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IS FACTOR ALLOCATION OPTIMAL?

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P.S. Andersen, M. Klau and E. Yndgaard

ABSTRACT:

From an international perspective, the European rate of unemployment has been relatively high and growing over the last one to two decades; on this background, the parallel rise in profit shares in a number of European countries seems to be at odds with expected economic behaviour.

The paper contributes to a dissolution of this apparent enigma in two steps. First, an empirical decomposition for two sub periods (1966-1981 and 1981-1996) suggests that the rise in profit shares during the second sub-period primarily originated from three sources: a marked fall in real capital prices, a clear upward shift of the return to capital as a result of wage moderation, and a slowdown in the rate of growth of the capital/labour ratio, compared with the first sub-period.

Second, based on various estimates of elasticities of substitution, this slowdown is analysed in greater depth. It turns out that the adjustment of firms to growing profits and falling user cost of capital compared with wages is sub-optimal. In the short run they do not substitute capital for labour in full accordance with cost minimising prescriptions and the speed of convergence towards a complete substitution is low. Hence, during this transitional period, investment –and thus labour productivity– has been lower than would follow from rational behaviour.

Keywords: investment, factor substitution, unemployment, profit share and labour productivity.

JEL classification: E0, E2 and J3.

Higher profits and lower capital prices: is factor allocation optimal?

P.S. Andersen, M. Klau and E. Yndgaard¹

Introduction

The trend rise in unemployment is a problem that has occupied European policy-makers for more than twenty years. Much less noticed is the fact that parallel to the rise in unemployment since the early 1980s, profit shares and rates of return to capital have also increased in a number of continental European countries. This is in marked contrast to the 1970s, when rising unemployment was accompanied by falling profits.²

According to most theories, a parallel rise in profits and unemployment would eventually lead to a correction whereby both profit shares and unemployment decline towards their equilibrium levels. Capital/labour ratios would be expected to increase and the resulting rise in labour productivity would boost firms' demand for labour, unless, of course, wage claims rise in step with or exceed labour productivity. However, even though the last fifteen years have seen a marked rise in capital/labour ratios, employment growth has remained subdued, notably in continental Europe. One explanation might be that the factor substitution process has not been accompanied by sufficient growth of overall demand. Alternatively, firms' attempt to cut costs, combined with a fall in the relative price of capital, may have imparted a capital deepening bias to investment.

However, slow employment growth in Europe is not the only puzzle. Another is that, contrary to what theory would have predicted, the shift in factor ratios in favour of capital has not generated lower rates of return to capital; in fact, since the early 1980s rates of return have generally increased, reversing a downward trend observed during the previous fifteen years. One explanation for the rise in returns might be that the period 1981-96 has been a period of transition between two equilibria owing to the large changes in relative factor prices and the limited speed with which factor ratios are adjusted. This hypothesis seems to be quite well supported by the data and also helps to explain why

¹ The first two authors are affiliated with the Bank for International Settlements in Basle, Switzerland and the first and third authors with the Institute of Economics, Aarhus University, Denmark. We gratefully acknowledge the graphical work by S. Arthur and comments on earlier drafts by W. Wascher and several colleagues at the Institute of Economics, University of Aarhus. The views expressed are entirely those of the authors and are not necessarily shared by their respective employers.

² Profits refer to the financial and non-financial business sector and a more appropriate term would be the capital income share. In the following we shall use profits and capital income interchangeably. Blanchard (1997) is the first to have noticed the parallel rise in European unemployment and profit shares. In his analytical and empirical work, he distinguishes between two groups of countries: the United States, the United Kingdom and Canada, on the one hand, and "continental Europe" (broadly defined to include Australia), on the other.

investment has not been more responsive to the improvement in profits and the fall in the relative cost of capital. Moreover, when we use an error-correction model, allowing for transitional lags as well as the influence of demand-side developments and changes in the distribution of rents, most of the puzzling increase in the *ex post* relative return to capital can be explained.

Nonetheless, given higher profits, lower capital costs and relatively favourable financing conditions, it cannot be excluded that capital formation has been too low and/or that other factors have damped investment spending. For instance, changes in the sectoral composition of output, combined with differences in capital/output ratios might have reduced the growth of the aggregate capital stock. We have briefly analysed this issue but from the evidence (which we do not report) it appears that while sectoral differences and shifts can be observed they have been too small to exert a major impact. It has also been suggested that capital stocks are approaching saturation points. Again, however, the hypothesis is not well supported by the data as actual capital/output ratios are well below those implied by “golden rules” of accumulation.

Section 1 of the paper analyses the immediate sources of changes in profit shares and rates of return, using a novel decomposition scheme which attributes a major part of the movements in profits and profitability to changes in capital/labour ratios, real profits per person employed and the real price of capital.³ Section 2 then turns to the underlying factor adjustment functions by estimating elasticities of substitution, using several models and specifications. We also reverse the direction of causality by estimating equations for *ex post* returns and factor income shares, using changes in factor ratios as well as the rate of unemployment, the real interest rate and output growth as the principal determinants. Section 3 summarises the empirical evidence and derives conclusions. It also points to areas in need of further research, in particular a broader analysis of demand-side effects with respect to labour demand and unemployment and the influence of changes in financial markets and corporate finance structures on investment and capital ratios.

In the Annex, we briefly look at changes in investment/output ratios, noting that the trend decline is most pronounced when measured in current prices and that it has not prevented investment per employee from rising. We also explore the issue of saturation by calculating capital stock and investment ratios according to "golden rule" criteria and then comparing them with actual ratios.

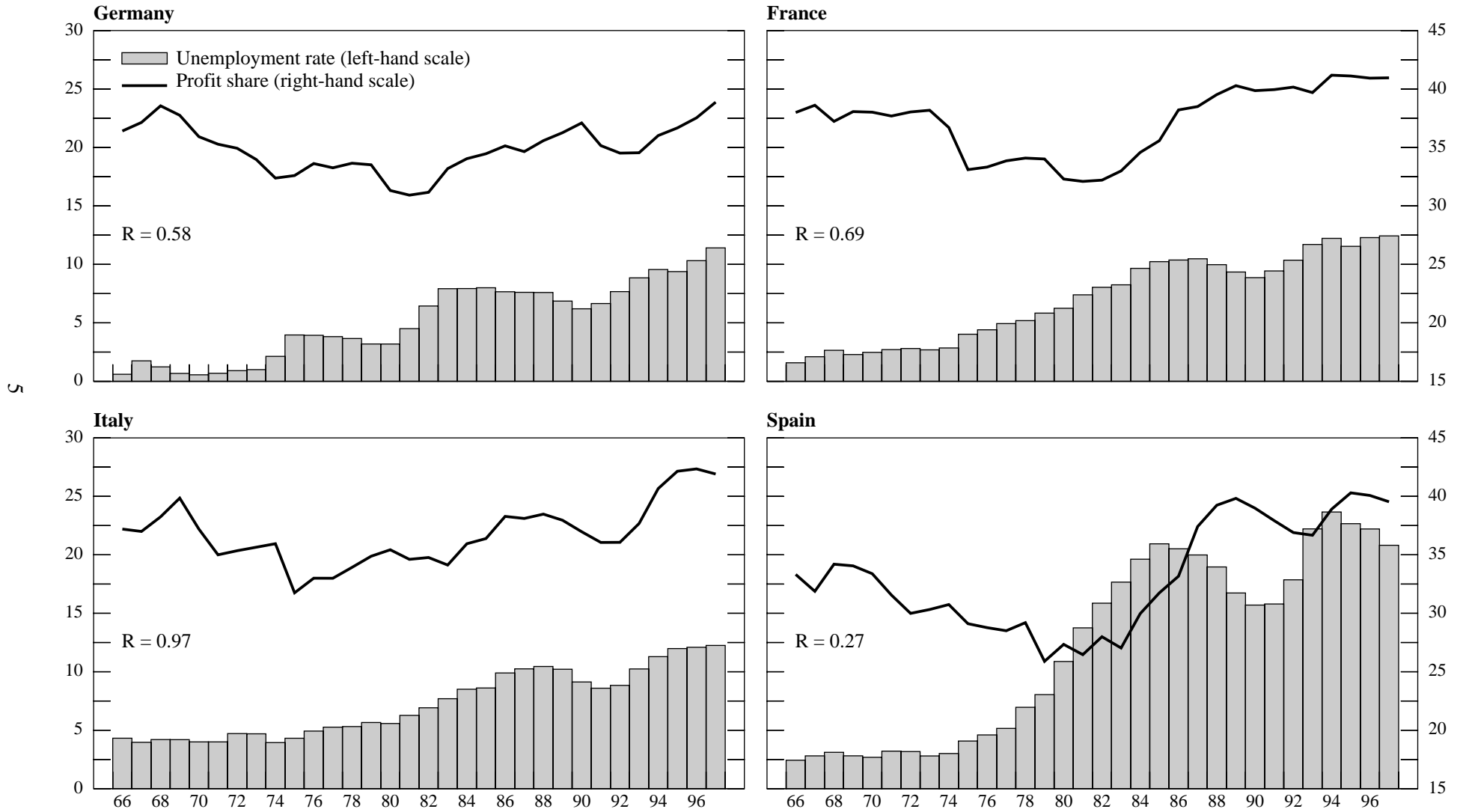
³ Note that throughout this paper, capital stocks are measured net of scrapping, and not net of depreciation. It is debatable which measure is more appropriate but the argument by Kirova and Lipsey (1997) that reinvestments contain more advanced technologies than the capital stocks that they replace persuaded us to use the broader measure. This also meant that we had to construct capital stocks for the United States, which are now only published net of depreciation.

Section 1: Decomposition of changes in profit shares and rates of return

While the 1970s were a period of generally declining profit shares and rates of return to capital, this trend has been reversed over the last fifteen years. At a first glance, the reversal is not surprising. Assuming a two-factor production function with constant returns to scale and an elasticity of substitution close to unity, neoclassical theory would predict that the functional distribution of income should be stationary. However, what is surprising is that, in several countries, the return of profit shares to the levels of the 1960s seems to have been accompanied by growing disequilibria in labour markets. This is clearly evident in Germany, France, Italy and Spain (Graph 1a), where profit shares and unemployment show a significant positive correlation in the 1980s and 1990s. A similar trend can be observed in some of the Nordic countries (Graph 1b), whereas, in Switzerland, higher unemployment has been accompanied by falling profits. A similar picture can be observed for Japan, while the Netherlands, Ireland and Belgium have combined rising profit shares with falling unemployment (Graph 1c). This combination is even more striking in the United States, where the fall in the rate of unemployment to the lowest level for almost thirty years has coincided with strong profit growth (Graph 1d). The United Kingdom has also seen a marked improvement in labour market conditions but, unlike in the United States, unemployment and profits seem to be positively correlated. Australia and Canada are similar in the sense that changes in unemployment and profits do not seem to be systematically related. However, while Australia has seen a marked rise in profits since the early 1980s, the profit share of Canadian companies has fallen.

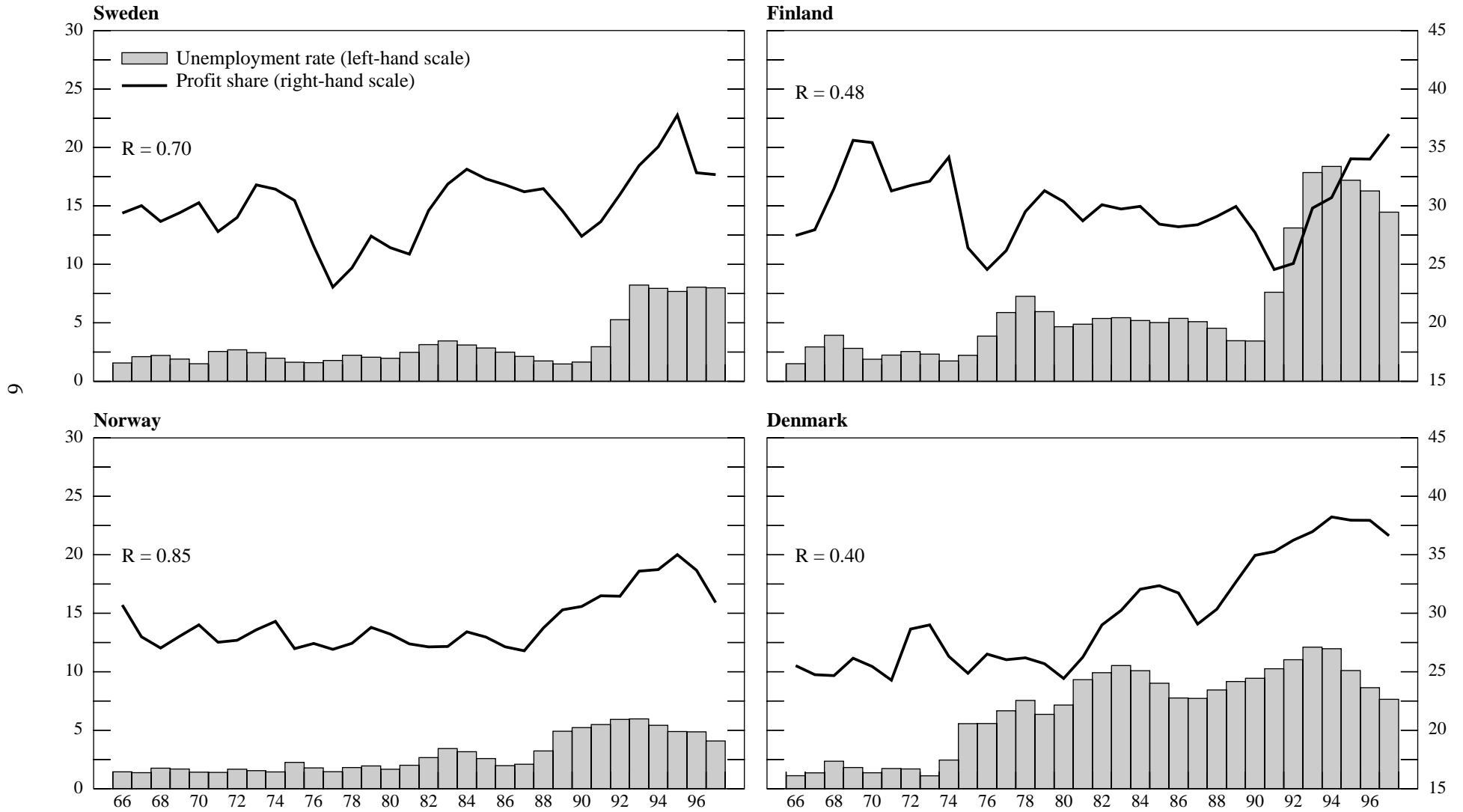
These deviations from the predictions of neoclassical theory are further illustrated in Table 1, which tests the time series properties of profit shares. In most continental European countries and in Ireland and Australia, as well, profit shares seem to be non-stationary, though in two-thirds of the cases, a stationary behaviour is found when allowing for a positive (negative in the case of Switzerland) trend. In contrast, for the United States, Japan, the United Kingdom, Canada and three of the Nordic countries, the null hypothesis of a stationary time pattern cannot be rejected, even without including a time trend. It is also notable, that the average profit share differs between countries. It is relatively high in most of continental Europe, Japan and Australia, whereas the Nordic countries and Ireland have much lower profit shares. The US profit share is close to the centre of the range and has been more stable than those of other countries.

