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LABOR AND INVESTMENT DEMAND AT THE FIRM LEVEL: A COMPARISON OF FRENCH, GERMAN AND U.S. MANUFACTURING, 1970-79

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ABSTRACT

We investigate how labor and investment demand at the firm level (gross as well as net and replacement investment separately) differs in French, German and U.S. manufacturing, and has changed since the 1974-75 crisis. We use three consistent panel data samples of large firms for 1970-79, and rely on simple models of the accelerator-profits type. We find that the accelerator effects and the profits effects did not vary much between 1970-73 and 1976-79, and were quite comparable in the three countries, the former being of a more permanent nature and the latter more transitory. To a large extent these effects account for the important changes and differences in labor and investment demand between the two subperiods and across the three countries.

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I - INTRODUCTION

The first oil shock at the end of 1973 marked a considerable break in the economic evolution of France, Germany, the United States and other industrial countries. For the first time in thirty years ("Les trente glorieuses"), aggregate industrial production dropped: this happened in 1974 in Germany and the United States, in 1975 in France. Since then the economic situation has not recovered to what it was before; most industrial countries have experienced weaker growth, with a slowdown in capital accumulation and rising unemployment. Many macroeconomic studies, a number of them in a comparative perspective, have tried to analyse and understand the various issues at stake. The present work is part of an effort to complement and enrich these studies, by considering some of the same issues at the microeconomic level, i.e., using firm panel data instead of aggregate time series.[1]

Our purpose here is to investigate whether the behavior of firms in regard to labor demand and investment demand (gross investment as well as net investment and replacement investment separately) is similar in the French, German and U.S. manufacturing industries, if not how it differs, and whether it has been stable before and after the 1974-1975 crisis, if not how it changed. To accomplish this we had to construct consistent and comparable data sets for French, German and U.S. manufacturing firms over a long enough period (1966-1979). In view of the formidable complexities of the formal modelling of factor demand decisions, as well as the lack of good information on theoretically relevant variables, or even that of acceptable proxies (especially as regards expected factor prices at the firm level), we resorted to simple models of the basic accelerator profits type. Further, of the many possibilities in structuring the data and specifying the estimated equations, we have chosen two: year to year growth rates and average growth rates. We have also kept the seemingly necessary minimum number of lags in the regressions. We thus bypass some of the difficulties of the econometrics of panel data.

It is necessary to define the scope and meaning of our study by giving some explanations of these matters, i.e., sample construction and the measurement of variables, choice of model and interpretation, specification and estimation considerations. We shall do so in the first part of the paper. We shall then present the empirical results and comment on them in the second part. We concentrate on the estimates of the accelerator profits equations, but we shall also report on some attempts to use additional explanatory variables on average labor costs and interest expenses. We end with a few brief remarks.

II - GENERAL FRAMEWORK AND BACKGROUND CONSIDERATIONS

2.1. On Samples and Variables

We have constructed our samples of firms for all three countries along the same lines. However, due to the different characteristics of the data banks from which we drew these samples (range of firms, extent of missing observations or large errors, proportions of firms entering, leaving or going through a major merger), we cannot consider them as truly representative in any definite sense.[2] They consist of 307 French firms, 145 German firms and 422 U.S. firms, for which we have complete data for our main variables over the 14 years 1966-79. Although these firms are only a small cohort out of the total number of manufacturing firms, they are relatively large companies, and they account for about 7 and 8 per cent, 9 to 10 per cent and as much as 50 per cent of total employment in French, German and U.S. manufacturing industries respectively. Their average sizes reflect the well known fact that U.S. firms are generally much larger than their French and also German counterparts: the geometric means of the number of employees being about 7000 in the U.S. sample as against 700 and 1400 in the French and German samples, respectively. Because our regressions involve three lags, our study period is in fact restricted to the 10 years 1970-79, i.e., four years before and four years after the 1974-75 break.

