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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

Introduction and Summary

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.

This paper examines the impact of exchange rate movements in the 1990s on two major sectors of the U.K. economy: manufacturing and distribution. The manufacturing sector is a net exporter, while the distribution sector is a net importer. Thus, one would expect to find differential effects of exchange rate movements on the two sectors. The main findings are that the sterling depreciation of 1992 led to increased profits for manufacturers and decreased profits for distributors. The sterling appreciation of 1996 had the opposite effects. Exchange rate movements had very small effects on total labor costs and only modest effects on real sectoral output relative to GDP.[2]

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:

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[2]I was unable to examine the effects on productivity and wage rates in this framework as the labor hours data are not available prior to 1993. The results for total labor costs and sectoral output are consistent with relatively small effects on wage rates and productivity, and a casual examination of output per hour after 1993 reveals little effect from sterling appreciation in 1996.

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

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).

This nominal identity also has an analog in real terms:

(5)   QVA = QRD + QRX - QID - QIM

Let us 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 on equation (4) is to increase the prices of exports and imports. For a

sector in which exports equal imports (and holding quantities constant) identical increases in

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[3]Gross value added equals net value added plus depreciation of fixed capital. The
accounts do not show depreciation by sector.

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.

The second-round effect of an exchange rate depreciation on prices 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 typically exceeds inputs by a wide margin, the net effect of a depreciation should be 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 overall domestic sales prices (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 given the unchanged target for overall prices. For non-tradable sectors in particular, the net effect of a depreciation under this monetary policy assumption is likely to be a decline in the domestic sales price (PRD) as well as the price of value added (PVA).

Finally, there are second-round effects of a depreciation on quantities. In particular, depreciations should encourage exports and reduce imports. There may also be second-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

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[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.

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. The exchange rate is also correlated with quantities of total exports and imports with a lag of 1 to 2 years. 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 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 also has the expected effect on the quantity of value added in manufacturing, with little effect on the quantity of value added in distribution. 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.

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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.
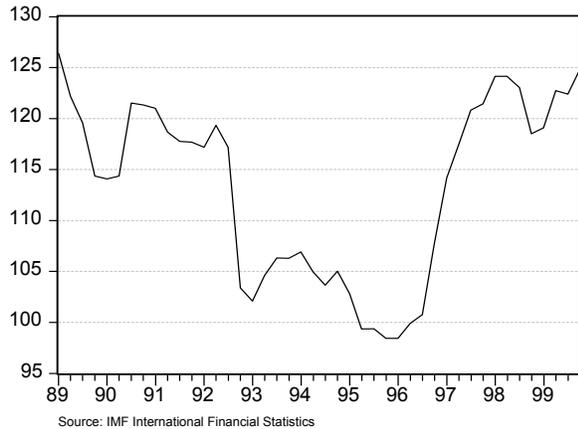
Sterling, Inflation, and Trade in the 1990s

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. The figure clearly documents the sharp depreciation of late 1992 and sharp appreciation of late 1996. The remainder of this paper will focus on annual data, since the sectoral accounts are not available at a higher frequency.

Figure 1. U.K. Nominal Effective Exchange Rate (1995 = 100)

Source: IMF International Financial Statistics

Figure 2 plots U.K. consumer price inflation (RPIX, the solid blue line) and the rate of change of foreign consumer prices converted into pounds (PFOR, the dash-dot black line).[7] The sterling depreciation of 1992 raised foreign consumer prices relative to U.K. consumer prices, and the appreciation of 1996 lowered 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

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[6]I focus on the 1990s because of the pronounced exchange rate movements. I keep the sample relatively short to minimize the muddying effect of other factors in this simple analysis. Few of the statistical results are overturned by extending the data back to 1979, but the coefficients typically are smaller and less significant in the longer sample.

[7]RPIX is the retail price index excluding mortgage interest; the RPIX inflation rate is the current target variable for monetary policy. 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.

