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The Effect of Exchange Rates on Prices, Wages, and Profits: A Case Study of the United Kingdom in the 1990s

by

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Abstract

During the 1990s the United Kingdom experienced large and sudden exchange rate movements that had no apparent impact on overall consumer prices. This paper shows that the stability of U.K. consumer prices was made possible in part by offsetting movements in the price-cost margins of foreign exporters and in part by offsetting price-cost margins in the U.K. distribution sector. At the same time, U.K. manufacturers experienced margin swings in the opposite direction, largely due to their role as exporters. Thus, sterling depreciation boosted the profits of U.K. manufacturers and squeezed the profits of U.K. distributors, while sterling appreciation had the opposite effects.

Keywords: appreciation, depreciation, operating surplus, pass-through

JEL Classification: D4, E3, F4

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Introduction

The United Kingdom experienced a sharp exchange rate depreciation in late 1992 (about 15 percent on a trade-weighted basis) followed four years later by an even sharper exchange rate appreciation (about 20 percent on a trade-weighted basis). These movements implied large changes in foreign prices in terms of sterling, and yet a broad index of consumer prices in the United Kingdom was remarkably stable. Given that the United Kingdom is a moderately open economy, with exports and imports each comprising slightly over 25 percent of GDP, it is remarkable that such large and persistent relative price movements between the United Kingdom and its trading partners should occur.

A growing literature is searching to understand the apparently weak relationship between exchange rates and domestic prices in many countries.[2] For example, Burstein, et al. (2002) explore the role of distribution costs and price measurement techniques in explaining the weak inflationary effects of some recent depreciations in emerging markets. Gagnon and Ihrig (forthcoming) focus on the role of monetary policy reactions to exchange rate movements in 20 industrial countries. Frankel et al. (2004) provide some support for both monetary policy and distribution margins in explaining low exchange rate effects on consumer prices. This paper directly examines prices and margins in two important sectors during a major depreciation and a major appreciation. I choose the manufacturing sector because it is the primary exporting sector. I also choose the distribution sector because it has been the focus of previous studies.

The main findings are that the sterling depreciation of 1992 led to increased profits for U.K. manufacturers and decreased profits for U.K. distributors. The sterling appreciation of

[2]This literature is not to be confused with a larger body of literature that explores the relationships between exchange rates and export or import prices. See Goldberg and Knetter (1997) for a survey of the trade price literature.

1996 had the opposite effects. The exchange rate effects on distributors likely result from the Bank of England's successful stabilization of consumer price inflation over this period. In order to keep overall prices stable in the face of changing tradables prices, prices of nontradable services, such as retailing, have to move in the opposite direction. Exchange rate movements had very small effects on total labor costs and real output in each sector.

A Simple Framework

The sectoral accounts section of the annual U.K. National Accounts provides a breakdown of gross output or revenue (REV) by major industry into its key components: intermediate inputs (INT), labor compensation (LAB), operating surplus (SUR), and indirect taxes less subsidies (TAX). Gross value added (GVA) is defined as gross revenue minus intermediate inputs.[3] These relationships are displayed in equations (1) and (2).

(1) $REV = INT + LAB + SUR + TAX$

(2) $GVA = REV - INT$

Gross revenue is composed of domestic revenue (REVD) and exports (REVX). Intermediate inputs include purchases from domestic suppliers (INTD) and imports (INTM). Making these substitutions yields equation (3).

(3) $GVA = REVD + REVX - INTD - INTM \ (= LAB + SUR + TAX)$

These nominal magnitudes can be expressed as products of price and quantity:

(4) $PVA*QVA = PRD*QRD + PRX*QRX - PID*QID - PIM*QIM$

[3]Gross value added equals net value added plus depreciation of fixed capital. The accounts do not show depreciation by sector. For documentation, see the U.K. Office of National Statistics, *The Blue Book 2004.*

where PVA and QVA are price and quantity of gross value added (GVA);
PRD and QRD are price and quantity of domestic revenue (REVD);
PRX and QRX are price and quantity of exports (REVX);
PID and QID are price and quantity of domestic inputs (INTD); and
PIM and QIM are price and quantity of imported inputs (INTM).