We have defined and measured our basic variables as similarly as possible for the three samples. With the major exception of the physical capital stock variable in the case of the German sample, they can be considered as closely comparable. Labor L is measured by the total number of employees (average number over the year). Both for France and the U.S., gross capital stock C is taken as the gross book value of fixed assets following an adjustment for inflation which involves a rough estimate of average age.[3] For Germany, such a measure is not possible and we constructed C as the sum of past investment expenditures based on a fixed average service life of 16 years. This required a retrapolation of the investment series for our firms before 1961 on the basis of the corresponding industry growth rates.[4] Gross investment I is measured as the total capital expenditures in plant and equipment deflated by the industry investment price indices. However, these investment numbers happened to be generally missing in the accounts of our German firms before 1974, and we had to compute them as the yearly change in the net book value of fixed assets plus the depreciation charges in the same year. Thereby we neglect corrections for acquisitions, disacquisitions or revaluations of assets. But though our investment variables are not strictly comparable for Germany, the problem in this case would seem to be less severe than as regards the capital stock measure. Output Q is defined as sales deflated by the available industry output price indices.[5] Profits P are taken as gross operating income adjusted for inventory changes, i.e., production less total cost of goods sold or value added less labor cost.[6]

In order to assess the possible influence of the inconsistency between our capital and investment measures for our three samples we also estimated the investment series for France and the U.S. in the same way as for Germany, and the capital stock figures for all three using the permanent inventory method with the standard assumption of a constant rate of replacement.[7] The results we obtain with these alternative measures are not on the whole too different from the ones we find with our main measures, and they lead essentially to the same conclusions. This is apparent in the estimates we present in the Appendix I.

The actual variables that we use are the rates of growth of labor, capital and output: DL, DC and DQ (computed as the first differences in Log L, Log C and Log Q, respectively), the ratio of gross investment to the capital I/C and the profit rate PR (computed as P/CV where CV is the value of the capital in current prices, i.e., the value in constant prices C multiplied by the appropriate investment prices indices). The two variables I/C and DC can also be termed the gross investment rate and the net investment rate, respectively, and their difference (I/C - DC) measures the proportion of capital that has been retired or scrapped, that is the ratio of replacement (and modernization) investment to capital, or the replacement rate R/C for short.[8] This variable is of course bound to suffer from all measurement errors affecting both our gross and net investment rates I/C and DC, and from the discrepancies between the two. We can expect however, that in the case of the French and the U.S. samples it conveys some useful and genuine information about the true replacement investment. Since so little is known about replacement ("The other half of gross investment" Feldstein and Foot, 1971), it seemed interesting to consider it explicitly in our investigations of these two samples. In the case of the German sample, by virtue of our construction of the capital stock measure, the replacement rate can only reflect (after some smoothing) the proportion of investment expenditures 16 years ago to the capital stock at present. However, we also consider this rate in that case so as to get a better feeling of how to judge the results for the other two samples.

2.2. On Resorting to the Accelerator Profits Model

As M. Feldstein (1982) put it in a somewhat provocative way "the investment process is far too complex for any single model to be convincing,... and the applied econometrician, like the theorist, soon discovers from experience that a useful model is not one that is "true" or "realistic" but one that is parsimonious, plausible and informative". We shall take up such a stand in this study - which is not so humble an attitude as Feldstein seems to suggest but already a quite ambitious claim.

At least four factors should a priori enter, and be tested as important determinants, in a behavioral model of the investment demand and (or) the labor demand by firms: expected output demand, expected profitability, the relative expected cost of labor and capital, and, to the extent that capital markets are imperfect, the actual current and past profits (or the financial liquidity of the firm). Except for the last one, these factors are generally unobservable. Moreover the way they should intervene in the model equations should specifically depend on the form of the production function (for example whether it is Cobb-Douglas or CES, or more importantly "putty-putty" or 'putty-clay"), the form of the costs of adjustment functions (or that of other relevant constraints), and the nature of the firms' objectives, expectations and market environment.

Being aware of such basic complexities and being bounded by the limitations of our data, as well as relying on the empirical findings of numerous econometric studies of factor demand, we had recourse to an accelerator profits type of model. As is customary, we have adopted a growth rate formulation, i.e., investment and labor change equations rather than capital stock and labor ones. This formulation can be advocated on various grounds. It provides equations which are conveniently linear both in the current and past changes of sales and in the current and past levels of profits. It can be viewed as a way to deal simply with the heteroscedasticity associated with the large differences in size of firms. It is also related to other more profound econometric issues of specification and estimation, as we shall show below.