Graph 1a
Unemployment rates and profit shares



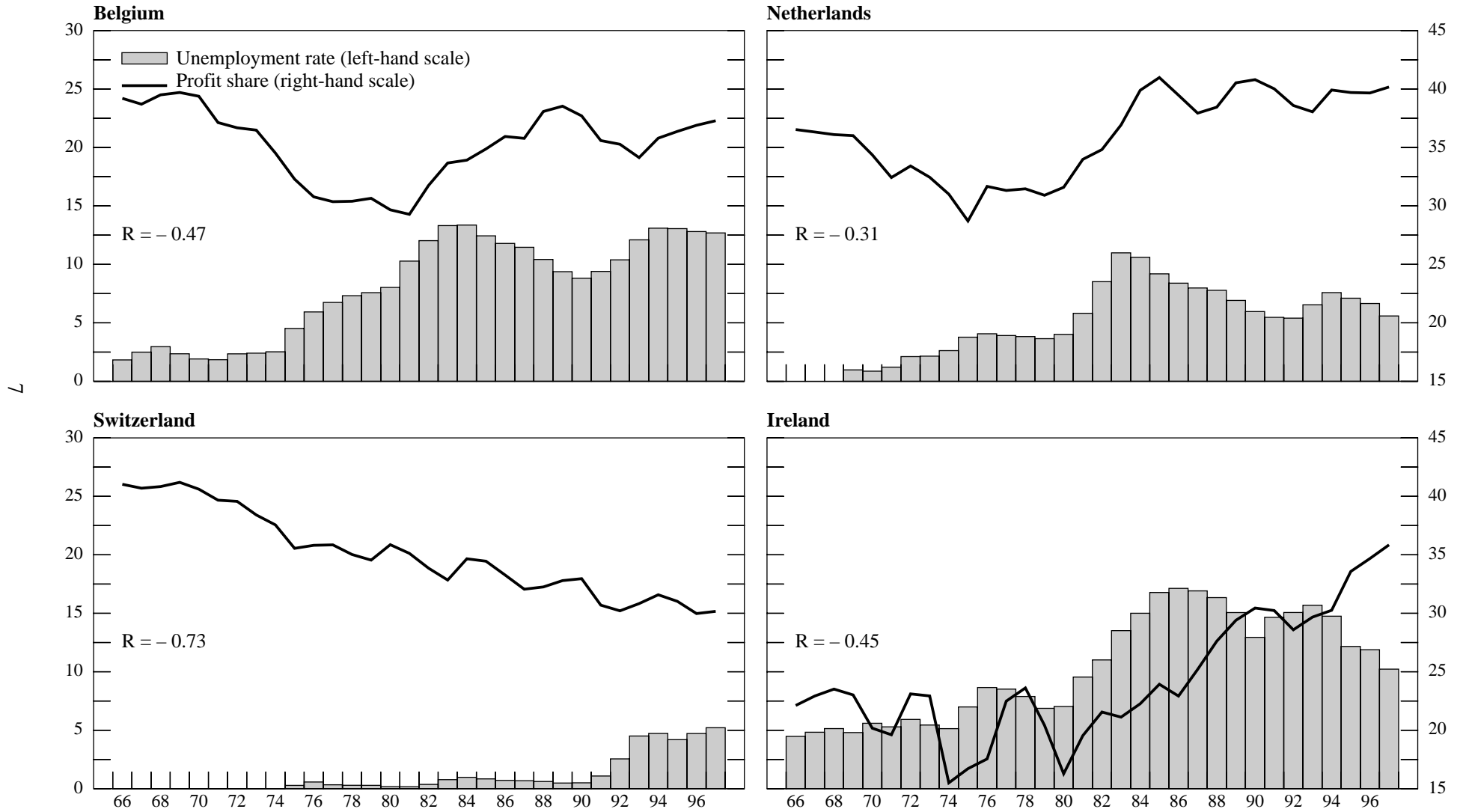
Note: The correlation coefficients are estimated over the period 1982 – 97.

Graph 1b
Unemployment rates and profit shares



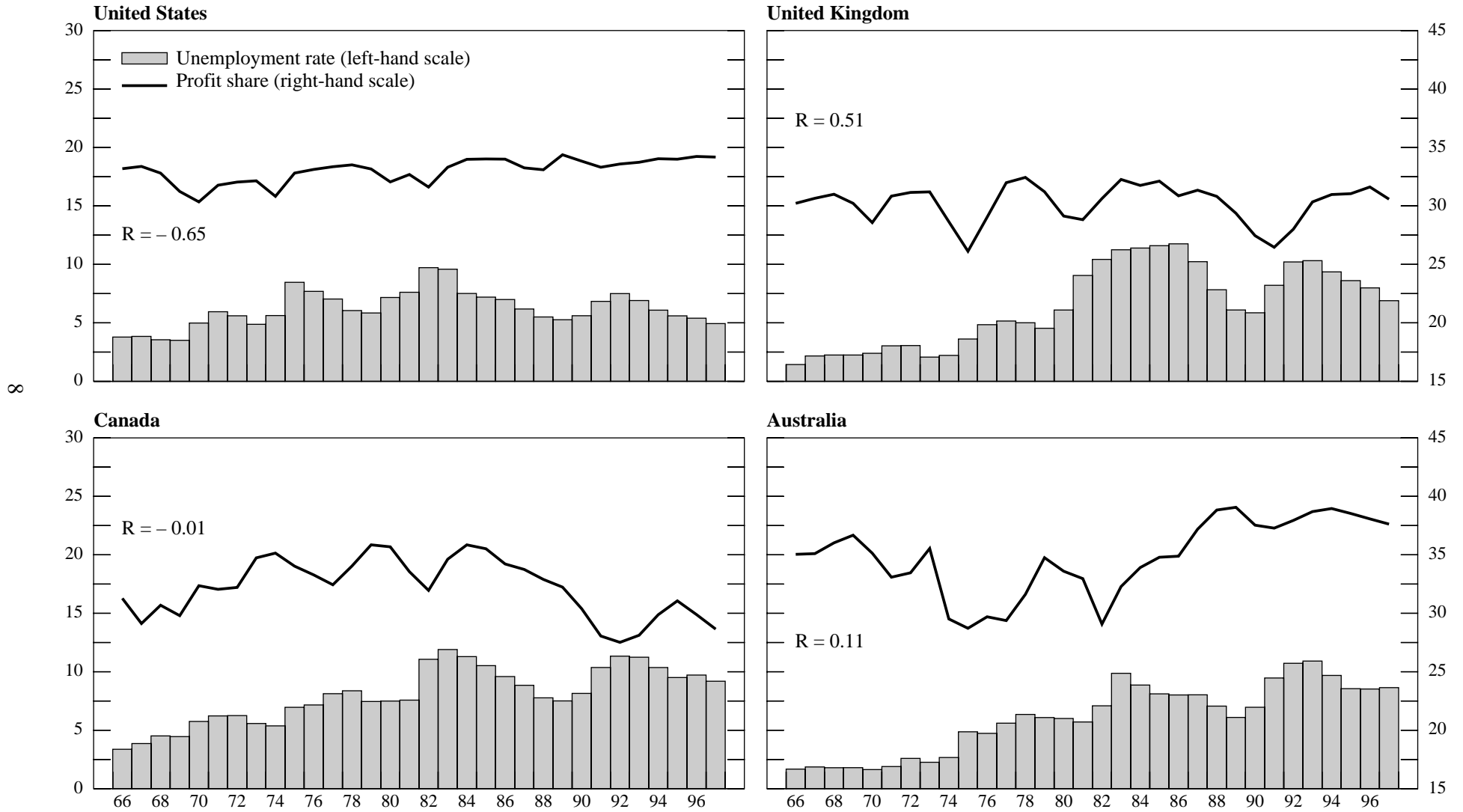
Note: The correlation coefficients are estimated over the period 1982 – 97.

Graph 1c
Unemployment rates and profit shares



Note: The correlation coefficients are estimated over the period 1982 – 97.

Graph 1d
Unemployment rates and profit shares



Note: The correlation coefficients are estimated over the period 1982 – 97.

Table 1: Various indicators of profit share developments

Countries	Period	Mean	St. dev.	Integration tests, t-values for β -coefficients*		
				level	trend	1st
United States	1961-97	32.9	1.31	- 2.81	no	- 6.25
Canada	1966-97**	32.0	2.53	- 1.95	no	- 4.21
United Kingdom	1962-97	30.3	1.53	- 5.10	no	- 6.05
Australia	1965-97	35.1	3.07	- 1.75	no	- 4.81
Japan	1965-97	34.0	4.33	- 1.96	no	- 3.20
Germany	1960-97	35.5	2.36	- 1.64	no	- 4.18
France	1965-97	37.4	3.02	- 1.04	no	- 4.25
				- 1.55	yes (+)	--
Italy	1966-97**	37.1	3.01	- 1.24	no	- 4.89
				- 1.71	yes (+)	--
Belgium	1966-97	35.3	3.11	- 1.73	no	- 3.75
Denmark	1961-97**	29.8	4.57	- 0.66	no	- 5.01
				- 2.60	yes (+)	--
Finland	1962-97**	30.4	3.16	- 3.35	no	- 4.75
Ireland	1961-97	25.2	5.73	- 0.71	no	--
				- 1.73	yes (+)	- 5.32
Netherlands	1966-97**	36.7	4.09	- 1.86	no	- 4.10
				- 3.32	yes (+)	--
Norway	1963-97	29.4	2.25	- 2.05	no	- 4.08
Spain	1964-97**	33.5	4.64	- 0.80	no	- 3.00
				- 1.84	yes (+)	--
Sweden	1965-97	30.3	2.88	- 2.83	no	- 4.57
Switzerland	1960-97	35.9	4.22	- 1.12	no	--
				- 3.08	yes (-)	- 6.34

* Test equation specified as:

$\Delta y_t = \alpha + \beta y_{t-1} + \delta \Delta y_{t-i}$, with $i = 1, \dots, 4$. Critical significance values for t-ratios (50 observations): 2.62 (1%), 1.95 (5%) and 1.61 (10%).

** Profit share estimated from OECD database for first 10-15 years of the period.

Source: OECD Business Sector Data Base.

As an initial step in exploring the sources of changes in rates of return and profit shares and how they have differed between countries, we used two accounting identities to select the relevant components (see also Poterba (1997)). First, by definition, the share of profits (S) in a given year can be written as:

$$(i) \quad S = (YP_y - WEm)/YP_y = (Y/Em - W/P_y)(Em/Y) = (Y/Em - W/P_y)(Em/K)(K/Y)$$

where Y = output, P_y = output deflator, Em = employment, W = compensation per employee and K = capital stock. While (i) is an identity, we may assume that, over time, the four components can be approximated by individual exponential functions, so that:

$$(ii) \quad S_0 e^{st} = Z_0 e^{zt} X_0 e^{xt} V_0 e^{vt} \varphi_t \quad \text{or, by differentiating with respect to } t:$$

$$(iii) \quad s = z + x + v + \varphi'$$

where φ' is a residual which "collects" discrepancies between the two sides of the equation.

Second, the rate of return (R) can be linked to the profit share by the identity:

$$(iv) \quad R = S(YP_y)/KP_k$$

where P_k is the price of capital goods. By analogy to the approximation used above, (iv) can be rewritten as:

$$(v) R_o e^{rt} = Z_o e^{zt} X_o e^{xt} F_o e^{ft} \psi_t \text{ or}$$

$$(vi) r = z + x + f + \psi'$$

where F denotes the price ratio P_y/P_k . Thus r is obtainable from s by replacing the trend of K/Y (v) by the trend of P_y/P_k (f). The trends of the "explanatory" components discussed above are shown for two sub-periods in Table 2 and Graph 2 together with the corresponding changes in rates of return and profit shares. To facilitate the reading of the table, we have denoted Y/Em by q (labour productivity) and W/P_y by wr (real wages) and below we shall frequently refer to $\Delta(wr-q)$ as the change in real unit labour costs or in the mark-up.⁴

As noted above, one remarkable feature of the last fifteen years is the recovery of profit shares and rates of return, following marked falls in most of the countries during 1966-81. This turnaround is usually attributed to the moderation of nominal and real wage growth, in particular in continental Europe. Indeed, as the table shows, real wage growth exceeded productivity gains by an average 0.3 percentage points during 1966-81. Over the next fifteen years, by contrast, productivity gains exceeded real wage growth by twice that amount, as real wage moderation went well beyond the slowdown in productivity gains. The shift was particularly marked in the four largest continental European countries, for which the discrepancy averaged 0.9 percentage points. However, it was also notable in several smaller European countries, Japan and Australia. In Switzerland, by contrast, real unit labour costs continued to grow and Canada has gone against the common trend in both periods. During 1966-81, real unit labour costs declined, thus boosting profits. However, over the next fifteen years, real unit labour costs increased, as real wages seem to have been immune to the slowdown in productivity growth.⁵

⁴ To clarify this concept, it might be helpful to rewrite equation (ii) as a mark-up function for the output price:

$$P_y = \mu(W / (Y / Em))$$

or, by taking logs and using the notation introduced above:

$$\log \mu = \log(P_y/W)(Y/Em) = (q - wr)$$

Thus changes in the mark-up would be equivalent to changes in real unit labour costs ($wr-q$) with the sign reversed.

