business cycle than goods that are more durable, such as furniture, metals, machinery, and rubber, whose cyclical income elasticities are all greater than one. This is the result that is expected since the purchase of more durable goods can be more easily postponed when compared to the purchase of nondurable goods.

GNP* reflects the long-term income trend variable and is a measure of potential GNP. Values of this variable greater than one indicate that output in the industry in question is rising faster than GNP. Values of less than one indicate that industry output is a falling share of GNP, while negative values indicate not only a falling share, but also falling real levels of output. Printing and publishing, petroleum products, rubber and plastics, lumber and wood products, non-electrical machinery, and electrical machinery are the industries with the greatest rising shares of production as potential GNP increases.

Primary metals manufacturing is a mature industry already in decline because of various domestic and foreign factors. The decline is secular and not cyclical. Domestic factors include changing tastes and technology, leading to saturation of consumption, particularly for steel, and an aging and outdated production capacity. It is no surprise to find that the estimated coefficient of

TABLE 2
EMPIRICAL RESULTS FOR EQUATION (1)
ESTIMATED FOR THE PERIOD 1973:3 to 1985:1

	Intercept	EXVUS	GNP/ GNP*	GNP*	PPI/ PY	PPI/ PPIF	GNPF	RHO	F	R^2
All Manufacturing	-2.11	-0.13	1.55	1.67	0.03	-0.84	-0.01	0.48	234	0.97
	(1.21)	(2.10)	(4.37)	(2.19)	(0.11)	(2.37)	(0.02)	(4.25)		
Food and Kindred Products	-3.82	-0.01	0.26	1.06	-0.06	0.02	0.08	0.73	878	0.99
	(3.63)	(0.40)	(1.28)	(2.28)	(0.42)	(0.12)	(0.20)	(7.68)		
Tobacco Products	-1.41	-0.17	-0.38	-0.21	-0.51	0.33	0.59	0.23	9	0.57
	(0.53)	(2.84)	(1.02)	(0.24)	(1.58)	(1.25)	(0.80)	(1.61)		
Textile Mill Products	10.52	-0.16	1.70	0.81	-0.85	-0.41	-0.89	0.72	20	0.76
	(1.55)	(1.04)	(1.94)	(0.35)	(1.18)	(0.54)	(0.50)	(7.06)		
Apparel Products	-5.35	-0.01	1.66	1.64	0.09	0.13	-0.73	0.75	29	0.82
	(0.75)	(0.05)	(2.08)	(0.75)	(0.09)	(0.20)	(0.46)	(7.44)		
Paper and Paper Products	-5.33	0.08	0.05	-0.71	-0.65	-0.59	1.84	0.53	124	0.95
	(2.18)	(1.17)	(0.10)	(0.65)	(1.85)	(1.50)	(1.95)	(4.36)		
Printing and Publishing	-6.99	0.04	1.14	2.82	0.31	-0.40	-0.69	0.79	1091	0.99
	(5.45)	(0.85)	(3.93)	(4.29)	(1.45)	(1.95)	(1.28)	(21.90)		
Chemicals and Related Products	-3.54	-0.04	0.59	0.13	-0.16	-0.29	0.92	0.78	179	0.97
	(1.68)	(0.47)	(1.23)	(0.12)	(0.49)	(0.90)	(1.05)	(10.48)		
Petroleum Products	11.55	-0.37	1.35	2.91	1.24	-1.48	-1.86	0.55	37	0.85
	(4.16)	(4.12)	(2.30)	(2.31)	(2.46)	(2.64)	(1.69)	(5.18)		
Rubber and Plastic Products	-4.72	-0.06	2.44	3.78	-0.41	-0.44	-1.55	0.46	145	0.96
	(0.99)	(0.48)	(3.43)	(2.31)	(0.79)	(0.65)	(1.10)	(3.58)		
Leather and Leather Products	13.75	-0.24	0.98	1.00	-0.09	0.08	-1.59	0.62	55	0.89
	(3.55)	(1.85)	(1.29)	(0.55)	(0.16)	(0.15)	(1.01)	(5.18)		