Consider some of the channels by which exchange rates may influence gross value added and its components in terms of prices and quantities. The first-round effect of an exchange rate depreciation operates through prices, holding quantities constant. For a sector in which exports equal imports (REVX = INTM) identical increases in PRX and PIM will have no effect on the price of value added.[4] For a net exporting sector the first-round effect will be to raise the price of value added and the opposite is true for a net importing sector.

A second-round effect of an exchange rate depreciation on prices (still holding quantities constant) depends on the tradability of the goods and services in question. If the sector's output is tradable, and thus competes with imports, a depreciation may raise the domestic price of its output (PRD). Similarly, if the sector's inputs are tradable, a depreciation may raise the price of domestic inputs (PID). Since total revenue exceeds intermediate inputs by a wide margin, the net effect of a depreciation is to increase the price of value added if both outputs and inputs are tradable. On the other hand, if the central bank has a target for a broad consumer price index (as the Bank of England does) it is likely to tighten monetary policy, *ceteris paribus*, in the face of a depreciation. The policy tightening is needed to put downward pressure on sales prices of domestically produced goods and services to offset the higher prices of imported goods and services. For non-tradable sectors in particular, the net effect of a depreciation under this

[4]A further complication is that the exchange rate might affect PRX and PIM by different proportions, but I show below that these effects are reasonably similar in practice.

monetary policy assumption is likely to be a decline in the domestic sales price (PRD) as well as the price of value added (PVA).

There are also second-round effects of a depreciation on quantities. In particular, depreciations should encourage exports (QRX) and reduce imports (QIM). There may even be third-round effects on quantities of domestic revenue and domestic input, but the export and import effects are expected to dominate. These quantity effects typically operate with a lag. Altogether then, a depreciation is expected to increase nominal value added in a sector to the extent that (1) the sector is a net exporter; (2) the sector's output is tradable; and (3) the sector's inputs are non-tradable.

The plan of the rest of the paper is as follows. I assume that the U.K. real exchange rate is exogenous with respect to the sectoral accounts.[5] I show that the real exchange rate is strongly correlated with overall export and import prices but that it has no correlation with overall consumer prices. Exchange rate depreciation tends to boost the quantity of exports and diminish the quantity of imports, but these effects are not statistically significant, possibly due to long lags. Next I choose two of the largest sectors of the U.K. economy for more detailed analysis. Manufacturing is a net exporter and its value added is tradable. Distribution is (effectively) a net

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[5]This assumption is consistent with the empirical results of Meese and Rogoff (1983) that exchange rates appear to be exogenous with respect to macroeconomic fundamentals. The standard explanation is that unobserved investor preferences and expectations about future macro policies are the main driver of exchange rates and that feedback from sectoral prices and quantities is both weak and slow. This assumption is plausible for the United Kingdom in the 1990s, when exchange rate movements were driven largely by actual and expected macroeconomic policies in the United Kingdom and its major trading partners. In particular, the depreciation of 1992 reflected the adoption of easier monetary policy and the abandonment of the fixed exchange rate. The appreciation of 1996 reflected a tighter fiscal and looser monetary policy in the rest of Europe during the runup to monetary unification.

importer and its value added is largely non-tradable. Sectoral data on prices and quantities of revenue and inputs do not exist, but the real exchange rate does have the expected effect on prices of value added in these sectors. The exchange rate has little estimated effect on the quantity of value added in either sector. Finally, I examine the extent to which movements in nominal sectoral value added driven by the real exchange rate are distributed between labor compensation and operating surplus. Essentially all of the effects show up in operating surplus.

Sterling, Inflation, and Trade in the 1990s

Figure 1 displays the quarterly nominal effective exchange rate index for the United Kingdom over the sample of interest.[6] This measure was calculated by the IMF and is taken from the IFS database. It is derived from exchange rates of 18 industrial countries using weights based on trade in manufactures. Figure 1 clearly documents the sharp depreciation of late 1992 and sharp appreciation of late 1996.