⁵ According to Freedman and Macklem (1998), there may be several reasons for the comparatively poor productivity and employment performance in Canada. First, due to different time patterns of changes in real exchange rates, restructuring started earlier in the United States (1980-85) than in Canada (1985-90). Second, plants are much larger in the United States than in Canada and large plants tend to adopt new technologies faster than smaller plants. Third, due to

Table 2: Decomposition of changes in profit shares and rates of return

Annual trend rates of change, in percentages

1966-81	S	q	wr	(q-wr)	(em-k)	(k-y)	(p _k -p _y)	R	e _{q,(k-em)}
United States	0.13	0.96	0.90	1.09	- 0.85	-0.11	0.01	0.23	1.13
Japan	- 2.97	5.01	6.80	1.89	- 8.37	3.93	- 1.51	- 5.39	0.60
Germany	- 1.21	3.48	4.14	2.22	- 4.29	0.98	- 0.11	- 2.08	0.81
France	- 1.27	3.79	4.52	2.47	- 4.27	0.65	0.13	- 2.05	0.89
Italy	- 0.81	3.61	4.09	2.77	- 3.41	- 0.07	1.51	- 2.25	1.06
United Kingdom	- 0.12	2.62	2.66	2.50	- 3.58	1.07	1.22	- 2.41	0.73
Canada	1.03	2.14	1.63	3.19	- 4.06	2.06	- 1.33	0.30	0.53
Australia	- 0.83	2.42	2.85	1.57	- 2.84	0.49	0.42	- 1.74	0.86
Belgium	- 2.36	3.97	5.28	1.52	- 4.37	0.58	- 0.69	- 2.25	0.91
Denmark	0.12	2.88	2.84	3.00	- 5.04	2.36	0.33	- 2.57	0.57
Finland	- 0.56	4.20	4.46	3.61	- 4.10	0.08	1.09	- 1.73	1.02
Ireland	- 1.29	4.98	5.31	3.63	- 3.70	-1.08	1.00	- 1.21	1.35
Netherlands	- 0.65	3.16	3.49	2.48	- 2.98	-0.08	- 0.22	-1.08	1.06
Norway	- 0.25	3.07	3.17	2.81	- 3.31	0.35	1.40	- 2.00	0.93
Spain	- 1.68	4.59	5.36	2.83	- 8.89	4.95	- 1.74	- 4.89	0.92
Sweden	- 1.12	2.35	2.78	1.20	- 5.16	3.03	- 1.01	- 3.14	0.77
Switzerland	- 1.32	1.94	2.77	0.60	- 4.06	2.24	- 1.54	- 2.02	0.87
<i>Average*</i>	<i>- 0.9</i>	<i>3.2</i>	<i>3.5</i>	<i>2.3</i>	<i>- 4.3</i>	<i>1.2</i>	<i>- 0.1</i>	<i>- 2.0</i>	<i>0.75</i>

1981-1996	S	q	wr	(q-wr)	(em-k)	(k-y)	(p _k -p _y)	R	e _{q,(k-em)}
United States	0.25	0.93	0.80	1.18	- 0.90	- 0.01	- 1.91	2.17	1.03
Japan	0.79	2.41	2.11	3.30	- 4.14	1.86	- 1.44	0.37	0.58
Germany	0.93	2.47	1.97	3.42	- 2.32	- 0.09	- 0.52	1.54	1.06
France	1.74	2.29	1.27	4.07	- 2.57	0.34	- 0.93	2.33	0.89
Italy	1.10	2.26	1.58	3.38	- 2.65	0.46	- 1.51	2.15	0.85
United Kingdom	- 0.39	1.64	1.88	1.31	- 1.32	- 0.29	- 0.89	0.79	1.24
Canada	- 1.32	1.16	1.78	- 0.18	- 4.31	3.31	- 2.69	- 1.94	0.27
Australia	1.66	1.38	0.43	3.01	- 1.54	0.19	- 0.93	2.40	0.90
Belgium	0.91	1.82	1.36	2.75	- 2.56	0.79	- 1.03	1.15	0.71
Denmark	2.21	2.13	1.03	4.38	- 2.72	0.66	- 1.12	2.67	0.78
Finland	0.42	3.75	3.53	4.18	- 4.14	0.55	- 0.02	- 0.11	0.90
Ireland	3.62	4.07	2.77	7.82	- 1.69	- 2.26	- 0.92	6.80	2.41
Netherlands	0.65	1.57	1.19	2.23	- 0.88	- 0.68	0.11	1.22	1.78
Norway	1.88	1.91	1.03	3.77	- 2.46	0.60	- 0.02	1.30	0.78
Spain	2.97	2.42	1.02	5.54	- 3.56	1.23	- 1.42	3.16	0.68
Sweden	1.05	2.14	1.57	3.14	- 3.13	1.07	- 2.10	2.08	0.68
Switzerland	- 0.91	0.36	0.80	- 0.56	- 1.56	1.23	- 2.57	0.43	0.23
<i>Average*</i>	<i>1.1</i>	<i>2.0</i>	<i>1.4</i>	<i>3.1</i>	<i>- 2.5</i>	<i>0.5</i>	<i>- 1.1</i>	<i>1.7</i>	<i>0.80</i>

* Unweighted

differences in labour institutions, wages are more flexible in the United States than in Canada. The data used in this study provide strong support for the third factor as real wages in Canada rose by a cumulative 21% during the 1980s, compared with only 8% in the United States, with broadly similar rates of productivity growth. At the same time, there is only little evidence, that restructuring occurred later in Canada than in the United States. Capital/output as well as capital/labour ratios have increased much faster in Canada than in the United States and the rate of growth was slightly faster during 1980-85 when the Canadian real exchange rates was depreciating.

While we agree with the consensus analysis, the decomposition schemes explained above allow us to analyse the trends over the two sub-periods from a somewhat different angle. In particular, the approximation by exponential trends contains a difference ($Y/Em - W/P_y$) and, because the two sub-components are likely to contain "internal" trends and the outcome thus depends on the initial conditions, the trend of the difference cannot be replaced by the difference between the trends of Y/Em and W/P_y .⁶ In fact, since profit shares were relatively high in 1966, real profits per person employed ($q - wr$) actually increased during the first sub-period, even though real wage growth exceeded productivity gains. At first glance, this seems inconsistent with the recorded fall in profit shares. It should be recalled, however, that changes in labour productivity are not endogenous but depend on changes in the capital/labour ratio.⁷ Consequently, profit shares will be subject to downward pressures if the rise in labour productivity does not "match" the rise in the capital/labour ratio.⁸ On the other hand, such pressures on profit shares (but not on rates of return) will be relieved to the extent that capital/output ratios also increase; see the last component in equations (i) - (iii).⁹

⁶ When used over longer periods, the approximation also involves a residual, even though equations (iii) and (vi) hold exactly for year-to-year changes.

⁷ This is easily seen for a Cobb-Douglas production with constant returns to scale which, in log changes, can be written as:

$$\Delta y = \alpha \Delta em + (1 - \alpha) \Delta k + e$$

where y denotes log output, em log employment, k log capital and e disembodied technical progress. Subtracting Δem on both sides we then have:

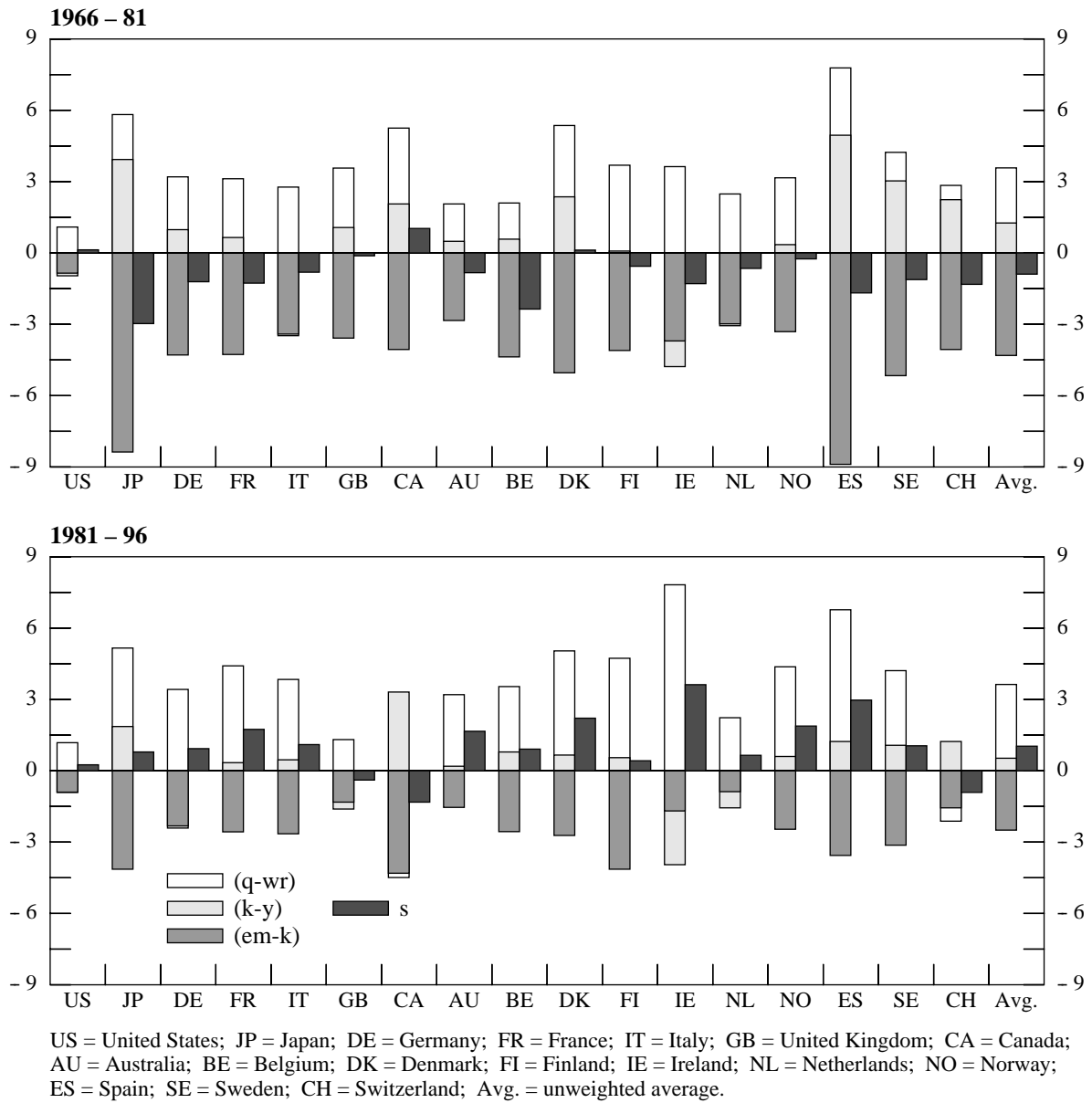
$$(\Delta y - \Delta em) = \Delta q = (1 - \alpha)(\Delta k - \Delta em) + e$$

From this it also appears that the distribution between capital and labour income will only remain constant, if the elasticity of labour productivity with respect to the capital/labour ratio equals unity; cf. the last column in Table 2.

⁸ As a preliminary indicator of potential downward pressures, we have included ratios between changes in respectively labour productivity and capital/labour ratios in the last column of Table 2.

⁹ We can illustrate this using the decomposition shown for the average trends in Table 2. For the first period, ($q - wr$), or real profits per person employed, grew by 2.3% while the amount of capital per person employed ($k-em$) grew by 4.3% , so that the difference between the first two components would have generated a trend decline in the profit share of 2.0% per year. However, the fact that the capital-output ratio grew by 1.2% during the same period limited the decline in the profit share to $2.0 - 1.2 = 0.8\%$. Allowing for the nature of the approximation, this is quite close to the actually recorded fall of 0.9%. As regards the rate of return over the first period, the decline in profit shares was reinforced by the rise in capital/output ratios but attenuated by the fall in the relative price of capital goods, generating a net fall of $0.9 + 1.2 - 0.1 = 2.0\%$.

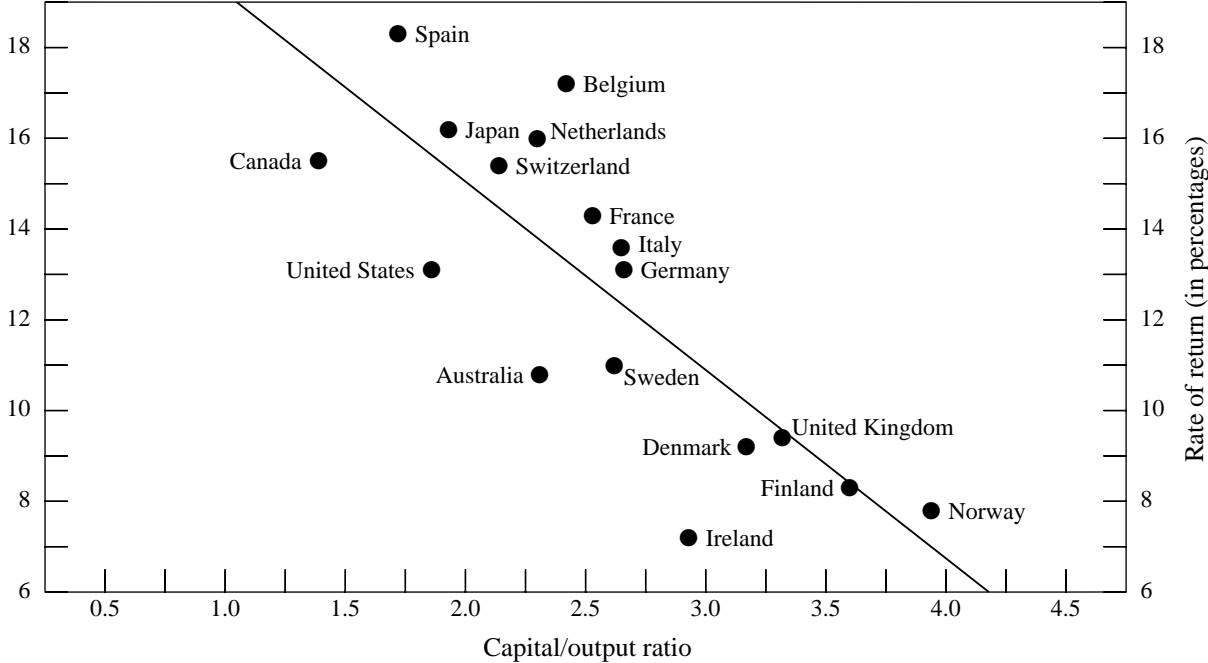
Graph 2
Decomposition of profit shares
 In per cent per year



From this perspective, it appears that those countries which, *ceteris paribus*, suffered the largest trend declines in profit shares during the 1966-81 were those which attempted to offset increases in real wages by high growth of capital per labour but did not succeed in getting a sufficiently high rate of labour productivity growth. Japan is the most extreme case, but similar developments can be observed in continental Europe. Canada also experienced a rather small productivity "return" on a strong increase in the capital/labour ratio. However, because real wage growth was relatively modest and the capital/output ratio rose sharply the profit share increased. Denmark shows a similar picture, except that real wage growth was much higher so that, with only a modest rise in the profit share, the expansion of the capital/output ratio led to a trend decline in the rate of return. The United States

recorded increases, albeit modest, in both the profit share and the rate of return. However, capital expansion played only a minor role and the capital/output ratio actually fell.

Graph 3
Capital/output ratios and rates of return



Reflecting the general slowdown in investment spending, the trend rise in capital/labour ratios slowed significantly in the second period and, since the growth in real profits per person employed accelerated, the net effect of these two components imparted a positive trend (3.1 - 2.5 = 0.6% for the seventeen countries on average) to profit shares. The slowdown in investment spending also meant that movements in capital/output ratios provided a smaller stimulus to profit shares than in the first period, but helped to ease downward pressures on rates of return. Thus, with the trend decline in real capital prices accelerating, rates of return almost returned to their levels of the 1960s. The continuous reduction in the capital/output ratio of Ireland is particularly notable in this respect. In the mid-1960s, Ireland was close to the bottom of the capital/output curve in Graph 3 and had the lowest rate of return of all the seventeen countries.¹⁰ However, by 1996, it was near the top while the rate of return had grown by almost 7% per year. In contrast, the capital/output ratio of Canada shows a continuous rise and, as productivity growth failed to pick up (see the last column), the rate of return has fallen by

¹⁰ The bilateral relationship between the rate of return to capital and the capital/output ratio only holds, given profit shares and real capital goods prices. We estimated a similar cross-country relation, replacing capital/output with capital/labour ratios. The fit was about the same as for the specification used in the graph, though only after allowing for Ireland (significant "underperformance") and the Netherlands and Switzerland (significant "overperformance") as "extreme" cases.

almost 2% per year since 1981. A similar process may be observed in Switzerland, except that the trend fall in real capital prices has more than offset the effect of the rise in the capital/output ratio.