Figure 2. U.K. Domestic and External Inflation
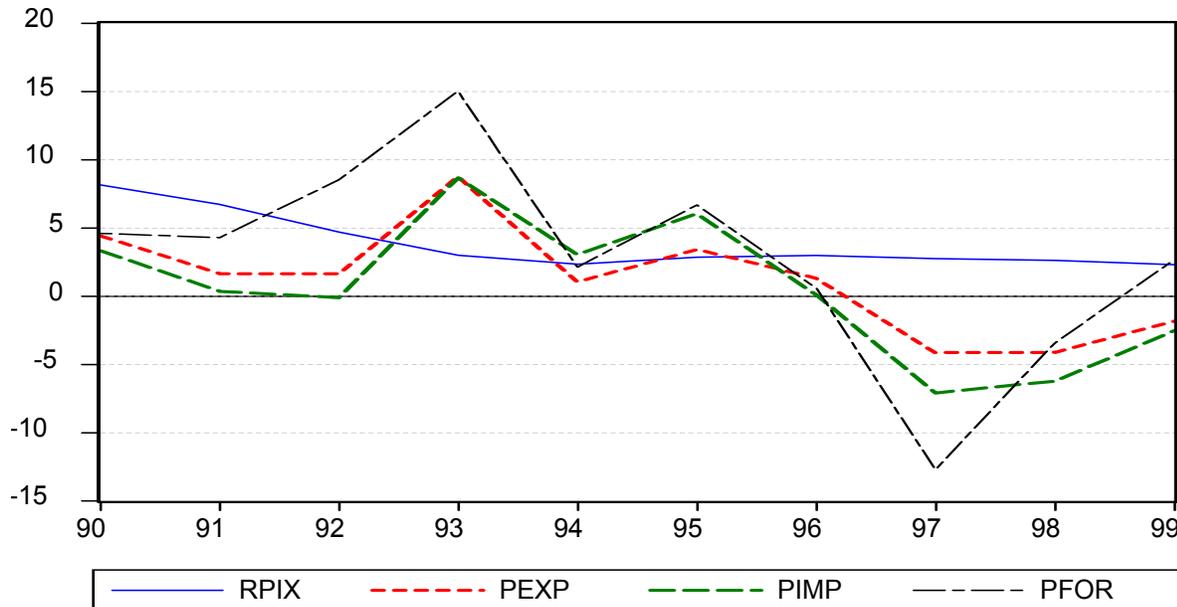
Source: IMF International Financial Statistics
United Kingdom National Accounts

downward trajectory, from 6.7 percent in 1991 to 4.7 percent in 1992, 3.0 percent in 1993, and

2.3 percent in 1994. 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 red

line, and PIMP, the dashed green line). 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.[8] 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

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

that the responses are less pronounced than the associated changes in exchange-rate-adjusted

foreign prices. To quantify this behavior, I estimated the following equations over the years

1989-99:[9]

```
log(PEXP/RPIX) = -0.063 - 0.018*TIME + 0.438*log(PFOR/RPIX)   R² = .95
(t-statistic)    (1.7)   (5.5)          (3.2)                  s.e.=.02


log(PIMP/RPIX) = -0.116 - 0.023*TIME + 0.594*log(PFOR/RPIX)   R² = .94
(t-statistic)    (1.4)   (3.2)          (2.4)                  s.e.=.03
```

These equations impose the restriction that in the absence of a trend and relative

movements in foreign prices, export and import prices move in line with domestic consumer

prices.[10] The downward trend in traded goods prices relative to overall prices is about 2 percent

per year. The coefficients on foreign prices imply that the marginal effect of a 10 percent

increase in PFOR relative to RPIX is to raise export prices relative to RPIX by over 4 percent

and to raise import prices by nearly 6 percent.[11] These results imply that just under half of the

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[9]An LM test for first-order serial correlation was significant at the 5 percent level for import prices and the 10 percent level for export prices. The reported regressions include estimated autocorrelation coefficients of 0.29 for export prices and 0.57 for import prices. Allowing for autocorrelated errors had no noticeable effect on the estimated coefficients for TIME and PFOR/RPIX, but it did reduce the t-statistics by a factor of two.
    The restriction that foreign-currency prices and the exchange rate have identical effects (embodied in the calculation of PFOR as foreign prices converted to sterling) cannot be rejected. Including both terms in the regression leads to an insignificant coefficient on foreign-currency prices.