Figure 2 plots U.K. consumer price inflation (RPIX, the heavy dashed line) and the rate of change of foreign consumer prices converted into pounds (PFOR, the solid line).[7] All variables in Figure 2 are four-quarter rates of change. The sterling depreciation of 1992 raised foreign consumer prices relative to U.K. consumer prices, and the appreciation of 1996 lowered

[6]I focus on the 1990s because of the pronounced exchange rate movements and because the sectoral data of the following section are available only from 1989 through 2002.

[7]RPIX is the retail price index excluding mortgage interest; the RPIX inflation rate was the target variable for monetary policy over most of this sample. PFOR is calculated from the IMF's real effective exchange rate index based on consumer prices (REC) and RPIX using the formula PFOR=RPIX/REC. RPIX was obtained from the U.K. Office of National Statistics website, www.statistics.gov.uk. REC was obtained from the IMF IFS database.

foreign consumer prices relative to U.K. consumer prices. One might expect that U.K. consumer price inflation would have increased in the aftermath of the depreciation of 1992. In fact, the opposite appears to be true. RPIX inflation maintained its downward trajectory, from 5.7 percent in 1991Q4 to 3.7 percent in 1992Q4, 2.7 percent in 1993Q4, and 2.2 percent in 1994Q4. Moreover, after the appreciation of 1996, U.K. inflation remained remarkably stable. From 1993 on, these inflation rates were well within the 1.5-to-3.5 percent target band adopted by the Bank of England at the end of 1992.

Figure 2 also shows rates of change of export and import deflators (PEXP, the dotted line, and PIMP, the dash-dotted line).[8] Due to faster technological progress in tradable goods than in the rest of the economy on average, there is a downward drift of trade prices relative to broader price measures.[9] Thus, export and import price inflation tend to be lower than consumer price inflation except in periods when foreign price increases are particularly strong. It is evident in Figure 2 that export and import prices do respond to exchange rate movements, but that the responses are less pronounced than the associated changes in exchange-rate-adjusted foreign prices (PFOR). To quantify this behavior, I estimated the following equations over the period 1989Q1-2002Q4:[10]

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[8]All national accounts data are available from the Office of National Statistics website, www.statistics.gov.uk.

[9]See, for example, Appendix A in Hooper, Johnson, and Marquez (2000).

[10]These specifications resulted from a general-to-specific procedure. The initial specification included a lagged dependent variable and three lags of the independent variables. Sequential testing showed that only the first and second lag of the independent variables were significant at the 10 percent level. LM tests for first-order and second-order serial correlation were not significant at the 10 percent level.

$$\Delta\log(PEXP/RPIX) = -0.004 + 0.226*\Delta\log(PFOR/RPIX) + 0.182*\Delta\log(PFOR/RPIX)_{-1}$$
(t-statistic) (2.6) (4.0) (3.3)

$R^2 = .44$ s.e.=.01

$$\Delta\log(PIMP/RPIX) = -0.005 + 0.376*\Delta\log(PFOR/RPIX) + 0.153*\Delta\log(PFOR/RPIX)_{-1}$$
(t-statistic) (2.9) (5.9) (2.4)

$R^2 = .52$ s.e.=.01

The negative intercept terms imply that both export and import prices tend to fall relative to consumer prices at a rate of roughly 2 percent per year. The coefficients on foreign prices imply that a 10 percent increase in PFOR relative to RPIX would raise export prices (relative to RPIX) about 4 percent and would raise import prices more than 5 percent.[11] These results imply that about half of the price adjustment to U.K. exchange rate movements is borne by foreign producers and buyers with the other half borne by U.K. producers and buyers.

A similar regression analysis on changes in the volumes of exports and imports relative to GDP found small effects in the expected direction. These were not statistically significant, probably reflecting the longer and more diffuse lags in the transmission of exchange rates to quantities as opposed to prices.[12]

Value Added, Wages, and Profits in Manufacturing and Distribution

I focus on two large sectors of the economy with different exposures to trade and

[11]These estimates imply that U.K. exporters pass-through 60 percent of exchange rate movements to their export prices and that foreign exporters to the United Kingdom pass-through more than 50 percent. These pass-through estimates are within the range surveyed by Goldberg and Knetter (1997).