In the continental EU countries, the slowdown in real wage growth since 1981 has led to a marked acceleration in the growth of real profits per person employed. Moreover, since capital/labour and capital/output ratios both increased at a slower rate and returns were also boosted by the accelerated rate of decline in the real price of capital goods, the profitability of European firms recovered substantially. Australia, Denmark and Sweden present very similar pictures, whereas the recovery was more modest in Norway and Finland. A main feature of US developments continued to be rather moderate changes, with lower capital goods prices the main contribution to the improvement in the rate of return.

All in all, the general slowdown in the trend growth of capital/output ratios and the fall in real capital goods prices have been favourable from the point of view of firms' rate of return. Nonetheless, and especially in continental Europe, these trends should also be seen against the background of sluggish labour demand growth and rising unemployment. Indeed, for the seventeen countries as a group, trend changes in capital/output ratios and relative factor prices accounted for almost one-third of the rise in rates of return, suggesting that firms have preferred to strengthen profit margins and rates of return rather than take lower capital goods prices as an opportunity to build up their capital stock.¹¹ The contribution of changes in factor ratios and relative prices is actually largest in the United States and the United Kingdom. But, unlike in continental Europe, capital spending seems to have been sufficiently strong to support high employment growth and lower unemployment.

However, to evaluate the adequacy of firms' investment response it is necessary to analyse and understand the underlying adjustment processes.

Section 2: Factor substitution, relative factor prices and rates of return

While the previous section essentially referred changes in rates of return and profit shares to movements in sub-components, a more fundamental question is how firms have adjusted factor proportions in response to changes in *ex ante* relative factor prices and how, in turn, *ex post* relative factor returns have reacted to changes in factor proportions. We analyse these issues using several approaches. As a starting point, Table 3 presents trend growth rates for respectively factor ratios and

¹¹ Since a substantial part of the real and relative fall in capital goods prices can be attributed to the steep decline in computer prices, various organisational constraints are likely to have slowed the adjustment. The gradual shift in the distribution of output and employment towards sectors with lower capital requirements may have played an additional role, depending, however, on the degree of sectoral disaggregation used. See Browne and Hellerstein (1997).

relative factor prices. As the table shows, the changes have been substantial, both for 1966-96 as a whole and for the two sub-periods. In most of the continental European countries, the growth of relative wages declined in response to the moderation of nominal wages during the second period, which might, in part, explain the slower growth of capital. Trend changes in capital/labour ratios could also have been influenced by the slowdown in European output growth and, perhaps, by shifts in elasticities of substitution. To explore these issues, sub-section (a) presents various approaches to estimating elasticities of substitution; in the following sub-section we then evaluate to what extent *ex post* factor returns have responded to changes in factor proportions.

Table 3: Capital labour ratios and relative factor prices, trend growth rates

Countries	$\Delta(K/Em)$			$\Delta(W/P_k)$			Memo: 1981-96	
	1966-96	1966-81	1981-96	1966-96	1966-81	1981-96	ΔK	ΔEm
United States	1.01	0.85	0.90	1.75	0.80	2.65	2.81	1.88
Japan	6.09	8.37	4.14	5.28	7.43	2.97	5.55	1.18
Germany	3.24	4.29	2.32	2.72	3.80	1.88	2.86	0.48
France	3.47	4.27	2.57	2.85	4.00	1.90	2.56	- 0.08
Italy	2.78	3.41	2.65	2.34	2.40	2.65	2.72	- 0.01
United Kingdom	2.54	3.58	1.32	2.25	1.60	2.65	2.69	1.34
Canada	4.72	4.06	4.31	4.41	2.96	4.43	5.92	1.36
Australia	2.39	2.84	1.54	1.46	2.35	1.45	3.65	2.05
Belgium	3.71	4.37	2.56	3.67	5.77	2.47	3.07	0.45
Denmark	3.83	5.04	2.72	1.92	2.45	2.25	2.90	0.10
Finland	3.83	4.10	4.14	3.38	3.23	3.25	2.26	- 1.97
Ireland	3.45	3.70	1.69	4.41	3.72	3.36	2.47	0.75
Netherlands	1.85	2.98	0.88	1.59	3.64	1.06	2.25	1.35
Norway	3.04	3.31	2.46	0.99	1.86	0.80	2.09	- 0.42
Spain	6.68	8.89	3.56	4.29	6.30	2.60	4.02	0.32
Sweden	3.93	5.16	3.13	2.98	3.55	3.67	2.95	- 0.27
Switzerland	2.49	4.06	1.56	3.32	4.72	3.92	2.89	1.28

Notation: K/Em: capital/labour ratio; W/P_k: ratio of nominal wage to price of capital goods; Δ : first-difference operator.

(a) Elasticities of substitution: various approaches

As a first approach, we estimated elasticities of substitution directly from the CES production function:

$$(i) \quad Y = C((1 - \alpha)K^\beta + \alpha Em^\beta)^{1/\beta}$$

where Y denotes output, K the capital stock, Em labour input while the elasticity of substitution (σ) can be derived as $1/(1-\beta)$.¹² The resulting technical elasticities of substitution are shown in Table 4 as σ_1 .

¹² The non-linear form does not lend itself easily to estimation and to obtain values for β we developed a Newtonian algorithm which minimised the squared sum of residuals between the left-hand side observations and the right-hand side

As a second approach, we assumed that firms choose factor inputs with a view to minimising production costs. Using again the CES production function in (i), the minimum cost condition requires that the ratio of marginal productivities has to equal the ratio of factor prices:

$$(ii) Y'_K / Y'_{Em} = UC / W$$

where W is compensation per employee and UC the user cost of capital. As a first approximation, we use the price of capital goods (P_K) as a proxy for UC even though capital costs, *inter alia*, also depend on the costs of debt financing, equity prices, tax rates and the tax rules applying to depreciation and debt interest payments. However, because investment is mostly financed out of retained earnings and firms appear to pay little attention to opportunity costs, we have left further discussion of the potential influence of interest rates and the shift to positive real interest rates in the 1980s to the next subsection.¹³ Since

$$(iii) Y'_K = (1 - \alpha)C((1 - \alpha)K^\beta + \alpha Em^\beta)^{(1-\beta)/\beta} K^{\beta-1}$$

and an analogous expression can be derived for Em , the factor price ratio must satisfy:

$$(iv) P_K / W = ((1 - \alpha) / \alpha)(K / Em)^{\beta-1}$$

which leads to the cost-minimisation condition:

$$(v) K / Em = (\alpha / (1 - \alpha))P_K / W)^{1/(\beta-1)} = a_o(W / P_K)^\sigma$$

since $\sigma = 1/(1-\beta)$. By taking logs, we then get the following equation for estimating σ :

$$(vi) \log(K / Em) = \log a_o + \sigma \log(W / P_K)$$

values as generated by iterations on the three parameters C , α and β . Two caveats are, however, in order here. First, the CES function in (i) disregards technical progress in the sense that when (i) is used in the cost minimising equations below, it is implicitly assumed that technical progress is of the Hicksian type. Second, it would probably have been more satisfactory to estimate (i) using a non-linear regression package, which would have enabled us to formally test the hypothesis that the estimated σ 's differ significantly from unity. However, in defence of our procedure we note that it produced excellent tracking abilities and seventeen out of seventeen σ 's that all exceeded unity.

¹³ In an attempt to extend UC to include interest costs, we initially estimated (vi) as:

$$\log(K / Em) = \log a_o + \sigma \log(W / P_k) + \sigma\eta \log IRL + \varepsilon$$

where IRL denotes the long-term borrowing rate and η (positive and ≤ 1) is included to capture the extent to which firms rely on external financing and/or pay attention to opportunity costs. However, in most cases, $\sigma\eta$ obtained the wrong sign or was insignificant. Moreover, in those cases where a significant negative coefficient was obtained, the implied value of η was less than 0.10.

Applying ordinary least squares to (vi) produces the substitution elasticities shown as σ_2 in Table 4, while the same equation in first differences yields the elasticities shown as σ_3 .¹⁴

As a third approach, we attempt to correct for cyclical fluctuations by introducing the simplifying assumption that both the K/Em and the W/P_K ratios trace exponential trends; i.e.:

$$(vii) \quad \begin{aligned} K/Em &= k_0 e^{bt} \\ W/P_K &= f_0 e^{ct} \end{aligned}$$

By inserting into (vi), we then have:

$$(viii) \quad \log k_0 + bt = \log a_0 + \sigma \log f_0 + \sigma ct$$

from which σ can be derived from estimates of b and c as $\sigma = b/c$. The corresponding elasticities are shown as σ_4 in Table 4, first for the whole period 1966-96 and then for the two sub-periods.

Table 4: Alternative elasticities of substitution

Countries	1966-96				1966-81	1981-96
	σ_1	σ_2	σ_3	σ_4	σ_4	σ_4
United States	1.37	0.53	0.10	0.58	0.98	0.33
Japan	1.09	1.14	0.97	1.15	1.08	1.26
Germany	1.50	1.16	0.84	1.19	1.06	0.96
France	1.34	1.17	0.66	1.22	1.00	1.23
Italy	1.41	1.14	0.35	1.19	1.42	0.99
United Kingdom	1.35	1.08	0.62	1.13	2.33	0.47
Canada	1.33	1.04	0.72	1.07	1.41	0.99
Australia	1.35	1.45	0.48	1.64	1.22	1.41
Belgium	1.71	0.97	0.69	1.01	0.77	1.08
Denmark	1.40	1.93	0.95	1.99	2.12	1.28
Finland	2.11	1.13	0.69	1.13	1.28	1.23
Ireland	1.34	0.82	0.48	0.78	0.91	0.45
Netherlands	1.32	1.01	0.52	1.16	0.82	0.79
Norway	1.48	2.36	0.49	3.07	2.07	2.29
Spain	1.62	1.49	1.09	1.51	1.37	1.47
Sweden	1.32	1.28	0.70	1.32	1.43	0.88
Switzerland	1.31	0.76	0.53	0.75	0.98	0.46
Average*	1.45	1.20	0.64	1.30	1.31	1.03

* Unweighted

Overall, the direct estimates of the technical elasticities (σ_1) tend to exceed those obtained using the cost minimisation assumption (σ_2) and the range across countries is also much narrower than for

¹⁴ We also estimated equation (vi) on panel data (variable intercept terms) for the seventeen countries (459 observations), obtaining the following results for variables in respectively levels and first differences (t-ratios in brackets):

	σ	R^2	St.e	DW
Levels	1.12	0.97	0.10	0.12
First differences	0.26 (7.1)	0.26	0.02	1.02

σ_2 . The elasticities obtained using the "short-cut method" (σ_4) are broadly consistent with σ_1 and σ_2 , but this consistency masks rather large changes between the sub-periods. On average for the seventeen countries, σ_4 has declined from 1.3 to 1.0 from the first to the second period, with particularly large falls observed for the Anglo-Saxon countries (except Australia), Italy, Denmark, Sweden and Switzerland. Other European countries offer a rather mixed picture while the elasticity appears to have increased in Japan. However, in evaluating these results it is important to take account of the large variations across countries in changes in respectively employment and capital. For instance, the rise in capital/labour ratios in continental Europe has mostly been generated through very low or negative rates of employment growth (Table 3, last column) while in the Anglo-Saxon countries both labour and capital inputs have increased. Hence, when estimating substitution elasticities on the assumption that all shifts originate on the supply side and ignoring policy-induced and other shifts of the demand for labour, there is a risk that the elasticity estimates will be biased.

It is also notable that while the elasticities obtained from variables in levels are broadly similar and, for most countries close to or above unity, those obtained from variables in first differences (σ_3) are significantly smaller and, for about half the countries, well below unity. This suggests that the adjustment of factor ratios to changes in relative factor prices is not instantaneous and that the sample period mostly contains observations from transitional movements between equilibria. This has two implications. First, an error correction model with variables in levels as well as first differences would be a more appropriate estimation procedure. Second, if the adjustment of factor proportions is subject to lags, *ex post* changes in factor shares of income and relative returns will differ from those predicted by the long-run elasticities of substitution.¹⁵ Hence, the surprisingly strong rise in profit shares and rates of return discussed in Section 1 might, to a large extent, be attributable to the lags in the adjustment process. In the following we attempt to implement models which capture both features and, in this context, we also introduce additional approaches to estimating elasticities of substitution.¹⁶

¹⁵ For instance, if changes in relative factor prices induce firms to substitute capital for labour, one would expect the return to capital to decline relative to the return to labour. However, if the substitution process is subject to long lags, the *ex post* relative return to capital might actually rise.

¹⁶ The differences between the two sub-periods could also be suggestive of shifts in the behaviour of firms. For instance, during 1966-81, firms probably increased their capital/labour ratios as a defensive response to the rise in real wages; in contrast, over the next fifteen years, the increase in capital/labour ratios seems to have been mainly driven by the

(b) Changes in factor proportions and ex post relative returns

To estimate and identify the lags in the adjustment of factor ratios and factor returns, we adopted a three-step procedure.

First, we estimated equation (vi) as an error correction model and then used the predicted factor ratios in steps two and three. Details of the estimates are given in Annex Table A1 while the implied elasticities of substitution and speeds of adjustment are shown in Table 6 below as σ_5 and γ_1 .

Second, to quantify the influence of adjustment lags on *ex post* factor shares, we went back to equation (iv) and replaced P_k with μ , to be interpreted as a measure of the return to capital or "revealed user cost":

$$(iv)' \quad \mu/W = ((1-\alpha)/\alpha)(K/Em)^{\beta-1}$$

Multiplying both sides of (iv)' by K/Em then gives:

$$(iv)'' \quad \mu K/WEm = ((1-\alpha)/\alpha)(K/Em)^\beta$$

The left-hand side of can be interpreted as a measure of the *ex post* distribution of factor income, since the numerator equals total profits while the denominator is the wage sum. As our second step, we estimated (iv)'' using an error correction model. The results are presented in Annex Table A2 while the implied elasticities of substitution and speeds of adjustment are shown in Table 6 as σ_6 and γ_2 ;¹⁷

As our third step, we again started equation (iv)' but used μ/W as a measure of *ex post* relative returns per unit of input as the left-hand variable.¹⁸ This ratio was also estimated using an error correction model, with the detailed results shown in Annex Table A3 and the implied elasticities of substitution (σ_7) and speeds of adjustment (γ_3) given in Table 6.¹⁹

development in capital goods prices and demand-side-induced lower output growth rates. while wage moderation helped to boost the return to capital.

¹⁷ Since the elasticity of substitution, σ , equals $1/(1-\beta)$, the exponent of (K/Em) in (iv)'' can also be written as $(\sigma-1)/\sigma$, from which it is easy to derive an implied value for σ . For details, see Annex Table A2.

¹⁸ More precisely, we defined μ/W as the ratio between the real return per unit of capital and the real return per unit of labour, with the latter approximated by the real wage. In practise, we derived the left-hand side as $(Return/P_y)/WR = Return/(W/P_k)$ since Return is defined as Profits/ KP_k .