The relations that we choose to estimate are thus of the following form:

$$\text{DL or DC or I/C or R/C} = c_0 + \sum_{j=0}^{\ell_1} a_j DQ_{-j} + \sum_{j=0}^{\ell_2} b_j PR_{-j}$$

In fact we used industry dummies (16 of them for each country) instead of a simple constant c_0.[9] Experiments with various lags have also shown that besides the current values three lags for sales growth rates ($\ell_1 = 3$) and one for profit rates ($\ell_2 = 1$) were sufficient and did not oblige us to shorten our study period too much. This is documented in the Appendix II, in which we provide the estimates of the total accelerator effects when using no lags, three and five lags and geometrically decreasing lags in the autoregressive form. For reasons to be given below we have at the same time estimated "long run versions" of our regressions with no lag and using average growth rates instead of the year to year ones:

$$\overline{DC} \text{ or } \overline{DC} \text{ or } \overline{I/C} \text{ or } \overline{R/C} = c_o + (\Sigma a)\overline{DQ} + (\Sigma b)\overline{PR}$$

The precise motivation and interpretation of the accelerator profits model need not be explained here at length. A detailed and very sensible account can be found in R. Eisner's 1978 book, which recapitulates his investigations pursued during many years on the individual firm data of McGraw-Hill capital expenditure surveys.[10] Although it properly concerns gross investment or net investment, to a large extent the same line of arguments applies to labor demand. We would expect, however, the profits effects to be smaller for labor than for investment, and the accelerator effects more rapid. The accelerator profits model can also be extended to the replacement investment demand, but in this case one would expect much smaller accelerator effects or even "decelerator effects".

Investment and labor hiring decisions are essentially forward-looking and depend on expectations. The more irreversible these decisions are (i.e., the more "fixed" capital and labor factors or the higher their costs of adjustment), the longer the time horizon of the relevant expectations. Thus only the sales increases which firms perceive as long term or permanent will lead to net investment and hiring, while short term or transitory changes will be generally met by changing the hours of work and the utilization of existing capital. In that respect perhaps the most drastic simplification of the accelerator model (and of most other factor demand models as well) is the substitution of current or past variables for anticipated future ones. It reflects the underlying investment and labor demand behaviors to the extent that firms view their current and past changes in sales as permanent. The proper meaning of the model is thus related to the validity and stability of the relationship between changes, or revisions, in expected output demand and observed current and past changes in sales, as much as it is to that of other behavioral assumptions and the form of the production function. The accelerator model is just a convenient short cut through an intricate system of relations and conditions. It should be gauged by its empirical significance and robustness and not by its appeal or status. When looking at our estimates for the different country samples and subperiods, we shall be at best comparing an overall average outcome of the processes by which firms have been forming their anticipations and on that basis have reached their investment and employment decisions.

Within such a general interpretation of the accelerator model, the appreciation of the respective roles of sales changes and profits warrants some discussion. It might seem intuitively appealing to take the sales change variables as a proxy for changes in expected demand, and the profit variables as a proxy for expected profitability as well as an indicator of the financial liquidity of the firm. The finding that only current and one-year lagged past profits come out to be statistically significant (as well as the fact that their estimated coefficients are larger in the regressions on the year to year growth rates than in the ones on the average growth rates) mainly supports the financial liquidity interpretation. On the other hand, it is plausible that profits would also convey information about the future demand addressed to the firm, and past sales changes information about its future profitability. To make the interpretation more clear-cut (though controversial), we can break this a priori symmetry by taking the view that all the relevant information about future demand (at least that which is more specific to the firm) pertains to the sales changes variables only, although all this information is not directly channelled and is partly transmitted through profits. Accordingly, following

Eisner's example, we will be justified in computing full or total accelerator effects as the sum of the direct effects of sales changes and of the indirect effects through profits. These total effects are the ones we would obtain if we had a pure accelerator model, and this is a simple way in practice to compute them (i.e., by omitting the profits variables and keeping only the sales changes variables in the estimated regressions).