[12]Lagged responses to exchange rates are commonly found to be greater in trade quantities than trade prices. See, for example, Helkie and Hooper (1988).

exchange rates.[13] As of 1989 manufacturing was the largest sector in terms of value added (24 percent of total value added), but by 2002 it had slipped to second place (16 percent of total) behind financial intermediation and essentially tied with the third-largest sector, distribution.[14]

Manufacturing is by far the largest exporting sector with nearly two-thirds of total exports in 2002. (Financial intermediation is the second largest exporting sector.) Exports by the distribution sector are negligible. Import data are not available by destination sector. If imports are assumed to be distributed in proportion to each sector's share of intermediate inputs, then manufacturing would have net exports of 10 percent of GDP in 1999, and distribution would have net imports of 3½ percent of GDP. There are several caveats to the foregoing calculation. First, some imports are purchased directly by households (e.g., tourism) and are thus not an input into any sector. Second, the manufacturing sector is likely to have a higher share of imports in intermediate inputs than most other sectors due to imports of raw materials. Third and most importantly, in the national accounts, merchandise bought and sold by the distribution sector is not counted either as an intermediate input or in gross revenues of that sector. Yet, retail shop prices clearly cover both the cost of the goods sold and the cost of running the shops. It is these shop prices that are recorded in the retail price index, which is the stabilization target of the Bank of England. In an economic sense, if not in the formal accounting, imported merchandise must be considered an input to the distribution sector. As the

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[13]There are 11 sectors in all: agriculture, mining, manufacturing, utilities, construction, distribution, transport, finance, public administration, health and education, and other services.

[14]The distribution sector includes wholesale and retail trade, hotels, and restaurants. I would have preferred to focus on wholesale and retail trade, but detailed data were not available at that level of disaggregation. Value added in wholesale and retail trade is roughly four times value added in hotels and restaurants.

distribution sector does not export, it must be a net importer.

The next two charts examine the effect of the exchange rate on the price and quantity of sectoral value added. Figure 3 plots the value-added deflators for the two sectors relative to the value-added deflator for all sectors. There is a clear expansionary effect of the 1992 depreciation on the manufacturing deflator. There is a smaller contractionary effect on the distribution deflator, which may be obscured in part by the secular rise in this deflator. These results correspond well to the predictions of the simple framework described above. Further evidence is provided by the following equations estimated over the period 1989-2002:[15]

$$\triangle \log(PVAM/PVA) = 0.003 + 0.747 * \triangle \log(PVAM/PVA)_{-1} + 0.220 * \triangle \log(PFOR/RPIX)$$
(t-statistic) (0.5) (3.9) (2.6)

$R^2 = .66$ s.e.=.02

$$\triangle \log(PVAD/PVA) = 0.008 - 0.055 * \triangle \log(PFOR/RPIX) - 0.115 * \triangle \log(PFOR/RPIX)_{-1}$$
(t-statistic) (3.7) (1.5) (3.4)

$R^2 = .62$ s.e.=.01

PVAM is the value-added deflator in manufacturing; PVAD is the deflator for distribution; PVA is the deflator for all sectors. The intercept terms indicate a significant tendency for PVAD to grow relative to PVA, with no significant trend in PVAM relative to PVA. A 10 percent increase in relative foreign consumer prices (PFOR/RPIX) would increase the relative price of value added in manufacturing 2 percent immediately with an estimated long-

[15]These and subsequent equations were estimated by a general-to-specific procedure. The initial specification included a lagged dependent variable and three lags of the independent variables. Sequential tests were conducted and terms that were not significant at the 10 percent level were excluded (unless a higher lag proved significant) and the equation re-estimated. LM tests for first-order and second-order serial correlation were not significant at the 10 percent level for any equation. Data were obtained from www.statistics.gov.uk.

run effect of more than 8 percent. The same 10 percent increase in relative foreign prices would reduce the relative price of value added 2 percent after one year.

Figure 4 displays real gross value added in each sector as a share of the total. The most striking feature of this chart is the secular decline of real value added in manufacturing. It appears that this decline may have been slowed temporarily after the depreciation of 1992, but the effect is not large. It is difficult to detect any effect of the exchange rate movements on real output in the distribution sector. These visual impressions were confirmed by regression analysis (not shown) which did not identify any statistically significant effects of changes in exchange rates on real value added in either sector.