¹⁹ Given the definition of σ , the elasticity of substitution for this approach can be derived from $\beta-1 = -1/\sigma_7$. Note that (iv)' and (iv)'' basically tell the same story so that the transition from (iv)' to (vi)'' and the associated estimates mainly involve a change in the stochastic assumptions.

Before turning to the estimates it may be useful to briefly look at the actual developments in relative factor shares of income and relative rates of return as shown in Table 5 and Graphs 4a-d. Given the definition of μ/W in (iv)' and the marked rise in capital/labour ratios, we would expect the *ex post* relative return to capital to have declined sharply when $0 < \beta < 1$ or, equivalently, $\sigma > 1$. As can be seen from the graph, this was indeed the case during the period 1966-81, as firms substituted capital for labour in response to the rise in real wages. However, since the early 1980s, the relative return to capital has fallen much less than predicted by equation (iv)' (see columns 4 and 5 of Table 5), even though the substitution of capital for labour continued, albeit at a slower pace than in the 1960s and 1970s. In fact, for about one-half of the countries, the relative rate of return to capital was actually higher in 1996 than fifteen years earlier, with particularly large increases in Ireland, Denmark and Spain.

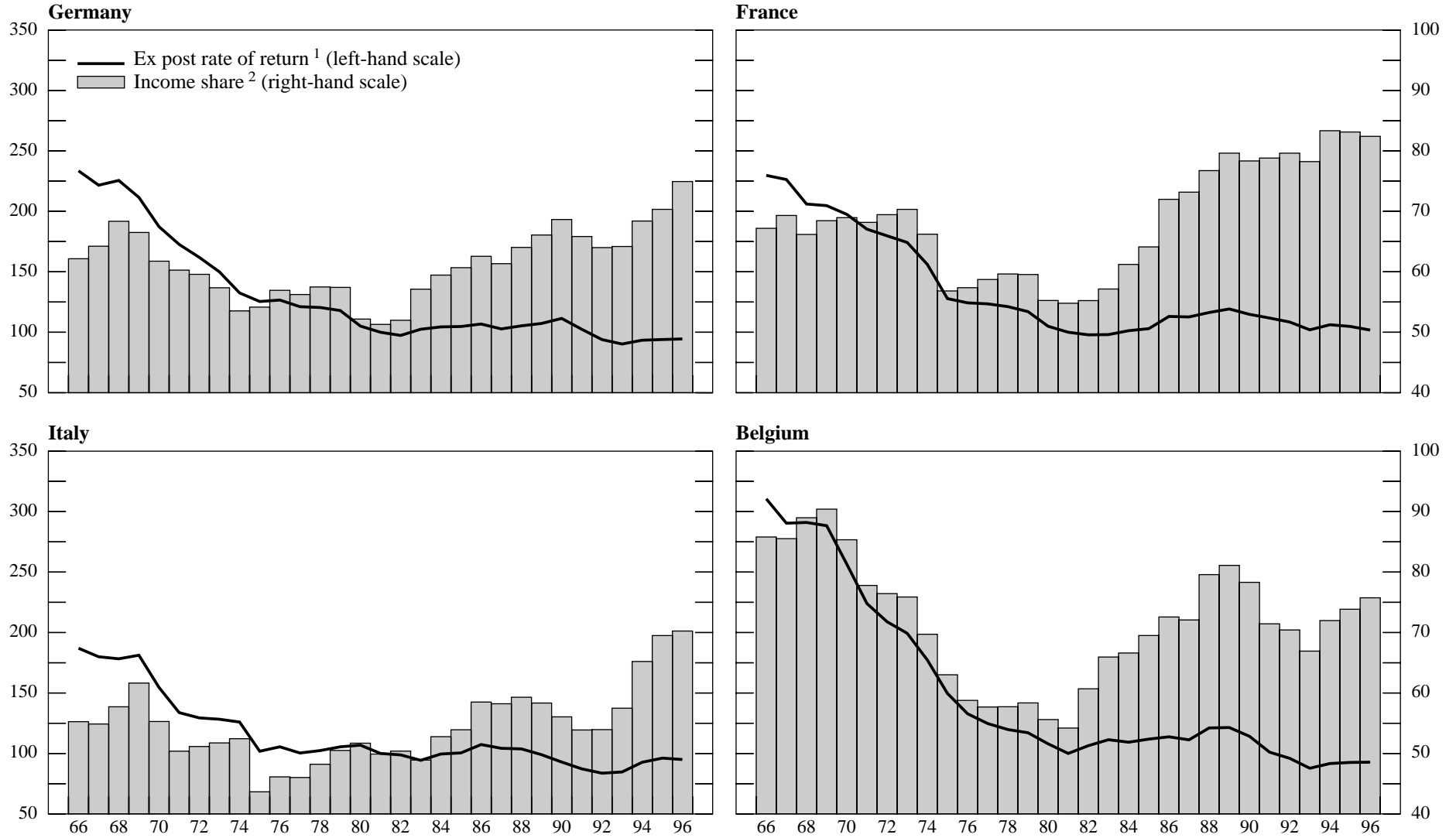
Table 5: Actual and predicted changes in relative rates of return
1981-96, in percentages

Countries	Factor Shares			Relative Returns		
	Actual	Predicted ¹	Predicted ²	Actual	Predicted ¹	Predicted ²
United States	7.8	5.4	7.5	- 10.9	- 14.7	- 11.3
Japan	20.5	7.8	15.0	- 35.0	- 86.3	- 38.1
Germany	46.1	6.2	40.5	- 5.5	- 12.5	- 8.6
France	50.4	12.5	52.2	1.8	- 35.5	0.4
Italy	40.8	12.0	40.5	- 5.0	- 35.4	- 7.7
United Kingdom	13.4	5.0	5.1	- 4.9	- 13.8	- 11.3
Canada	- 16.0	23.3	- 15.3	- 57.1	- 72.7	- 59.7
Australia	24.0	5.5	24.6	2.5	- 15.9	3.0
Belgium	39.8	14.2	35.5	- 7.3	- 26.6	- 11.3
Denmark	69.2	12.5	65.7	16.5	- 31.5	12.6
Finland	32.2	36.1	29.3	- 21.7	- 40.4	- 22.9
Ireland	126.6	7.8	131.6	72.8	- 23.7	68.2
Netherlands	28.3	8.0	29.0	7.7	- 23.5	7.3
Norway	45.2	10.5	40.5	1.9	- 22.5	- 3.9
Spain	88.4	26.1	87.8	8.2	- 42.7	4.1
Sweden	103.2	38.2	129.3	3.1	- 43.2	17.3
Switzerland	- 23.7	6.2	- 20.5	- 43.0	- 19.8	- 43.0

Notes: ¹ Obtained by multiplying the change in K/Em (in logs) by $(\sigma_1-1)/\sigma_1$ and $-1/\sigma_1$ respectively, with σ_1 the technical elasticities of substitution shown in Table 4. ² Obtained from the estimated equations presented in Annex Tables A2 and A3, respectively.

As regards the ratio of factor incomes as defined in equation (iv)', a rise in the capital/labour ratio can, *ceteris paribus* be expected to raise profits relative to wages, as long as the elasticity of substitution exceeds unity; i.e. $\beta > 0$. As can be seen from the first two columns of Table 5, the actual increases in profits have, for most countries, exceeded those predicted by applying the technical substitution elasticities (σ_1) to the actual changes in capital/labour ratios. This is consistent with the aforementioned changes in *ex post* returns and with the developments in profit shares discussed in Section 1. Note, however, that even though the rise in capital/labour ratios was much more pronounced during 1966-81, profits tended to fall relative to wages. In other words, during this period, long-run elasticities of substitution higher than unity did not prevent relative profits from falling.

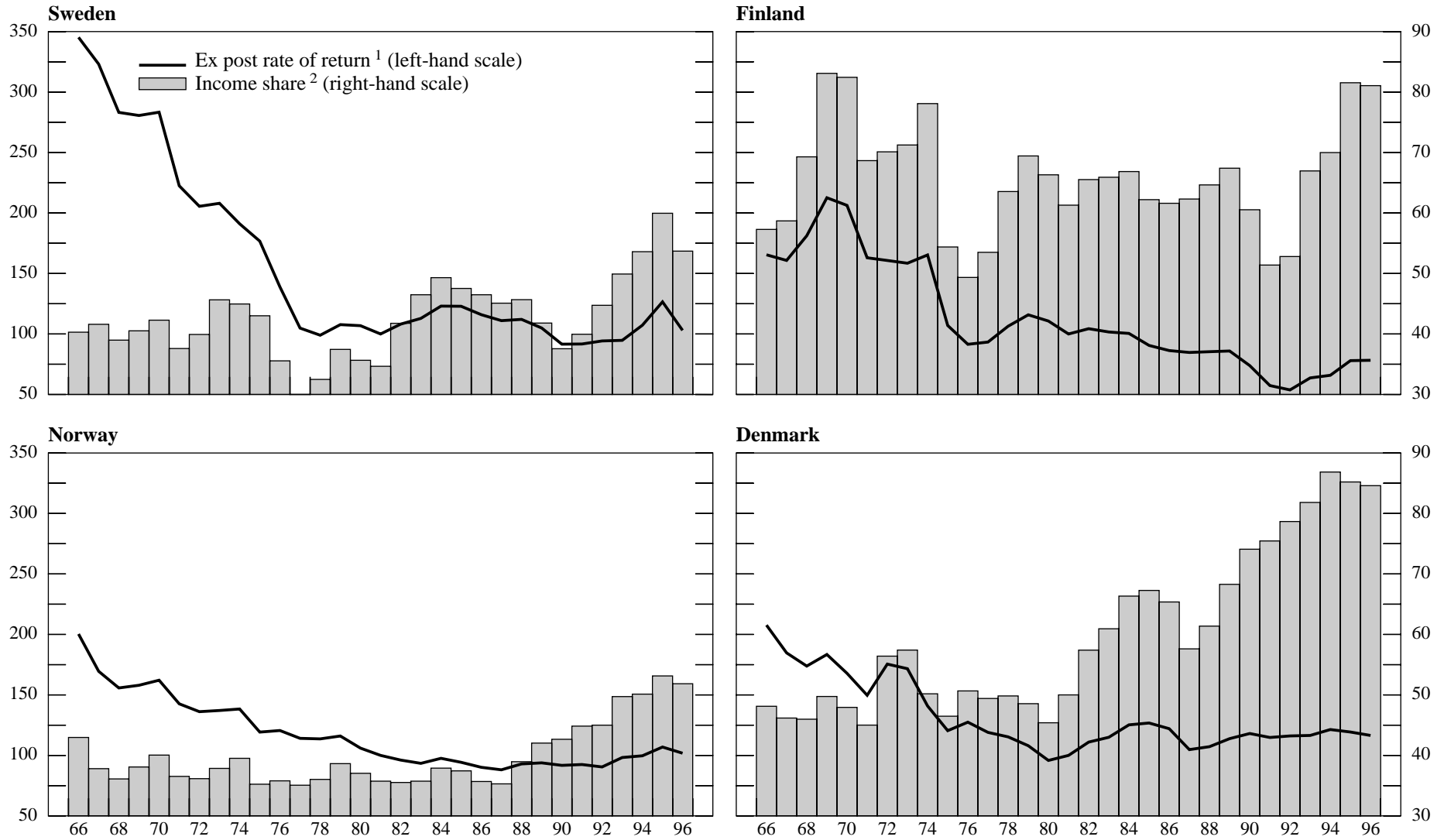
Graph 4a
Ex post rates of return and income shares



¹ Defined as the ratio of the real return per unit of capital to real compensation per employee; indices, 1981 = 100. ² Defined as profits relative to total wages, in percentages.

Graph 4b
Ex post rates of return and income shares

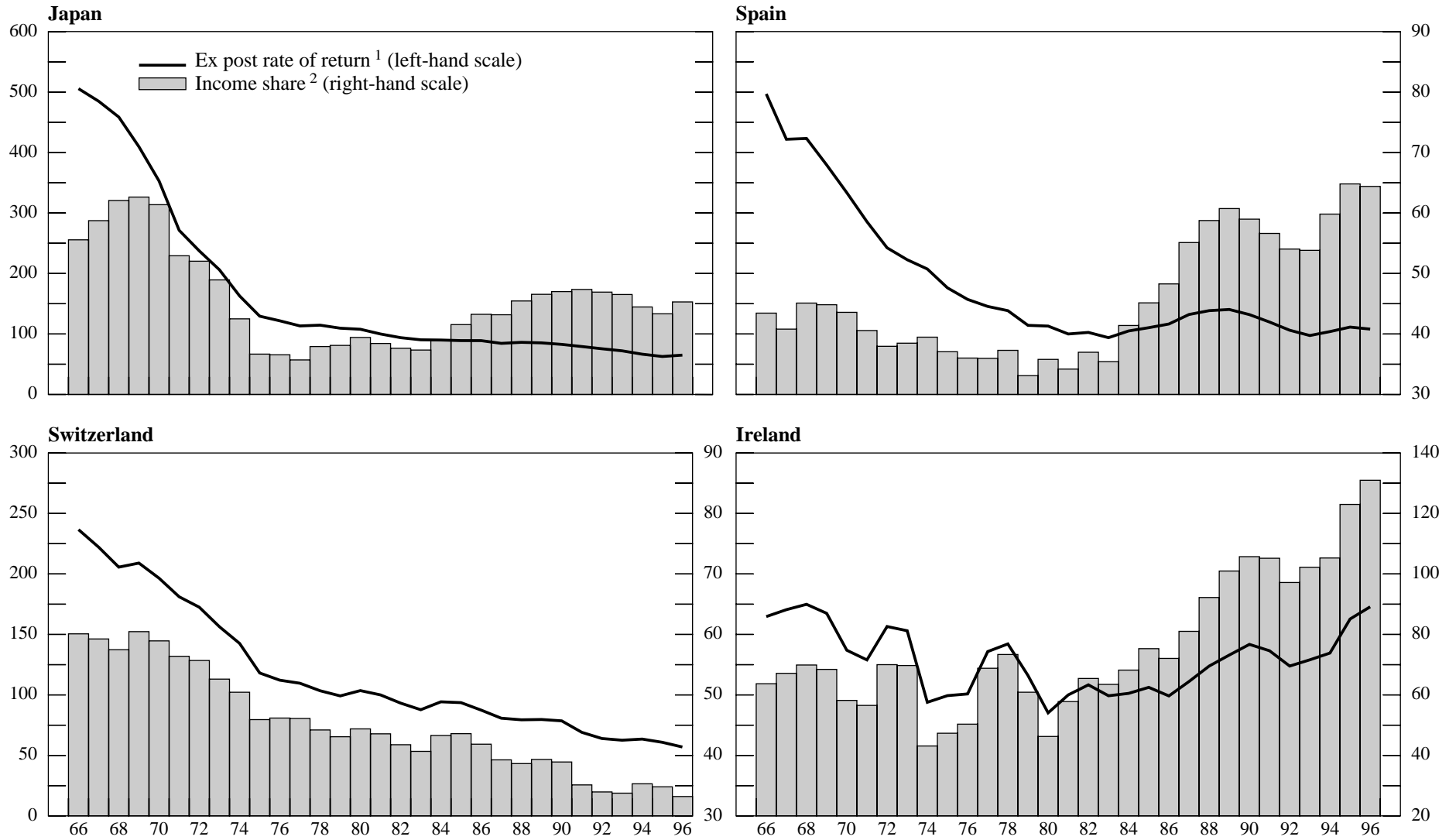
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¹ Defined as the ratio of the real return per unit of capital to real compensation per employee; indices, 1981 = 100. ² Defined as profits relative to total wages, in percentages.