2.3. On Year to Year and Average Growth Rates Estimates

Panel samples such as ours offer a number of possibilities for structuring and handling the data, which lead to various types of estimators. In the case of a standard linear regression model, if it is well specified, these various estimators should all be consistent. Conversely, their differences when significant imply some sort of specification errors, and this can provide formal specification tests (see for example Hausman and Taylor, 1981). More interestingly, if one is ready to be specific about the kind of misspecification occurring, these differences can be used to retrieve the characteristics and orders of magnitude involved in such misspecification. For instance, it is possible to assess the importance of correlated specific effects (possibly due to the omission of unobserved firm characteristics in the model) or that of random errors in variables, which are the two specification errors usually put forward. Comparing estimates for different structurings of data can contribute to a richer understanding and knowledge of the model and the data, as well as to a better awareness of their limits.

The most usual transformations applied to panel data (and the corresponding least-squares estimates) can be roughly put into two groups depending on whether or not they remove the individual specific effect u_i in an error components model (where the overall error term e_{it} is decomposed into two independent terms $u_i + w_{it}$, the subscripts i and t standing for firm and year, respectively). In general, when the original variables are in levels (or in logs of levels or in the form of more or less structural or stable ratios), the variability of the individual effect u_i is largely predominant, and the two groups of transformations can be viewed as providing cross-sectional and time series type estimates, respectively. The total estimates performed on the untransformed variables y_{it} and the between-firm estimates performed on the firm means $y_{i.}$ belong typically to the first category. The within-firm estimates relying on the deviations to the firm means $(y_{it}-y_{i.})$, the first difference or long-difference estimates using the year to year differences $(y_{it}-y_{it-1})$ or their average over a given period $(y_{it1}-y_{ito})/(t_1-t_o)$, are the usual candidates in the second category. When starting with a model in logarithms, which is our case, first and long differences correspond to yearly and average growth rates, respectively.

The general view is to believe that the individual effect u_i is more likely to be seriously correlated with the explanatory variables than the disturbance w_{it}, and therefore that time-series type estimates would be the better, less biased ones. Although this view may be controversial (see Mairesse, 1978 and Griliches and Mairesse, 1984), we shall go along with it here.[11] However, one of the important drawbacks of the time series estimates is that they tend to be quite sensitive to random errors of measurement in the variables. This is specially true of the first-difference estimates, but less so for the long-difference estimates, inasmuch as they will average out over a long period such errors. Long-difference estimates (and to a lesser degree within estimates) have thus the specific advantage of reducing the errors in variables biases (see Griliches and Hausman, 1984). Unfortunately, on the other hand, taking long differences does not permit in practice to estimate the lag structure of the explanatory variables in a dynamic model such as the accelerator-profits model. Unlike first differences (which are often quite moderately correlated) the long differences of lagged variables are bound to be strongly collinear. Hence, the estimates of the individual lagged coefficients are bound to be very imprecise and unstable,; furthermore, even relatively minor errors of measurement in the variables would result in aggravating this problem. In fact, we can only expect to estimate well the sum of the coefficients. Since the current values act as excellent proxies of the lagged values, there is not much sense in specifying lags in a model to be estimated on long differences. In the version without lags the estimated coefficient will be the long-run coefficient, corresponding to the sum of the lagged-variables coefficients in the model with lags. Similar considerations largely apply to the within estimates, which are not better than the long differences estimates in that respect; moreover, in short panels they will also suffer from serial-correlation biases.

In our context, the first and long difference estimates (i.e., the estimates on yearly and average growth rates) can be given a more specific interpretation, and this is a further reason to consider both types. By comparing them, we can illustrate the distinction between permanent and transitory sales changes or profits, and the fact that firms in their labor and investment decisions will typically respond much more strongly to permanent sales changes than to transitory changes, and that conversely they will react more markedly to transitory than to permanent profits. If we are willing to accept some extreme simplifications, we can give a more definite meaning to these notions and infer what are the orders of magnitudes involved. Trying to make less stringent assumptions would lead us in fact to adopt a vector autoregressive framework in the line of Mairesse and Siu ("An extended accelerator model of R&D and physical investment", 1984). We present a more precise distinction between transitory and permanent effects in Appendix III.