TABLE 2 CONTINUED

	Intercept	EXVUS	GNP/ GNP*	GNP*	PPI/ PY	PPI/ PPIF	GNPF	RHO	F	R^2
Lumber and Wood Products	-3.02 (0.65)	0.17 (0.82)	-0.22 (0.21)	3.77 (1.67)	-0.42 (0.63)	1.07 (1.58)	-2.68 (1.50)	0.85 (10.70)	29	0.82
Furniture and Fixtures	-0.25 (0.08)	-0.08 (0.81)	1.91 (3.55)	1.99 (1.52)	-0.15 (0.27)	-0.91 (0.06)	-0.44 (0.42)	0.80 (18.44)	206	0.97
Clay, Glass, and Stone Products	-1.09 (0.38)	-0.14 (1.16)	1.36 (2.32)	0.33 (0.24)	0.01 (0.03)	-0.32 (0.68)	0.58 (0.53)	0.85 (10.96)	69	0.91
Primary Metal Products	4.37 (0.64)	-0.12 (0.59)	3.23 (2.84)	-1.73 (0.65)	-0.38 (0.45)	0.54 (0.49)	1.07 (0.47)	0.56 (4.79)	47	0.88
Fabricated Metal Products	1.90 (0.80)	-0.07 (0.77)	2.40 (5.01)	0.51 (0.46)	0.37 (1.00)	-0.36 (0.96)	0.12 (0.13)	0.69 (6.55)	89	0.93
Non-Electrical Machinery	-5.29 (2.60)	-0.19 (2.72)	1.85 (4.48)	2.06 (2.18)	0.13 (0.34)	-1.00 (3.38)	0.11 (0.14)	0.64 (6.86)	411	0.98
Electrical Machinery	-12.47 (6.25)	-0.14 (1.71)	1.67 (3.62)	3.36 (3.31)	-0.21 (0.44)	-0.74 (2.42)	-0.27 (0.32)	0.79 (21.73)	893	0.99
Transportation Equipment	-5.53 (1.21)	-0.08 (0.50)	1.31 (1.37)	1.03 (0.48)	-1.08 (1.19)	0.46 (0.70)	0.07 (0.04)	0.77 (8.11)	31	0.83
Instruments	-0.61 (0.43)	-0.15 (2.92)	1.10 (3.41)	0.42 (0.59)	-0.34 (1.03)	-0.38 (1.75)	0.55 (0.93)	0.74 (7.42)	242	0.97
Miscellaneous Manufacturing	3.26 (1.52)	-0.23 (2.70)	1.34 (3.03)	1.44 (1.44)	0.32 (1.04)	-0.80 (2.22)	0.39 (0.45)	0.67 (9.09)	57	0.90

Note: Absolute t - statistics are in parentheses.

GNP* for the Primary Metal Products industry is negative. Primary metals shows declining industrial production -- in fact, output of primary metals has fallen by almost 30% from 1972 to 1985.

PPIi/PY and PPIi/PPIF are the price variables. PPIi/PY is a measure of the own-real price effect, and the empirical estimates are generally negative, as can be seen in Table 2. PPIi/PPIF measures the price of domestic manufacturing output relative to the price of foreign manufacturing output. The signs of the estimated coefficients of PPIi/PPIF are negative for the most part, and its effect in influencing output in the U.S. manufacturing sector is limited. This is the result expected since exports and imports in general are a small percentage of GNP. This same analysis helps to explain the sign and significance level of GNPF.

The EXVUS variable is a measure of the exchange rate value of the dollar. On theoretical grounds, it is expected that its sign will be negative. The higher EXVUS, the higher the cost of U.S.-made goods relative to foreign-made goods. For the most part, the empirical results confirm what theory suggests. The size of the estimated coefficients are generally small as expected. Changes in overall income and in the relative prices of individual products are normally more important to industrial performance than are exchange-rate movements. The high exchange rate may accelerate deterioration of some industries, where decline is already under way, or slow an industry's expansion. Based on the empirical results, a high-valued dollar is not the main cause of the declining manufacturing industry in the short-run. If EXVUS only captured relative price differences, all of the effect of such relationships would be captured by the PPIi/PPIF variable, and the exchange rate coefficient would equal zero. The empirical results demonstrate that this is not the case.

However, small increases in EXVUS over many quarters can become large as the cumulative effect of exchange-rate appreciations grow. A 30 percent rise in the exchange rate over time can lead to a substantial deterioration in overall industrial production. Different industries react in different ways to an increased value of the dollar. In general, the short-run effects of an increase in the value of the dollar are small among the individual 2-digit SIC industries as well as at the aggregate level. One reason for this is that foreign trade in manufacturing is not a large part of total U.S. manufacturing. Even among individual industries, increases in EXVUS over time will severely cut back production in those industries.

Conclusion and Suggestions for Further Research

By examining the variables which impact upon the level of manufacturing output for each of 20 2-digit SIC industries and an industry aggregate, and the empirical magnitudes of these influences, we are able to isolate the effect of the foreign exchange value of the dollar on the U.S. manufacturing sector. The basic result is that its effect is small in the short-run, but can become quite large as the dollar's strength persists. This is true at both the individual industry and aggregate levels.

Since the latter half of 1985, the foreign exchange value of the dollar has fallen dramatically. An expected consequence of this is that the world demand for U.S. industrial production should increase, ceteris paribus. This effect is not likely to be instantaneous. Even as the dollar has been receding in value, many foreign goods may be able to hold on to their market shares because consumers, who are now familiar with these products, may remain loyal to them. Prolonging this effect is the foreign producers' ability to take advantage of established sales and distribution networks. Thus, only a large and sustained depreciation in the value of the dollar can have a major impact on future U.S. industrial production.

In order to address this issue empirically, Equation 1 should be estimated using data from the latter half of 1985 to the present. The coefficient estimate obtained on EXVUS should be compared with the one obtained in this paper. An F-test could be performed to see if these two coefficient estimates are statistically distinct in value.

Similar analyses could be performed to study the coefficient estimates of the other independent variables in Equation 1 under these two different period-of-time regimes. Unfortunately, the data set needed to perform these analyses would have approximately 20 observations, which is typically not enough to allow one to perform a truly convincing statistical demonstration. The passage of time should ameliorate this situation.

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