Graph 4c
Ex post rates of return and income shares

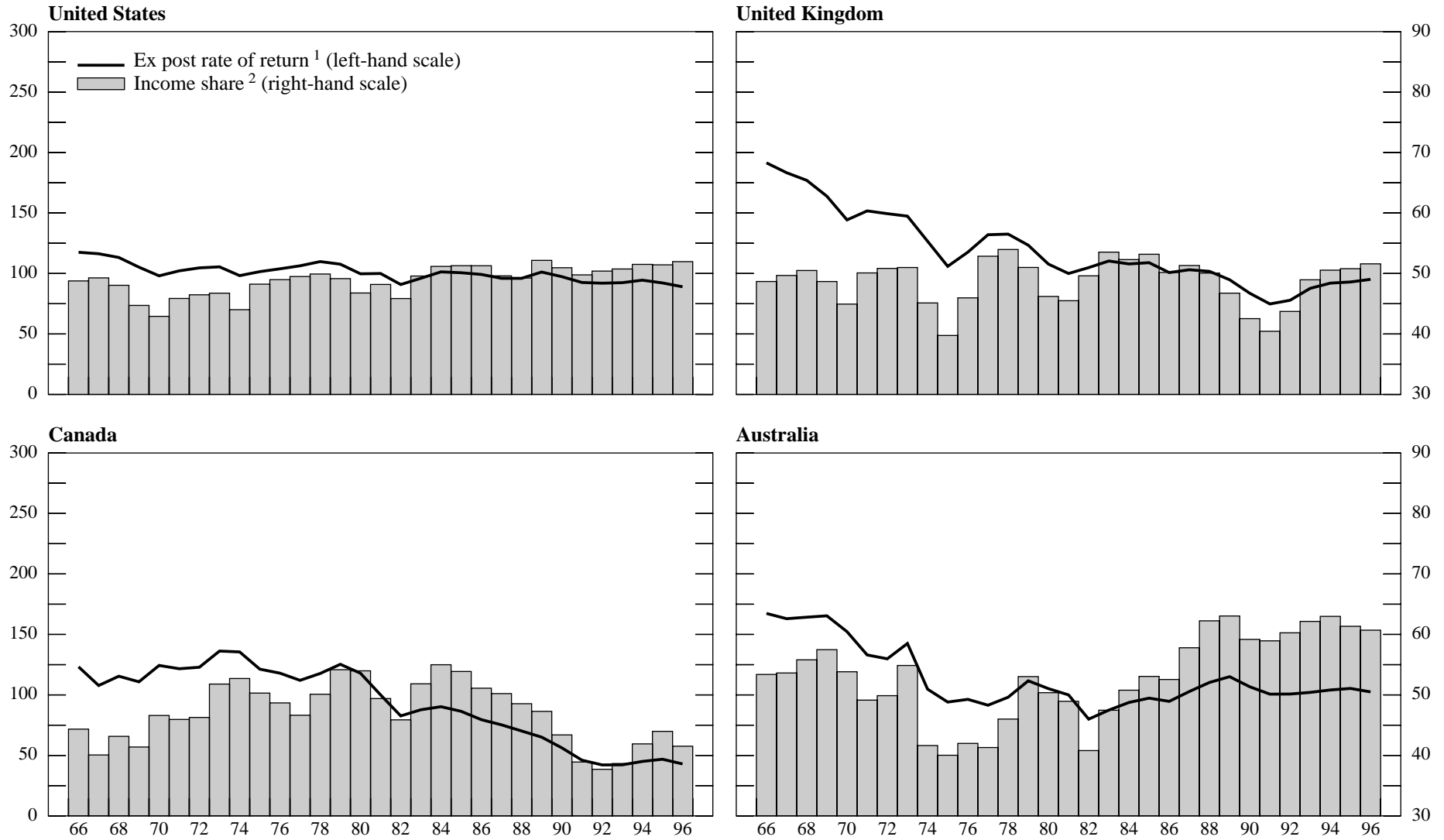
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¹ Defined as the ratio of the real return per unit of capital to real compensation per employee; indices, 1981 = 100. ² Defined as profits relative to total wages, in percentages.

Graph 4d
Ex post rates of return and income shares

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¹ Defined as the ratio of the real return per unit of capital to real compensation per employee; indices, 1981 = 100. ² Defined as profits relative to total wages, in percentages.

As noted earlier, we attempted to identify the influence of adjustment lags and other factors by estimating three error correction models with the following specifications:

$$\begin{aligned}\Delta(k - em) &= \beta(k - em)_{-1} + \varphi(w - p_k)_{-1} + \lambda\Delta y_{-i} + \phi\Delta(w - p_k)_{-i} + \rho\Delta(k - em)_{-i} + \varepsilon, \\ \Delta\log(\pi / emw) &= \alpha + \beta\log(k / em)_{-1}^* + \varphi\log(\pi / emw)_{-1} + \lambda\Delta y_{-i} + \phi\log U_{-i} + \varphi\text{rint}_{-i} + \rho\Delta\log(k / em)_{-1}^* + \varepsilon \\ \Delta\log(rr) &= \alpha + \beta\log(k / em)_{-1}^* + \varphi\log(rr)_{-1} + \lambda\Delta y_{-i} + \phi\log U_{-i} + \varphi\text{rint}_{-i} + \rho\Delta\log(k / em)_{-1}^* + \Delta\log(p_k - w)_{-i} + \varepsilon\end{aligned}$$

with $k-em$ = capital/labour ratio, $w-p_k$ = relative factor prices, Δy = rate of output growth, π = profits, $em \cdot w$ = wage sum, k/em^* = estimated capital/labour ratio, U = rate of unemployment, rint = real rate of interest, and rr = real rate of return per unit of capital/real product wage. Δ is the first-difference operator and each equation also includes a random error.

The first equation is a straightforward transformation of the earlier equation (vi) and only adds output changes as an additional variable. The equations for respectively factor shares and factor returns also allow for shifts in the distribution of rents by introducing the rate of unemployment as a measure of relative bargaining strength. Moreover, on the assumption that higher real interest rates might give firms an incentive to raise profit margins²⁰ and that profits tend to be more procyclical than wages, real long-term interest rates and rates of output growth were included as well.²¹

The results for the factor adjustment equation reveal several interesting features (see Annex Table A1). First, the adjustment process contains a significant cyclical component, as slow (fast) growth tends to induce a faster (slower) change of factor ratios. Second, the implied elasticities of substitution (σ_5 in Table 6) are only about half as large as those found earlier. Third, the speed of adjustment is extremely low as, for most countries, less than 10% of the gap between the actual and the desired capital/labour ratio is closed within one year. Although for some countries the parameters are not as precisely estimated as we would have liked, the long lags, combined with the relatively low elasticities of substitution, seem to suggest that the underlying production function is ‘putty-clay’ rather than ‘putty-putty’ as implicitly assumed in equations (i)-(iv).

These findings have two inter-dependent implications for the expected changes in the *ex post* relative returns and factor incomes. First, because of the time required to adjust the capital stock in accordance with changes in relative factor prices, firms will be operating with sub-optimal factor ratios and, more specifically, with too little capital. Consequently, *ex post* measures of the return to

²⁰ It is debatable whether movements in real interest rates act as an independent factor or affect factor returns via changes in the rate unemployment. See Phelps (1994) on the role of real interest rates in explaining developments in European unemployment and Nickell (1998) for evidence of real interest rate effects on UK unemployment. It should also be recalled that profits in this paper refer to non-financial as well financial firms so that net interest payments and receipts cancel out. However, the hypothesis would still hold if non-financial firms react to higher real interest rates, whereas banks and other financial institutions do not.

²¹ Alternative measures of real long-term interest rates are discussed in Andersen (1999).

capital is likely to contain an element of excess profits.²² Second, due to the time lags, the elasticities of substitution that are relevant in evaluating the production adjustment functions and its implications for factor returns and incomes are well below unity. As a result, using the technical substitution elasticities to predict changes in *ex post* relative returns will give a highly misleading impression, as can be seen from columns 4 and 5 of Table 5. Changes in the distribution of factor income are more difficult to predict, because the actual change will depend on the size of the substitution elasticity as well as the actual change in the capital/labour ratio. In addition, *ex post* changes in relative factor shares may be influenced by other changes in firm behaviour.

Table 6: Elasticities of substitution (σ) and speeds of adjustment (γ)
Error correction equations*

Countries	σ_5	γ_1	σ_6	γ_2	σ_7	γ_3
United States	0.56	0.077	1.88	0.617	3.20	0.434
Japan	0.65	0.034	1.40	0.167	1.60	0.240
Germany	0.78	0.053	0.53	0.193	0.77	0.344
France	0.52	0.075	1.35	0.250	1.05	0.181
Italy	0.65	0.089	2.28	0.251	1.00	0.406
United Kingdom	0.48	0.079	0.72	0.897	1.34	0.395
Canada	0.64	0.081	0.69	0.381	0.74	0.357
Australia	0.63	0.101	1.80	0.255	1.60	0.400
Belgium	0.64	0.105	0.49	0.181	0.64	0.200
Denmark	0.64	0.037	1.46	0.374	1.77	0.371
Finland	0.60	0.043	0.65	0.525	0.64	0.532
Ireland	0.46	0.053	0.40	0.330	0.66	0.429
Netherlands	0.69	0.082	2.04	0.689	1.94	0.583
Norway	0.66	0.072	0.77	0.338	0.88	0.429
Spain	0.55	0.050	0.70	0.212	0.91	0.257
Sweden	0.60	0.063	1.87	0.298	0.97	0.395
Switzerland	0.67	0.196	0.64	0.272	0.80	0.230
<i>Mean</i>	<i>0.61</i>	<i>0.076</i>	<i>1.15</i>	<i>0.380</i>	<i>1.16</i>	<i>0.353</i>
<i>St. dev.</i>	<i>0.080</i>	<i>0.037</i>	<i>0.626</i>	<i>0.238</i>	<i>0.661</i>	<i>0.150</i>

* For details, see Annex Tables A1-A3.

In fact, as can be seen from Tables A2 and A3, the slow change in factor ratios is not the only reason for discrepancies between actual and expected changes in relative factor returns and factor shares. For about two-thirds of the countries, the coefficient on the rate of unemployment is highly significant and for some of the European countries the rise in unemployment seems to account for a substantial part of the increase in the profit share and the relative return to capital. The hypothesis that higher real interest rates tend to boost profit margins is also quite well accepted by the data. However,

²² The relative low elasticities of substitution generated by the factor adjustment functions would imply that firms have not increased their capital stocks corresponding to the technical substitution elasticities (σ_1) in Table 4 and the rise in relative labour costs. This reluctance to increase investment (or the lags in the adjustment process) has, obviously, attenuated the downward pressures on the *ex post* return to capital.

even though there are large real interest rate effects for intermediate years, they tend to be only transitory and, for the period 1981-96 as a whole, real interest rates have had only a moderate impact.²³ For most countries, the effect of real output growth is positive and highly significant, with the size of the coefficient suggesting that it may be capturing demand-side effects as well as the pro-cyclical behaviour of profits.

The estimated equations are also quite successful in predicting changes in factor income ratios and relative returns (see columns 3 and 6 of Table 5) and the implied "pseudo" elasticities of substitution in Table 6 are, except for a few cases, not implausible.²⁴ On average, they tend to be below the technical substitution elasticities (σ_1) in Table 4, which is to be expected when firms do not take full advantage of the change in relative factor prices or have not had sufficient time to adjust. At the same time, the "pseudo" elasticities are, on average, not too different from those (σ_2) derived directly from equation (vi), implicitly suggesting that *ex post* factor shares and relative returns respond more quickly than factor ratios. This is also seen from the implied speeds of adjustment which, for most countries, indicate that one-third to one half of the "gap" between the actual and the long-run ratios of respectively factor incomes and factor returns is closed within one year. In contrast, for factor proportions, less than 10% of the gap between actual and desired ratios is closed within one year.

Section 3: Summary and conclusions

The first section of this paper looked at the sources of changes in profit shares and rates of return since the mid-1960s. Most earlier analyses have attributed the marked decline in profit shares until the early 1980s and the subsequent recovery to changes in real wages relative to labour productivity growth. However, using a new decomposition, we find that real profits per person employed actually increased during the period 1966-81 and that most of the decline in profit shares can be attributed to an exceptionally large increase in the capital/labour ratio which was not sufficiently matched by higher labour productivity. Over the next fifteen years, the moderation of real wage growth helped to raise real profits per person employed while the rate of growth of the capital/labour ratio slowed. An additional factor was a marked fall in the price of capital relative to both output prices and wages.

While the discussion in Section 1 is merely based on a decomposition of profit share changes, Section 2 looks further into the underlying adjustment process, in particular changes in capital/labour

²³ This is consistent with what theory would predict, as monetary policy is neutral with respect to long-run real output.

²⁴ We refer to these as "pseudo" elasticities since they are obtained from equations with relative factor returns or factor shares as the dependent variable. Moreover, firms do not choose their factor ratios on the basis of *ex post* figures.

ratios and the puzzling slowdown in capital spending during a period when investment conditions were favourable. The evidence and the implications can be summarised in three major points.

First, from the elasticities of substitution presented in Table 4 it appears that firms do not take full advantage of the technical substitution possibilities, as the elasticities based on the cost minimisation assumption (σ_2) are well below the technical elasticities (σ_1).²⁵ Moreover, when estimating the equations on variables in first differences rather than in levels, the implied elasticities drop substantially, indicating long adjustment lags.

Second, while such lags would slow the adjustment of *ex post* factor returns towards their long-run equilibrium levels, the evidence presented in Table 5 implies that other factors have also influenced this process, as actual returns differ substantially from those predicted by changes in capital/labour ratios since 1981. In particular, the real return to capital has fallen only marginally (or even increased) relative to that on labour, indicating that firms have enjoyed significant excess returns.

Third, when adopting an error correction framework for estimating the underlying production function as well as the path of relative factor returns, several interesting results are obtained:

- the adjustment of capital/labour ratios to changes in relative factor prices is indeed very slow as for most countries less than 10% of the ‘gap’ between actual and desired (i.e. cost minimising) factor ratios is closed within one year. It thus appears that the underlying production function is putty-clay rather than putty-putty, so that, given the fall in relative capital prices, firms have been operating with sub-optimal capital/labour ratios for most of the last fifteen years;
- the sub-optimal capital/labour ratios could also have affected employment unfavourably. Since the marginal productivity of labour would have been higher if firms had operated with optimal capital stocks, labours’ competitiveness would have been improved, potentially increasing employment through an upward shift in the demand curve for labour. Consequently, the slow adjustment of factor proportions seems, *ceteris paribus*, to have impeded the demand for labour, compared with a situation where firms were operating with optimal capital/labour ratios. On the other hand, actual employment was higher than it would have been if actual output had been produced under optimal conditions;
- while the long adjustment lags go a long way towards explaining the rise in profit shares and in the relative return to capital, they do not go far enough as other factors have also raised the return to capital relative to that on labour. In Spain, for instance, the dampening

²⁵ This would also suggest that the assumption that the ratio of marginal productivities equals relative factor prices is not satisfied.

effect on real wages of the rise in unemployment since the early 1980s has more than offset the fall in the return to capital as a result of the rise in the capital/labour ratio over the same period. In Germany, the two effects are about equally large while, in Italy, the rise in unemployment has offset about two-thirds of the fall in the relative return to capital due to the higher capital/labour ratio. The rise in real interest rates during the early 1980s has also strengthened the return on capital relative to that on labour. However, unlike the influence of unemployment, this effect has, for most countries, been only transitory.