III. PRESENTATION AND ANALYSIS OF THE RESULTS

3.1. Looking at the Average Record

Table 1 lists the means (in %) and standard deviations of our main variables: the labor, capital and sales rates of growth (DL, DC, DQ) and the gross investment, replacement and profit rates (I/C, R/C, PR). These are given for the three samples, the overall period 1970-79, and the three subperiods: 1970-73, 1974-75 and 1976-79. We also give corresponding "macro" figures for the growth rates of total employment and output (i.e., the aggregate estimates for manufacturing in the three countries). For the convenience of comparison, we have added the growth rates of labor productivity (DQ - DL) implicit in these numbers for our samples and manufacturing as a whole.

When looking at such averages computed from "micro" data, and in particular if one brings them together with similar "macro" figures, one should be quite aware of the many discrepancies that could arise from the selection of the samples and the measurement of the variables. Among other things, computing unweighted rather than weighted averages, or using even close variants to adjust variables - for example deflating them with different prices indices which may be available for more or less disaggregated industrial breakdowns - can really matter. It is our experience, however, that even in these cases when the discrepancies on averages could be large, the second order characteristics (standard deviations and correlations), especially if they concern relative magnitudes (or logs), will not be significantly affected in general. Thus the results of regression analyses, and the estimated elasticities of interest - such as the ones we will be considering next - are usually quite robust.[12]

Another difficulty - but a usual one this time - when comparing averages of growth rates is that they may be very sensitive to the exact periods on which they are computed (and particularly if it is not possible to choose beginning year and end year occupying similar positions in the business cycle). Despite these warnings of caution about averages, the general picture they provide in Table 1 seems quite consistent, and would deserve a number of comments. We shall limit them to a few observations, leaving to the interested reader to look into more details.

For our three samples as well as for manufacturing as a whole in the three countries, the two years 1974-1975 mark a severe break. Employment and output dropped in absolute terms by as much as 10% for employment in Germany, and 10% for output in the U.S. It is noteworthy that by dismissing workers to such an extent Germany was able to maintain gains in labor productivity even in these two years, unlike France and the U.S.

Although the 1974-75 crisis seems to have hit the three economies with similar force, their relative situations before and after have changed a great deal. Between 1970-73 and 1976-79, in both the French and German samples, output growth has been slowing down strongly, net and gross investment have dropped drastically and employment has started diminishing. The firms in the U.S. sample on the contrary appear to have recovered completely: their production and labor force have been growing even more rapidly. These trends are confirmed by the aggregate numbers on output and employment for manufacturing as a whole. However, it should be pointed out that the deceleration observed for France and Germany is much more marked in our samples than in the aggregate, while conversely for the U.S. the acceleration is more pronounced in the aggregate than in the sample. Such a discrepancy which is strikingly similar for our three samples might be explained by a comparable selection bias: by selecting firms which are in existence over a long period, we necessarily exclude the new-comers which are plausibly more rapidly growing firms; we also exclude firms growing through major mergers.

It is also interesting to underline the comparable increase in the replacement investment ratio between the two periods for our three samples. As it is clear from the computation of this ratio in the German case, this increase reflects the slowdown in the stock of capital; in the cases of France and the U.S. it may also illustrate to a certain extent what is often said about the shortening of capital service lives and the acceleration of obsolescence. Last, the differences in the average levels of the rate of profits computed for our three samples should be taken as very dubious, and particularly the much lower rate in Germany. Such shortcoming does not preclude of course that these measures should be good proxies for the true differences (between firms) and changes (within firms) in the rates of profits for each sample separately.

3.2. Comparing the Accelerator and Profit Effects Between Countries and Periods

Comparing our estimates (sales changes and profits coefficients) for the four equations of interest (labor and capital growth rates, gross investment and replacement rates), the two types of estimates (on yearly and average rates), the three country samples, and the two periods 1970-73 and 1976-79 (we shall leave aside 1975-76), involves indeed a lot of numbers. We shall try to go through them in just about that order, looking at the differences first between the two types of estimates, then between countries, last between periods. The estimates of the two types are respectively given in Table 2 and 3 for the four equations by three countries. Since, by and large, as we shall see, these estimates do not change much from the first to the second period, they are only given in full detail for the overall period 1970-79. The sums of sales changes coefficients (or direct accelerator effects) and of the profits coefficients (or profits effects) have been also computed in Table 2; they are directly comparable to the (unique) sales changes and profits coefficients in Table 3. In addition, the total accelerator effects (obtained from running the same regressions without the profits variables) are presented in the last lines of Table 2 and 3. Both types of estimates of the direct and total accelerator effects and profits effects are recorded in Table 4 for the two periods 1970-73 and 1976-79 separately. Last, Table 5 highlights the contributions of our models in explaining what are on average our labor and investment variables during the two periods, and in explaining their average changes between these two periods.