Next I decompose these effects into the main components of value added: labor compensation and operating surplus.[16] Figure 5 displays labor compensation in each sector relative to total value added. Once again, the most pronounced feature is the secular downward trend in manufacturing. There also appears a less pronounced upward trend in distribution. It is difficult to discern any effect of exchange rate movements on labor costs in manufacturing. However, the depreciation of 1992 does seem to have been followed by a small decline in labor costs in distribution and the appreciation of 1996 seems to have been followed by a small increase. These conclusions are supported by the following regressions.

[16]I ignore indirect taxes as they are very small.

$$\Delta\log(LABM/GVA) = -0.027 - 0.080*\Delta\log(PFOR/RPIX)$$
(t-statistic) (5.7) (1.1)

$R^2 = .09$ s.e.=.02

$$\Delta\log(LABD/GVA) = 0.011 + 0.155*\Delta\log(PFOR/RPIX) - 0.250*\Delta\log(PFOR/RPIX)_{-1}$$
(t-statistic) (1.9) (1.7) (2.7)

$R^2 = .45$ s.e.=.02

Figure 6 displays operating surplus in each sector. Here the exchange rate effects are striking. Manufacturers' operating surplus rose by nearly 2 percent of total value added (essentially 2 percent of GDP) in the wake of sterling depreciation, despite the secular downtrend in manufacturing output and the sharp rise in input costs. These gains were given back soon after sterling appreciation in late 1996. An opposing but somewhat less pronounced pattern occurs in the distribution sector, whose profits are squeezed by depreciation and recover with appreciation. These conclusions are confirmed by regression analysis:[17]

$$\Delta\log(SURM/GVA) = -0.023 + 0.581*\left[\sum_{i=0}^{2} \Delta\log(PFOR/RPIX)_{-i}\right]$$
(t-statistic) (1.0) (3.1)

$R^2 = .47$ s.e.=.08

$$\Delta\log(SURD/GVA) = -0.004 - 0.486*\Delta\log(PFOR/RPIX)$$
(t-statistic) (0.3) (2.6)

$R^2 = .38$ s.e.=.04

After two years, operating surplus in manufacturing moves 1.7 times as much as relative foreign prices. Higher foreign prices have a significant negative effect on surplus in distribution, but the magnitude of this effect is much smaller than that in manufacturing.

[17]The three lags of foreign relative prices in the manufacturing sector all had nearly the same coefficient. To conserve degrees of freedom, I restricted the coefficients to be equal.

Robustness

I obtained similar results when estimating the regressions in this paper in terms of log levels of the variables. However, the nonstationarity apparent in many of the figures motivated the use of regressions in first differences in order to apply standard statistical inference. The sample is too short for a full cointegration analysis. Moreover, there appear to be omitted trending influences--such as manufacturing's declining share of output--that would need to be explicitly modeled in any cointegration analysis (and that were proxied by time trends in the levels regressions). The regressions in differences require only the assumption that the omitted factors are not correlated with changes in the real exchange rate.

To test for the possibility of an asymmetric effect of depreciations and appreciations, a dummy variable was created for periods in which the exchange rate appreciated. All regressions were re-run adding the appreciation dummy times the relative foreign price, but the additional term was never significant at the 10 percent level.

A related hypothesis is that the relationship between the exchange rate and the economy may have been different in the depreciation of 1992 than in the appreciation of 1996. One reason for the difference may be that agents viewed the 1992 movement as either more or less permanent than the 1996 movement. To test this hypothesis, I conducted Chow tests on all regressions with a break date of 1996. None of the test statistics were significant at the 10 percent level.

Conclusion

This paper shows that large exchange rate movements can coincide with stable consumer

prices because firms in affected sectors absorb large changes in their profit margins. After the sterling depreciation of 1992, U.K. manufacturers enjoyed a large increase in operating surplus while U.K. distributors suffered a significant decline in operating surplus. The sterling appreciation of 1996 led to the opposite effects. Changes in labor compensation and real output across sector were relatively minor.