The sub-optimal capital/labour ratios, combined with the excess returns to capital and the high profit shares, also makes it easier to understand policy-makers' concern that firms seem to prefer investing their profits in financial rather than real assets. Similarly, the empirical results justify unions' claims that real wage moderation has mostly served to boost profits and has not been accompanied by job creation through capital widening investment.

Nonetheless, given the preliminary nature of the estimates, some caution is called for in attributing sluggish investment to adjustment lags alone. It still cannot be excluded that firms have underestimated expected returns on additions to their capital stocks and, as a result, have invested too little. On the other hand, our interpretation of μ as a measure of revealed user costs or as an indicator of excess returns may be false. First, the apparent rise in μ could indicate that firms' opportunity costs have risen as they are increasingly relying on financial markets rather than banks as a source of external financing. In fact, this could explain firms' reluctance to embark on irreversible expansions of their own capital stocks and their preference for indirect investment in financial assets. Second, because the measured rise in the rate of return to capital is partly the result of falling real prices of capital goods, it could be argued that rates of return as well as profit shares are overstated as they are not corrected for capital losses on the existing stock. Fears that demand would not be sufficiently strong may also have increased and adversely affected investment intentions; and there might be further reasons, which we have not considered.

All in all, a study focused on the supply-side response can only provide a partial evaluation of the apparent weak response of capital formation to the boom in profits and the fall in relative capital costs. Demand-side effects and financial market developments are other and equally important parts which we plan to pursue in a separate and later study. Such a study is relevant in its own right but also –and not least– to provide a more comprehensive basis for identifying policy implications.

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Annex 1: Investment/output ratios and optimal capital stocks.

(a) Developments in investment/output ratios

As discussed in the main text, most countries have experienced a slowdown in the rate of growth of capital compared with both output and labour. Allied with a trend decline in investment relative to output, this has led to concerns that, in some sense, investment is too low. European policy-makers have mainly worried about the risk that capital shortages might constrain future growth of output and employment while US policy-makers have seen weak capital formation as a major reason for the slow rate of labour productivity growth.²⁶

Measured in current prices, the fall in investment relative to output since 1981 has, indeed, been substantial and widespread (Table 1, columns 1 and 2). On average for the seventeen countries, the investment/output ratio has declined by over 3½ percentage points, with only Denmark and Spain managing to raise the ratio or prevent it from falling. The decline in the proportion of profits spent on investment appears to be even more dramatic (columns 3 and 4)²⁷ and, in countries where wage moderation has been seen as a precondition for more investment and employment growth, this may pose a threat to continued wage moderation. Although the 33% drop should be seen against the unusually low profit shares in the early 1980s, it is suggestive of a growing reluctance to invest in real assets. This is especially the case when the progressive easing of credit conditions and the rise in equity prices are also taken into account.²⁸

However, some qualifications to these gloomy assessments are called for. First, because of the fall in the real price of capital goods, measures in current prices give a misleading impression of the extent to which firms' investment intentions have weakened. Measured in constant prices (columns 5 and 6), investment/output ratios have fallen by only 1 percentage point on average since 1981. The change is most pronounced for the United States and Canada where the decline in real capital goods prices has been most dramatic.²⁹ In contrast, even in constant prices, large and structurally induced declines are still observed in Norway, Finland, Ireland and Belgium. In most other European countries

²⁶ Such arguments are sometimes based on the simple Cobb-Douglas function we used in note 6. From this it is easily seen that higher growth of the capital/labour ratio will increase the growth of labour productivity.

²⁷ The investment/profit ratios should not be interpreted as the inverse of self-financing ratios, as capital income is not corrected for taxes and dividends and, in the case of non-financial firms, net interest payments.

²⁸ For further discussion, see Browne and Hellerstein *op cit*.

²⁹ The relatively large declines observed for the United States and Canada is, in part, related to the fact that these are among the few countries, which apply hedonic price indices for computers.

and Australia, the move from current to constant prices mainly helps to moderate the decline in investment/output ratios.

Second, (columns 7 and 8 of Table 1), investment per employed worker has increased over the last fifteen years. Even though the United States obtains a low rank with respect to the level of the investment/output ratio, capital formation was sufficiently strong to support an increase in investment per employed worker as well as a substantial rise in the number of persons employed.³⁰ The investment/employment ratios also rose in Canada and the United Kingdom despite relatively fast employment growth. In continental Europe, by contrast, the rise in investment/employment ratios mostly reflects the slow growth (or actual decline) of employment and the capital-deepening nature of the investment undertaken.³¹

(b) Saturation and optimal capital/output ratios.

Despite the above qualifications, it could still be argued, that with profits growing and the relative price of capital goods declining, firms could have undertaken more *real* investment and prevented the slowdown in the growth of capital/output ratios rather than boosting their purchases of financial assets. In this context, some have argued that one reason for the hesitant capital spending might be that, by the early or mid-1980s, capital stocks had become "too large" so that firms preferred to reduce the growth of their real assets to improve their rates of return. As noted in the text, Irish enterprises seem to have experienced an exceptionally large rise in their rates of return by reducing their capital/output ratio. Similarly, though on a smaller scale, firms in Denmark, Finland, the Netherlands and Spain have seen a marked rise in rates of return, while capital/output ratios have fallen or grown at a slower rate than during the previous fifteen years.

While firms reaction to the low rates of return in the 1980s may be entirely rational from the point of view of maximising profits, the resulting slowdown in investment spending, nevertheless, raises the question whether the trend decline in investment/output ratios has reached a point where it poses a risk to output growth. In other words, is investment spending so low that earlier estimates of potential rates of output growth need to be revised down?

³⁰ The US investment/employment ratio is probably understated, as the United States has not only seen a marked decline in relative capital goods prices but capital goods also tend to be cheaper in the United States than in other countries. For further discussion, see Kirova and Lipsey, *op cit*.

³¹ For instance, if, over the period 1991-96, Germany and France were to have increased employment by respectively 2 and 1,5 million more than they actually did and thus reduced the rate of unemployment in 1996 to 5-6%, the investment/output ratios should, *ceteris paribus*, have been 19-20% rather than 14-15%. Except for 1991-92, when German investment was boosted by reunification expenditure, neither country has recorded such investment ratios for the last thirty years.

We attempt to answer these questions using various measures derived from the "golden rule" of accumulation as proposed by Phelps (1961). According to this rule, the capital stock should be expanded until the marginal product of capital equals the natural rate of growth of the economy or:

$$(i) \quad r - \delta = g = n + \tau$$

where r = the marginal product of capital, δ = the rate of scrapping, g = the natural or potential rate of growth, n = the rate of growth of the labour force and τ = the rate of growth of labour augmenting technical progress. Assuming a Cobb-Douglas technology and competitive markets, (i) can be rewritten as:

$$(ii) \quad K/Y = \alpha/r, \text{ where}$$

α = capital's share of income. The corresponding rule for steady-state investment (net of scrapping, I^n) can be derived from:

$$(iii) \quad I^n = \Delta K = gK$$

which, after dividing by output on both sides, gives:

$$(iv) \quad I^n/Y = g (K/Y) = g (\alpha/r)$$

In Table 2, we have used the above relations, taking 1981 as a starting point and ranking the countries according to the actual change in capital/output ratios over the period 1981-96. In the following Table 3 we then evaluate current investment and capital ratios against the golden rule requirements. Because most of the parameters and variables in (ii) and (iv) are subject to uncertainty, both tables provide ranges rather than point estimates. Starting with Table 2, columns 1 and 2 present plausible ranges for capital/output ratios, using equation (ii) as explained in the notes while the actual ratios are shown in column 3. The next four columns of the table then compare actual investment ratios to those implied by the golden rule and the maximum and minimum capital/output ratios as shown in the first two columns.³²

As the table shows, actual capital/output ratios in Ireland, the United Kingdom, the Netherlands and Finland were rather close to the levels implied by the golden rule in 1981. This may, in part, explain the subsequent reduction in investment spending and in the capital intensiveness of output in these countries. Similarly, the slow growth of the capital/output ratio in Australia looks more plausible, once the initial situation is taken into account. Conversely, the relatively high growth of the

³² We have also included the investment ratios required to maintain average growth for the 1990s without reducing the capital stock. However, in most cases, actual growth rates have been well below potential rates of growth, so that the "required" ratios are mostly very low and of relatively little interest. It might also be noted that the maximum and minimum investment ratios contain an inconsistency with respect to the potential growth rates used. However, the inconsistency is deliberate as it helps to widen the evaluation range.

capital/output ratios of Canada and Switzerland may be justified by the fact that, in 1981, actual ratios were far below the ranges implied by the golden rule. Similarly, though most pronounced in Switzerland, the 1981 investment/output ratio was much too low to close the "gap" between actual and optimal capital/output ratios.

Nonetheless, even with the low profit shares of the early 1980s, actual capital/output ratios were generally rather low compared with golden rule ratios. Consequently, if firms were to have reduced the gap between actual and optimal capital/output ratios, investment/output ratios should, at least temporarily, have been increased rather than reduced. From this perspective, investment appears to have been particularly low in Denmark, as the actual ratio is below the minimum of the range. Similarly, as noted above, investment by Swiss firms seems to have been on the low side. In contrast, even though the US ratio is comparatively low, it is close to the maximum of the range and thus sufficiently high to raise the actual capital/output ratio and maintain growth.

However, these evaluations are based on the very low profit shares of the early 1980s and a more relevant question is, perhaps, whether firms' willingness to invest has remained sufficiently strong, once the improvement in profits and the change in capital goods prices over the last fifteen years are taken into account. This is further analysed in Table 3 where, in the first four columns, we augment the earlier table by adding average values for the last five years for respectively output growth, scrapping rates and gross and net profit shares. With the exception of the United Kingdom, actual capital/output ratios are well below the ranges implied by the golden rule, suggesting that fears of saturation are unlikely to have constrained investment spending. Moreover, as shown in the last four columns of the table, actual investment/output ratios are, for several countries, higher than or just below the maximum golden rule requirements and thus suggestive of attempts to bring future capital/output ratios closer to their optimal level. This is the case for the United States, Japan, the United Kingdom, Canada and Norway. In contrast, for the continental EU countries as well as Australia, Ireland and Switzerland, actual investment ratios seem rather low, thus confirming policy-makers' concerns that weak investment may constrain future employment. This is particularly the case in Denmark, where the actual ratio is still below the minimum of the range and only marginally higher than the ratio required to maintain current growth.

However, two caveats are called for in evaluating the above results. First, the recent rise in profit shares has significantly raised the golden rule ratios compared with the early 1980s. If, however, firms regard this improvement as cyclical and/or temporary, their intentions with respect to investment and the desirable growth of their capital/output ratios would be below the figures shown in Table 3. Second, it needs to be kept in mind that the golden rule only applies to an economy *in* steady state and that, for most countries, the last fifteen years mark a period of transition *between* steady states.

Table 1: Indicators of investment and capital stocks

Countries	I*P _K /Y*P _Y		I*P _K /Pr		I/Y		I/Em		K/Y		PPP
	1996	1981	1996	1981	1996	1981	1996	1981	1996	1981	1990
Norway	34.9	44.0	105.1	162.8	33.8	43.8	18.8	18.9	4.1	3.9	0.65
Japan	20.1	21.9	60.4	72.3	21.9	19.4	10.1	6.6	2.6	2.0	0.74
Canada	18.0	24.9	53.2	65.4	18.2	17.6	7.1	5.7	2.1	1.3	0.90
Australia	17.0	21.7	45.5	66.6	18.5	20.6	6.9	6.2	2.3	2.3	0.92
Spain	16.3	16.3	37.5	56.9	17.5	14.7	6.1	3.6	2.3	1.9	0.93
Sweden	14.9	16.0	48.1	61.6	16.9	13.8	10.7	6.2	2.9	2.6	0.63
United Kingdom	14.9	16.1	45.0	53.3	16.4	15.5	6.0	4.4	3.3	3.6	0.93
Germany	14.4	15.4	38.1	49.7	15.5	15.0	8.1	6.3	2.9	2.7	0.77
Netherlands	14.0	15.3	35.4	45.1	14.3	15.4	4.6	2.7	2.2	2.4	0.84
Finland	13.9	20.0	41.4	70.5	14.6	20.5	9.7	7.8	3.4	3.6	0.60
France	13.6	16.2	33.2	50.4	14.5	15.4	4.7	3.6	2.7	2.6	0.82
Italy	13.3	16.3	31.4	47.2	13.7	14.2	6.7	5.1	2.8	2.6	0.84
Ireland	13.2	26.8	30.4	109.7	12.7	22.6	5.5	5.4	2.1	3.0	0.87
Belgium	12.8	19.6	34.7	67.0	13.1	17.5	8.4	5.0	2.7	2.4	0.84
United States	12.7	16.3	37.1	49.8	13.9	13.1	6.8	5.6	2.0	1.9	1.00
Denmark	9.0	8.1	23.7	31.0	9.8	7.5	5.5	3.0	3.6	3.5	0.66
Switzerland	8.1	9.9	24.2	25.2	11.1	8.8	6.5	4.9	2.7	2.2	0.63
<i>Average*</i>	<i>15.4</i>	<i>19.1</i>	<i>42.6</i>	<i>63.8</i>	<i>16.3</i>	<i>17.4</i>	<i>7.8</i>	<i>5.9</i>	<i>2.75</i>	<i>2.60</i>	<i>--</i>

Notation: I*P_K/Y*P_Y: investment/output ratio, current prices; I/Y: investment/output ratio, constant prices; I/Em: investment/labour ratio in US dollar at 1990 exchange rates;

I*P_K/Pr: investment/profit ratio, current prices; K/Y: capital/output ratio at 1990 prices and PPP rates: and PPP: 1990 PPP rates. *Unweighted.