Permanent Versus Transitory Effects

Our first general observation on Tables 2 and 3 is that the pattern of differences between our two types of estimates of the accelerator and profits effects is always the same for the different equations across countries. With only very few exceptions, the estimates of the accelerator effects on average rates (i.e., long differences in logs over 10 years) are larger by about 20 to 50% than the estimates on yearly rates (i.e., first differences in logs). The reverse situation is true for the profits effects: the average rates estimates are smaller in about the same proportions than the yearly rates estimates. The same pattern of differences is also visible, but much less consistently so, in Table 4, when we consider the corresponding estimates for the two periods (long differences in logs over 4 years only and first differences in logs).

Such a pervasive finding extends the similar results obtained by Eisner (1978) and Oudiz (1978) for the gross investment equation on their respective samples of U.S. and French firms. It illustrates clearly the importance of the distinction between permanent and transitory effects. Firms tend to view their actual sales changes as partly transitory and are cautious not to alter their labor and investment demands in response to these transitory fluctuations. They take their labor hiring and investment decisions on the basis of expectations of their future output demand, and they form these expectations on the basis of their past sales changes to the extent that they consider these changes permanent. Granted the assumptions and simplifications indicated in the Appendix III, it is possible to give more substance to such interpretation and to retrieve tentative orders of magnitude by comparing the two types of estimates. The weight of the transitory component (relative to that of the permanent component) in the total variance of sales changes practically vanishes when going form yearly rates to 10 years average rates (from roughly about 25% in the three countries down to less than 5%). The finding of smaller estimates of the accelerator effects on yearly rates than on average rates thus reflects to what extent the elasticity of firms own demand expectations is smaller in response to transitory sales changes than in response to permanent ones. The "transitory elasticity" could range from 0 to 0.20 and the "permanent elasticity" from 0.60 to 0.80 on the basis of the orders of magnitudes found for the labor and investment equations in the three countries (i.e., total accelerator effects in the range of 0.5 to 0.6 and of 0.6 to 0.8 when estimated on yearly rates and 10 years average rates, respectively).

Beyond the numbers themselves, these results point to the fact that the accelerator effects should not be simply conceived as technological parameters (to be equal to 1 in the long run assuming constant returns to scale and neutral technological progress in production for cost minimizing firms). It makes a more plausible story to consider them as also dependent on the elasticities of firms sales expectations (or even to strictly identify them with such elasticities).

Turning to the profits effects, the interpretation runs in the same way but with reverse implications. The transitory profits effects are higher than the permanent ones. Firms tend to hire more labor and to invest more in the years when they make higher profits or in the years that immediately follow them, even if they perceived these profits as short run. They do not, however, sustain such decisions to a comparable extent, whenever the higher profits persist. In other words there is a timing influence of profits. Firms which may encounter difficulties in borrowing on financial markets will accelerate or delay their investments as well as their labor hiring decisions depending on good or bad profits. Looking at the tentative orders of magnitude under the assumptions of Appendix III, the weight of the transitory component in the total variance of profits could be as high as 50 percent in terms of the yearly rates, and be reduced to about 10 percent in terms of the 10 years average rates. On this basis the transitory and permanent profits effects would be respectively of about 0.15 and 0.05 for labor demand and 0.20 and 0.10 for net investment demand (taking 0.10 and 0.05 as the estimates of the profits effects on yearly rates and 10 years average rates respectively in the labour equation and 0.15 and 0.10 as the corresponding estimates in the net investment equation).

Differences Between Countries

Our second general observation on Tables 2 and 3 is that the differences between countries for the four estimated equations are for most of them relatively small; although they may be statistically quite significant, they usually correspond to orders of magnitude which are roughly the same. The prevailing impression is one of overall similarity, showing that in fact the labor and investment demand behaviors of the large manufacturing firms making up our samples are largely comparable in France, Germany and the U.S.