[10]Due to the smoothness of domestic consumer prices, I was unable to obtain sensible unrestricted estimates of their effect while also allowing for the trend decline in traded goods prices. The restriction cannot be rejected at the 5 percent level.

[11]These estimates imply that both U.K. and foreign exporters pass-through nearly 60 percent of exchange rate movements to their export prices. This degree of pass-through is well within the range documented by Goldberg and Knetter (1997).

price adjustment to U.K. exchange rate movements is borne by foreign producers and buyers with just over half borne by U.K. producers and buyers.

The following regressions display the impact of relative foreign prices on quantities of exports and imports relative to real GDP over the years 1989-99. For exports the strongest effect occurred with a lag of two years. For imports, the strongest effect occurred after one year. In neither case was there significant evidence of first-order autocorrelation. In both cases, relative prices have the expected effect. Higher foreign prices (exchange rate depreciation) tend to boost real exports and contract real imports with a lag. The positive time trend captures the tendency of trade volumes to grow faster than GDP.

```
log(QEXP/QGDP) = -1.465 + 0.036*TIME + 0.178*log(PFOR/RPIX)_-2  R² = .99
(t-statistic)  (150.4)  (29.7)        (3.1)                      s.e.=.01


log(QIMP/QGDP) = -1.418 + 0.033*TIME - 0.316*log(PFOR/RPIX)_-1  R² = .91
(t-statistic)   (50.2)   (8.7)         (2.0)                    s.e.=.04
```

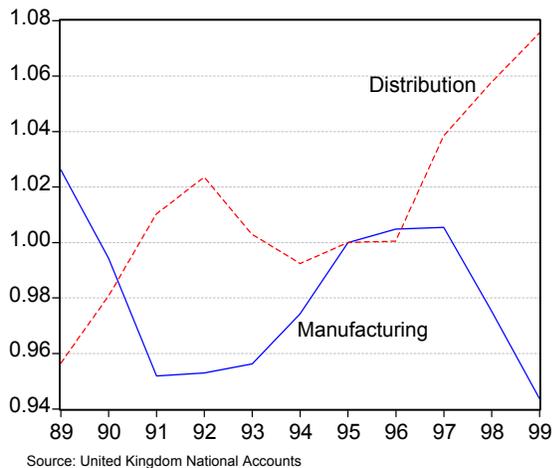Value Added, Wages, and Profits in Manufacturing and Distribution

I focus on two large sectors of the economy with different exposures to trade and exchange rates.[12] As of 1989 manufacturing was the largest sector in terms of value added (24 percent of total value added), but by 1999 it had slipped to second place (19 percent of total) behind finance. The distribution sector was the third largest sector in terms of value added throughout the years 1989-99; as of 1999 it contributed nearly 16 percent of total value added.[13]

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

[13]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

In nominal terms, manufacturing is by far the largest exporting sector with two-thirds of

total exports in 1999. 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 2½ 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 include compensation for payments

by distributors to manufacturers and 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 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

Figure 3. Relative Value-Added Deflators by Sector

Source: United Kingdom National Accounts

value added in hotels and restaurants.

overall retail price index. There is a clear contractionary effect of the 1992 depreciation on the

distribution sector deflator and an expansionary effect on the manufacturing deflator. These

results correspond well to the predictions of the simple framework described above. Further

evidence is provided by the following estimated equations:[14]

```
log(PVAM/RPIX) = 0.036 - 0.004*TIME + 0.177*log(PFOR/RPIX)_-1   R^2 = .78
(t-statistic)   (2.0)   (1.7)          (2.4)                    s.e.=.02


log(PVAD/RPIX) = -0.028 + 0.005*TIME - 0.232*log(PFOR/RPIX)    R^2 = .84
(t-statistic)    (3.1)    (3.4)         (4.7)                  s.e.=.01
```