Table 2: Investment and capital output ratios: actual relative to "golden rules", 1981

In ratios and percentages

Countries	Capital/output ratios ¹			Investment/output ratios ²				$\Delta(K/Y)$
	Maximum	Minimum	Actual	Maximum	Minimum	"Required"	Actual	1981-96
Ireland	4.1	2.8	3.00	14.3	7.0	15.3	22.1	- 2.2
United Kingdom	4.4	3.3	3.60	15.4	8.2	4.3	15.0	- 0.6
Netherlands	5.2	3.8	2.40	18.2	9.5	3.5	14.7	- 0.6
Finland	5.2	3.7	3.55	18.2	9.2	11.2	20.0	- 0.3
Norway	6.4	4.3	3.95	22.5	10.7	9.4	43.0	0.2
Australia	6.3	4.4	2.30	22.0	11.0	7.3	20.0	0.2
Denmark	6.6	4.3	3.50	23.0	10.7	3.6	7.3	0.2
United States	3.6	2.8	1.90	12.6	7.0	6.1	12.3	0.2
Germany	5.4	3.9	2.75	18.9	9.7	6.0	14.5	0.3
France	5.8	4.1	2.55	20.3	10.3	7.0	15.0	0.4
Italy	7.7	5.2	2.60	27.0	13.0	8.8	13.8	0.6
Sweden	4.9	3.5	2.60	17.1	8.7	0.5	13.5	0.7
Belgium	6.2	4.2	2.75	21.6	10.5	3.4	17.0	0.9
Spain	4.6	3.3	1.95	16.1	8.2	1.6	14.2	1.2
Switzerland	7.8	5.2	2.20	27.3	13.0	4.8	8.6	1.4
Japan	4.5	3.3	2.00	15.7	8.0	8.5	18.5	1.8
Canada	5.6	4.1	1.30	19.5	10.2	4.8	17.0	3.3

Notes: ¹ Maximum and minimum capital output ratios calculated from the formula: $K/Y^* = \alpha / (\Delta y^* + \delta)$, with α = gross (net) profit share for the maximum (minimum), Δy^* = potential output growth, with 2.5% (3.5%) assumed for the maximum (minimum) and δ = scrapping rate, with actual scrapping rate less (plus) 0.5 percentage point used for the maximum (minimum). ² Maximum and minimum net investment ratios are calculated from the formula: $I^n/Y = \Delta y^* K/Y^*$, with K/Y^* corresponding to the maximum and minimum capital ratios and Δy^* assumed to equal 3.5 and 2.5%, respectively; "required" ratio calculated as actual capital/output ratio times actual growth rate.

Table 3: Investment and capital output ratios: actual relative to "golden rules"

In ratios and percentages

Countries	Average values, 1992-96 ¹				Capital/output ratios ²			Investment/output ratios ³			
	Δy	δ	$(\pi/Y*P_y)^g$	$(\pi/Y*P_y)^n$	Maximum	Minimum	Actual	Maximum	Minimum	"Required"	Actual
Ireland	6.8	2.75	31.5	30.5	6.6	4.5	2.15	23.1	11.2	14.6	12.5
United Kingdom	3.0	4.5	31.0	29.0	4.8	3.4	3.30	16.8	8.5	9.9	15.7
Netherlands	2.6	4.5	38.6	36.9	5.9	4.3	2.20	20.6	10.7	5.7	14.8
Finland	2.0	3.5	30.5	29.5	5.5	3.9	3.45	19.2	9.7	6.9	14.0
Norway	3.6	2.25	33.5	32.7	7.9	5.2	4.05	27.6	13.0	14.6	33.0
Australia	4.4	3.25	38.5	37.2	7.3	5.1	2.35	25.5	12.7	10.3	17.9
Denmark	2.4	2.0	37.5	36.7	9.4	6.1	3.60	32.9	15.2	8.6	9.6
United States	2.9	7.0	34.0	31.5	3.8	2.9	1.95	13.3	7.2	5.8	12.9
Germany	1.4	3.75	35.8	34.5	6.2	4.5	2.85	21.7	11.2	4.0	15.0
France	1.2	3.5	40.5	39.2	7.4	4.9	2.75	25.9	12.3	3.3	14.0
Italy	1.2	2.5	39.8	38.0	8.8	5.8	2.85	30.8	14.5	3.5	13.5
Sweden	1.6	3.25	34.0	33.0	6.5	5.3	2.90	22.7	13.2	4.6	16.3
Belgium	1.4	2.75	35.7	34.7	7.5	5.1	2.75	26.2	12.7	3.8	14.3
Spain	1.4	3.75	38.5	37.2	6.7	4.8	2.35	23.5	12.0	3.3	17.0
Switzerland	0.0	2.5	30.7	29.9	6.8	4.6	2.70	23.8	11.5	4.0	10.8
Japan	1.4	4.75	33.0	31.5	4.9	3.6	2.60	17.1	9.0	3.6	20.9
Canada	2.4	4.0	29.5	28.0	4.9	3.5	2.15	11.8	8.7	5.2	17.5

Notes and notation: ¹ Δy : average growth of real GDP; δ : scrapping rate; $(\pi/Y*P_y)^g$: gross profit share; and $(\pi/Y*P_y)^n$: net profit share. ² Maximum and minimum capital output ratios calculated from the formula: $K/Y^* = \alpha / (\Delta y^* + \delta)$, with α = gross (net) profit share for the maximum (minimum), Δy^* = potential output growth, with 2.5% (3.5%) assumed for the maximum (minimum) and δ = scrapping rate, with actual scrapping rate less (plus) 0.5 percentage point used for the maximum (minimum). ³ Maximum and minimum net investment ratios are calculated from the formula: $I^n/Y = \Delta y^* K/Y^*$, with K/Y^* corresponding to the maximum and minimum capital ratios and Δy^* assumed to equal 3.5 and 2.5%, respectively; "required" ratio calculated as actual capital/output ratio times actual growth rate (for Switzerland, however, actual growth rate replaced by 1.5%).

Annex Tables

Table A1: Production adjustment functions¹

Countries	k/em ₋₁	w/p _{k-1}	Δy	Δ(w-p _k) _{-i}	Δ(k-em) ₋₁	R ²	DW ²	σ ₅ ³
United States	- 0.077	0.043	- 0.64**	--	0.16	0.67	1.52	0.56
Japan ⁴	- 0.034**	0.022**	0.22**	--	0.49**	0.83	2.50	0.65
Germany	- 0.053**	0.042**	- 0.32**	--	0.32**	0.47	1.36	0.78
France	- 0.075**	0.039**	- 0.40**	--	--	0.65	1.53	0.52
Italy	- 0.089**	0.058**	- 0.43**	0.12*	--	0.47	1.15	0.65
United Kingdom	- 0.079**	0.038**	- 0.59**	0.16**	--	0.75	2.05	0.48
Canada	- 0.081**	0.051**	- 0.82**	0.16**	--	0.75	2.01	0.64
Australia	- 0.102**	0.064**	- 0.55**	--	--	0.55	2.58	0.63
Belgium	- 0.105**	0.068**	- 0.28**	--	--	0.62	1.49	0.64
Denmark	- 0.037**	0.024**	- 0.39**	0.15*	0.33**	0.77	4.67	0.64
Finland	- 0.043**	0.026**	- 0.51**	--	0.25**	0.70	5.11	0.60
Ireland	- 0.053**	0.025**	- 0.30**	0.10*	0.44**	0.65	5.52	0.46
Netherlands	- 0.082**	0.056**	- 0.33**	0.15*	0.38**	0.76	4.45	0.69
Norway	- 0.072**	0.047**	- 0.77**	--	--	0.60	2.29	0.66
Spain	- 0.050**	0.028**	- 0.35**	0.16*	0.37**	0.81	32.9	0.55
Sweden	- 0.063**	0.038**	- 0.56**	0.13**	--	0.71	1.60	0.60
Switzerland	- 0.196**	0.131**	- 0.44**	- 0.16	0.40**	0.63	5.65	0.67

¹ Coefficients obtained from estimating the following error correction model (all variables in logs):

$$\Delta(k - em) = \beta(k - em)_{-1} + \varphi(w - p_k)_{-1} + \lambda\Delta y + \phi\Delta(w - p_k)_{-i} + \rho\Delta(k - em)_{-i} + \varepsilon$$

with k-em = capital/labour ratio, w-p_k = relative factor prices, Δy = rate of output growth, ε = random error and Δ = first-difference operator. ² Durbin's h when lagged dependent variable included ³ Calculated as φ/β. * and ** significant at respectively 5 and 1% level of significance. ⁴ Δy entered with one lag.

Table A2: Developments in factor ratios and relative factor shares¹
Rate of return to capital/real labour costs

Countries	k/em^*_{-1}	$\pi/w \cdot em_{-1}$	Δy_{-i}	U_{-i}^2	$Rint_{-i}^3$	$\Delta k/em^*_{-1}$	R^2/DW	σ_6^4
United States	0.289**	- 0.617**	0.63**	--	--	--	0.51/1.93	1.88
Japan	0.049*	- 0.167**	1.42**	--	0.56**	--	0.76/2.14	1.41
Germany ⁵	- 0.193**	- 0.171**	--	0.26**	--	--	0.57/1.95	0.53
France	0.066**	- 0.250**	1.44**	--	1.53**	--	0.72/2.02	1.36
Italy ⁶	0.141**	- 0.251**	0.20**	--	1.20**	--	0.52/1.81	2.28
United Kingdom ^{6,7}	- 0.345**	- 0.897**	0.85**	0.12**	--	0.38**	0.72/0.80	1.54
Canada ⁶	- 0.170**	- 0.381**	0.79**	0.17**	--	--	0.48/1.99	0.69
Australia ^{6,8}	- 0.113*	- 0.254**	1.55**	--	--	1.36**	0.54/2.20	1.80
Belgium ⁹	- 0.188**	- 0.181**	--	0.98*	0.78**	- 2.94	0.63/2.37	0.49
Denmark ^{10,6}	0.117*	- 0.374**	1.52**	0.87*	--	--	0.45/1.52	1.46
Finland ⁶	- 0.289**	- 0.525**	0.90**	0.20**	--	--	0.68/1.88	0.65
Ireland	- 0.498	- 0.330*	3.74**	0.51**	0.73	--	0.55/2.05	0.40
Netherlands ⁵	0.352**	- 0.689**	1.24**	0.19**	2.76**	--	0.73/1.73	2.04
Norway ⁵	- 0.099**	- 0.338**	--	0.37**	--	--	0.22/1.93	0.77
Spain ^{5,7}	- 0.091*	- 0.212**	0.90**	0.16**	--	- 0.32**	0.53/0.07	0.70
Sweden ⁵	0.139**	- 0.298**	2.38**	0.24**	--	--	0.39/1.18	1.87
Switzerland ⁶	- 0.153**	- 0.272**	0.88**	--	--	--	0.33/1.62	0.64

¹ Coefficients obtained from estimating:

$$\Delta \log(\pi / emw) = \alpha + \beta \log(k / em)_{-1}^* + \varphi \log(\pi / emw)_{-1} + \lambda \Delta y_{-i} + \phi \log U_{-i} + \varphi r int_{-i} + \rho \Delta \log(k / em)_{-1}^* + \varepsilon$$

with π = profits, $em \cdot w$ = wage sum, k/em^* = estimated capital/labour ratio, Δy = rate of output growth, U = rate of unemployment, $rint$ = real rate of interest, $i = 0,1,2$, Δ = first-difference operator and ε = random error term. * and ** denote significance levels of respectively 5 and 1%. ² Coefficients multiplied by 10, except for $\log U$. ³ Coefficients multiplied by 100. ⁴ Calculated as $-\varphi/(\beta-\varphi)$. ⁵ U rather than $\log U$. ⁶ ΔQ rather than $\Delta \log Q$. ⁷ Lagged dependent variable rather than $\Delta \log(k/em)$. ⁸ Actual rather than fitted value for $\Delta(k-em)_{-1}$; also include an intercept dummy to capture the effects of exceptionally high wage increases in 1975 and 1982. ⁹ Actual rather than fitted value for $\Delta(k-em)_{-1}$. ¹⁰ Unemployment only significant after 1981.

Table A3: Developments in factor ratios and relative factor returns¹

Real return per unit of capital/real labour costs

Countries	k/em* ₋₁	rt/rw ₋₁	Δy ₋₁	U _{-i} ²	Rint _i ³	Δk/em* ₋₁	R ² /DW	σ ₇ ⁴
United States ⁵	- 0.136**	- 0.434**	1.76**	--	0.71*	- 1.16**	0.85/1.61	3.20
Japan	- 0.150**	- 0.240**	1.43**	--	0.63**	--	0.85/1.96	1.60
Germany ⁶	- 0.443**	- 0.344**	0.91**	0.24**	--	--	0.73/1.91	0.77
France ⁶	- 0.173**	- 0.181**	1.87**	0.10	1.04**	--	0.79/2.12	1.05
Italy ⁶	- 0.404**	- 0.406**	1.66**	0.22**	--	--	0.66/1.55	1.00
United Kingdom ⁷	- 0.295**	- 0.395**	2.83**	1.15	--	--	0.60/1.90	1.34
Canada ⁶	- 0.482**	- 0.357*	1.40**	0.25**	--	--	0.57/1.78	0.74
Australia ⁸	- 0.246*	- 0.400**	2.34**	0.54**	0.11*	- 2.70**	0.90/1.62	1.62
Belgium ⁹	- 0.315**	- 0.201*	--	--	0.60**	- 3.73**	0.82/2.33	0.64
Denmark ^{10,6}	- 0.210**	- 0.371**	2.04**	0.88*	--	--	0.63/1.71	1.77
Finland ⁶	- 0.827**	- 0.532**	1.11*	0.19**	0.76	--	0.71/2.30	0.64
Ireland	- 0.651**	- 0.429**	3.95**	0.40**	1.16	--	0.57/1.90	0.66
Netherlands	- 0.301**	- 0.583**	2.40**	0.15**	2.13**	--	0.84/1.95	1.94
Norway ⁶	- 0.487**	- 0.429**	--	0.47**	--	--	0.28/1.94	0.88
Spain ⁶	- 0.283**	- 0.257**	1.44**	0.15**	--	--	0.69/2.72	0.91
Sweden	- 0.408**	- 0.395**	3.67**	0.12**	--	--	0.70/1.83	0.97
Switzerland ⁵	- 0.287**	- 0.230**	1.13**	--	--	- 0.77**	0.64/1.95	0.80

¹ Coefficients obtained from estimating:
$$\Delta \log(rr) = \alpha + \beta \log(k/em)_{-1}^* + \phi \log(rr)_{-1} + \lambda \Delta y_{-i} + \phi \log U_{-i} + \varphi \text{rint}_{-i} + \rho \Delta \log(k/em)_{-1}^* + \Delta \log(p_k - w)_{-i} + \varepsilon$$

with rr = real rate of return/real product wage, k/em* = estimated capital/labour ratio, Δy = rate of output growth, U = rate of unemployment, rint = real rate of interest, i = 0,1,2, Δ = first-difference operator and ε = random error term. * and ** denote significance levels of respectively 5 and 1%. ² Coefficient multiplied by 10, except for log U. ³ Coefficient multiplied by 100. ⁴ Calculated as -φ/β. ⁵ Δlog (p_k - w). ⁶ U rather than log U. ⁷ ΔU rather than log U. ⁸ Δlog U rather than log U and actual rather than fitted value for Δ(k-em)₋₁; also include an intercept dummy to capture the effects of exceptionally high wage increases in 1975 and 1982. ⁹ Actual rather than fitted value for Δ(k-em)₋₁; also includes Δlog (p_k - w) with a coefficient of - 1.03 (3.8). ¹⁰ Rate of unemployment only significant after 1981.

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