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Figure 1. U.K. Nominal Effective Exchange Rate
(Index, 2000=100)

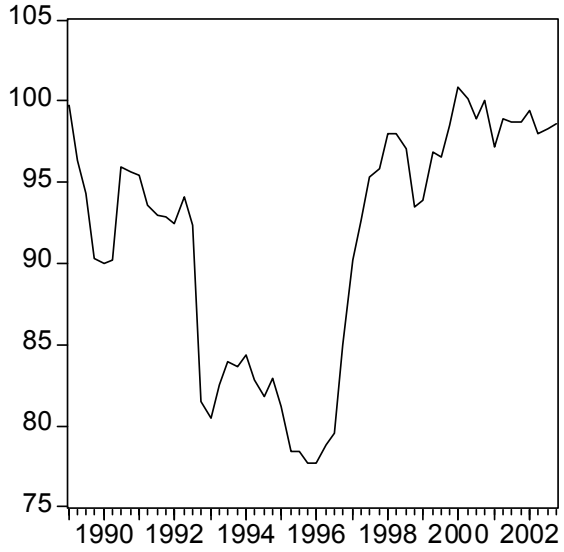

Figure 2. U.K. Domestic and External Inflation

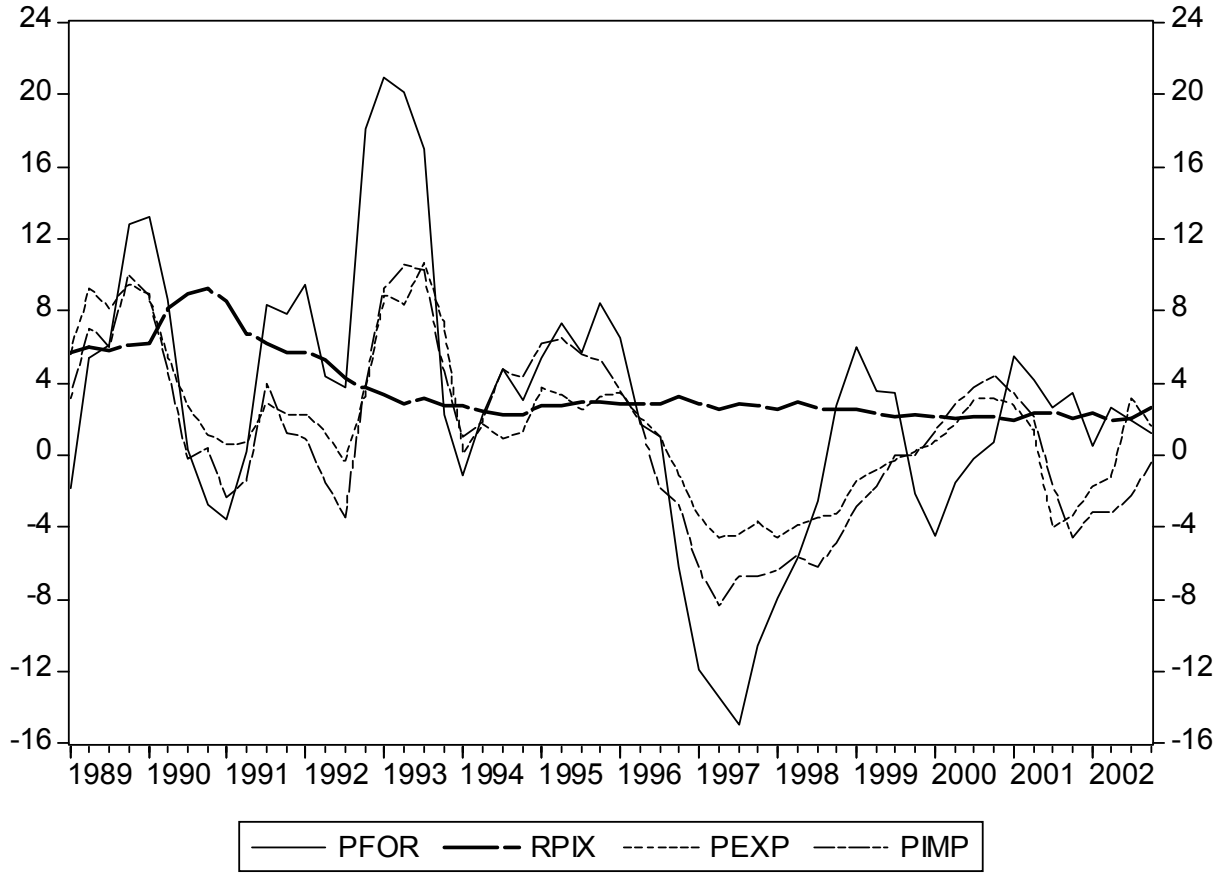

Figure 3. Relative Value-Added Deflators