PVAM is the value-added deflator in manufacturing; PVAD is the deflator for distribution. A

time trend is included to control for the downward trend in manufacturing and the upward trend

in distribution relative to the rest of the U.K. economy both in price and quantity terms. The

secular decline in manufacturing prices presumably reflects faster technological progress in

manufacturing than in services. Relative foreign consumer prices (PFOR/RPIX, or the inverse of

the real effective exchange rate) have statistically significant effects on the prices of value added

in both sectors.[15]

Figure 4 displays real gross value added in each sector as a share of real GDP in order to

control for economy-wide shocks. We are particularly interested in differential impacts of

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[14]An LM test for first-order serial correlation was significant at the 10 percent level for
PVAM but not for PVAD. The reported regressions include an estimated autocorrelation
coefficient of 0.67 for PVAM. Allowing for autocorrelated errors had no significant effect on
the estimated coefficients in either equation.

[15]These and subsequent regressions specify a lagged relative price in manufacturing and a
contemporaneous relative price in distribution. The equations uniformly fit better with this
timing convention, and in some cases the improvement in fit was statistically significant. The
estimated coefficients never differed by more than two standard errors across specifications.

Figure 4. Real Sectoral Output (Value Added)
(Share of Real GDP)

Source: United Kingdom National Accounts
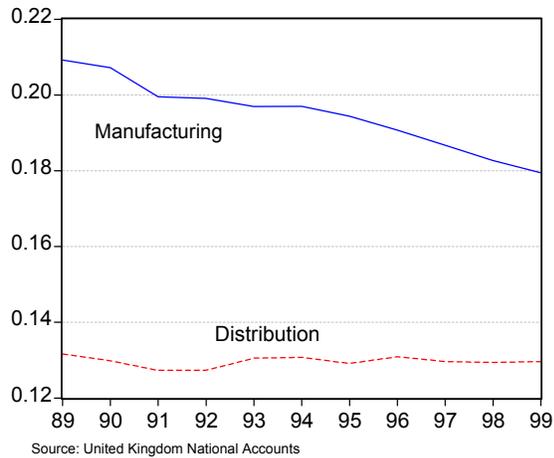
exchange rates on the two sectors. The effects of exchange rates on real value added in these sectors appear to be small, but they do operate in the expected directions. In particular, manufacturing appears to get a small reprieve from its secular decline after the 1992 depreciation. Regression analysis confirms this visual impression. The following equations demonstrate that there is a small, but statistically significant, positive effect of relative foreign prices on real manufacturing output (QVAM) relative to real GDP (QGDP).[16] Both price and output effects reinforce the overall effects of the exchange rate on nominal value added. Next we look at the decomposition of these effects into the main components of value added: labor compensation and operating surplus.[17]

```
log(QVAM/QGDP) = -1.89 - 0.014*TIME + 0.093*log(PFOR/RPIX)_-1   R^2 = .98
(t-statistic)  (394.9) (22.5)          (3.5)                      s.e.=.02


log(QVAD/QGDP) = -1.97 + 0.0004*TIME + 0.047*log(PFOR/RPIX)    R^2 = .15
(t-statistic)  (271.5) (0.4)            (1.2)                     s.e.=.01
```

Figure 5 displays total labor compensation in each sector. Apart from secular trends, it is difficult to discern any effect of exchange rate movements on labor costs. This conclusion is supported by the following regressions, in which relative foreign prices have no significant effect

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[16]LM tests found no evidence of serial correlation in these and subsequent regressions at any significance level.

[17]We ignore indirect taxes as they are very small.

on sectoral labor compensation (LABM, LABD) relative to GDP.

```
log(LABM/GDP) = -1.92 - 0.020*TIME - 0.040*log(PFOR/RPIX)_-1   R² = .99
(t-statistic) (294.2) (23.4)          (1.1)                    s.e.=.01

log(LABD/GDP) = -2.57 + 0.010*TIME + 0.062*log(PFOR/RPIX)      R² = .71
(t-statistic) (173.9)  (4.4)          (0.8)                    s.e.=.02
```


Figure 5. Labor Compensation by Sector
(Share of GDP)

Source: United Kingdom National Accounts

Figure 6. Operating Surplus by Sector
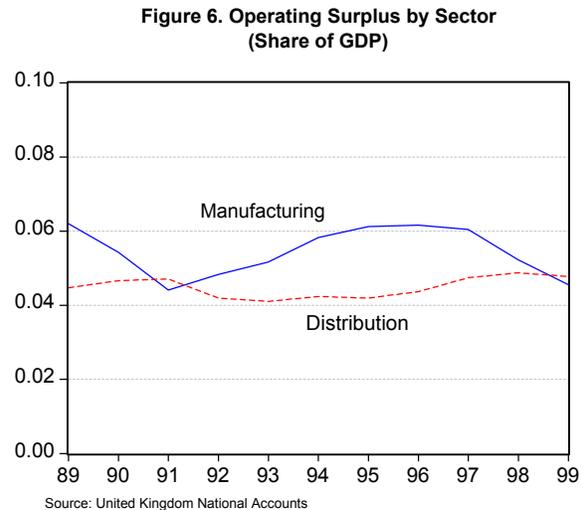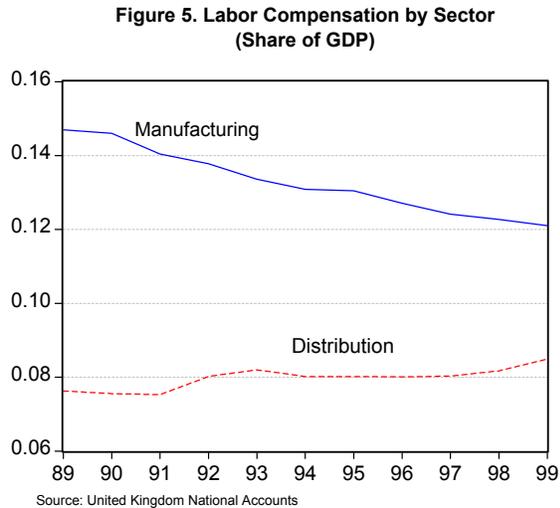(Share of GDP)

Source: United Kingdom National Accounts

Figure 6 displays operating surplus in each sector. Here the exchange rate effects are striking. Manufacturers' operating surplus rose by nearly 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:

```
log(SURM/GDP) = -2.77 - 0.001*TIME + 1.287*log(PFOR/RPIX)_-1   R² = .68
(t-statistic)  (48.8)  (0.1)          (4.1)                    s.e.=.08


log(SURD/GDP) = -3.19 + 0.002*TIME - 0.586*log(PFOR/RPIX)      R² = .76
(t-statistic) (140.8)  (0.6)          (4.7)                    s.e.=.03
```

Operating surplus in manufacturing moves more than proportionally with relative foreign prices. Higher foreign prices have a significant negative effect on surplus in distribution, but the magnitude of this effect is about half of that in manufacturing.

References

Goldberg, Pinelopi, and Michael Knetter (1997) "Goods Prices and Exchange Rates: What Have We Learned?" *Journal of Economic Literature* 35, 1243-72.

Hooper, Peter, Karen Johnson, and Jaime Marquez (2000) "Trade Elasticities for the G-7 Countries," Princeton Studies in International Economics No. 87, August.

Meese, Richard, and Kenneth Rogoff (1983) "Empirical Exchange Rate Models of the Seventies: Do They Fit Out of Sample?" *Journal of International Economics* 14, 3-24.