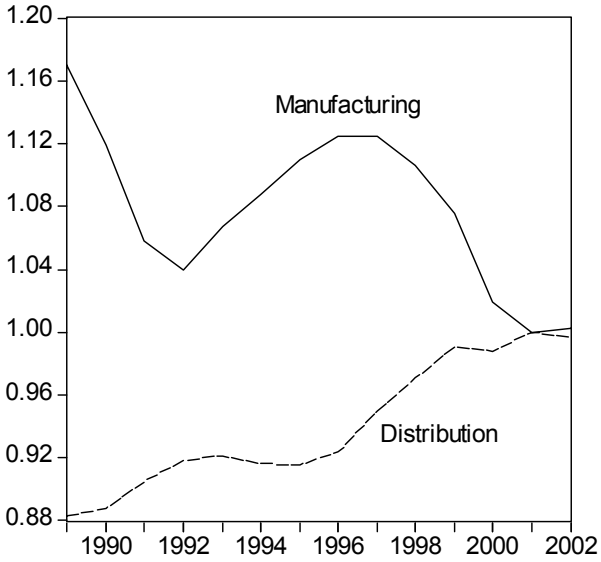

Figure 4. Real Output (Value Added)
(Share of Total, 2001 prices)

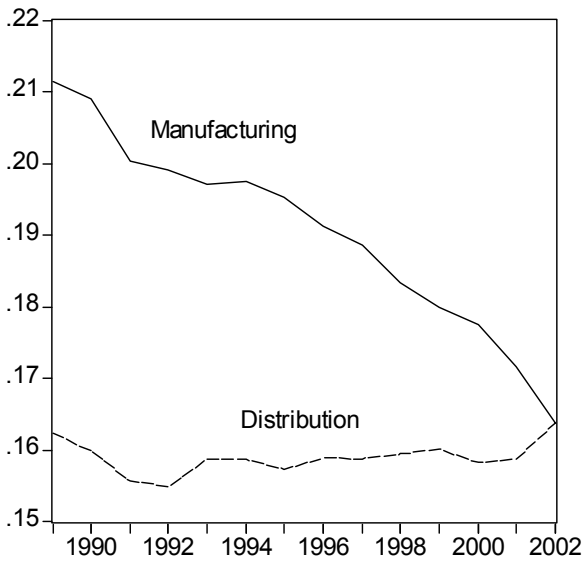

Figure 5. Labor Compensation
(Share of Total Value Added)

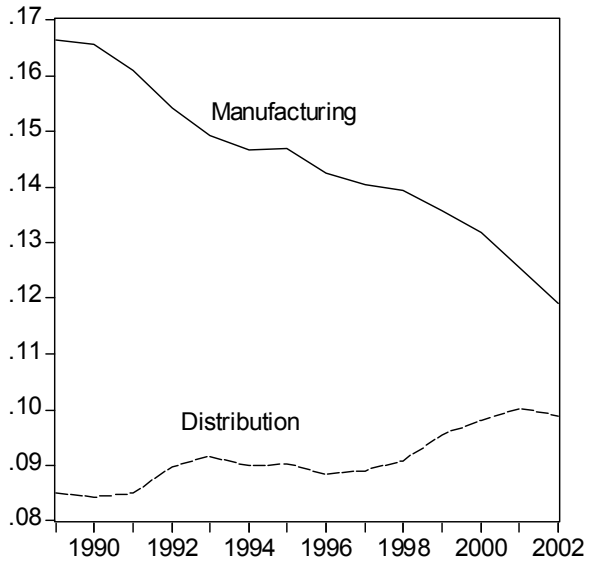

Figure 6. Operating Surplus
(Share of Total Value Added)