Concentrating on the total accelerator effects, and considering chiefly the average rates estimates (i.e., practically the permanent effects) to make comparison easier, these effects are of about 0.6 to 0.7 for both labor and net investment demands in France and Germany. The smaller coefficient in the net investment equation for Germany is in fact not statistically different from the French one; to some extent it may also reflect the difference in the measurement of the capital stock variable for Germany (as we can gather from the estimates using more comparable measures in Annex I). The accelerator effects appear also to be almost equal for the two equations in the U.S., but of somewhat higher order of magnitude (0.8).

Looking at the gross investment equation instead of the net investment one, the total accelerator effects are well reduced, being about 0.4 to 0.5 in the three countries. These reductions correspond to the "decelerator effects" apparent in the replacement investment equation. Such effects are particularly important for the U.S. sample, less so but still manifest for the French sample, and not really significant for the German one.

As we explained, in the case of Germany, the replacement rate is by construction the proportion of 16 years ago past investment to current capital stock. Thus we expected to find zero effects for the German replacement equation. If we consider them altogether, the estimates we get are indeed quite poor. The sales changes coefficients are clearly insignificant. The profits coefficients, though, come out significantly negative for our two types of estimates. Such result may seem strange and could be spurious. They may also simply reflect the fact that firms with a relatively low R/C ratio (the way it is calculated in the German sample) are rapidly growing firms with relatively high profits. In the case of France and the U.S., the evidence for decelerator effects appears strongly by way of contrast with Germany. The total decelerator effects would be of about -0.30 in the U.S. and of about -0.15 in France. If we look, however, at the estimates by subperiods in Table 4, there is clearly a change occurring for France: the decelerator effect, which was smallish before 1974-75, becomes quite important after and comparable to what it is for the U.S. Despite the severe measurement problems which probably affect also our replacement investment ratios for French and U.S. firms, it would seem that we can attach credence to the finding of sizeable decelerator effects in these two cases. Other things equal, firms tend to increase their replacement and modernization investments when their sales slow down and their expected capacity needs get weaker; conversely they tend to diminish them when they anticipate that their capacity needs will intensify. In France such behavior seems to have really come into action only since the 1974-75 crisis. This might confirm - in a perhaps less ambiguous way than the increase of the average replacement rate - the widespread beliefs about the acceleration of obsolescence.

Turning to the profits effects, they appear more variable between the different equations and also across countries than the accelerator effects. If we put aside the replacement equations in which the influence of profits seems rather dubious (for Germany as we have said, but also for France and the U.S. where this influence is at best small and tends to go in opposite directions), the profits effects are clearly smaller in the three countries for labor than they are for net and gross investments. This may be considered as another indication of the predominance of the financial role of the profits variable in our equations. One noticeable difference between the three countries is that one year lagged profits have the largest impact in France and Germany relatively to current profits, while the opposite is true for the U.S. Apparently American firms react almost immediately to the good or bad news about their profits, and French and German firms are slower in their responses.

Some last remarks are worth mentioning about the time profile of the accelerator effects and the relative importance of the direct and total accelerator effects. If we compute the proportion of the accelerator effects taking place in the first year, it is of about 60 percent for labor in both France and Germany, and as much as 80 percent in the U.S. It is much less but still high, about a third, for gross and net investment in the three countries. The proportion of the direct accelerator effects (working through sales changes only) to the total effects (transmitted also via profits) is overwhelming and pretty much the same in the three countries: on the order of 90 percent for labor, and 60 to 80 percent for net and gross investment.

Changes After 1974-75

Examining thoroughly in Table 4 the various estimates of the accelerator and profits effects obtained for our two periods 1970-73 and 1976-79, the general conclusion is one of no drastic changes and of a relative overall stability. Although economic environment altered vastly and mostly for the worse, firms have sustained basically the same labor demand and investment demand behaviors, as characterized in our equations and variables.

However, a general tendency towards both smaller accelerator effects and smaller profits effects is clear, these coefficients being reduced on average by as much as one fourth in the second period relative to the first one. An exception, that we have already stressed, is the appearance of a sizeable decelerator effect for replacement investment in France after 1974-75, which is comparable to the one found for the U.S. Of course, such a reduction in our estimates does not necessarily mean that the "true" accelerator and profits effects, in as much as they have a structural interpretation, are really undermined; it could indicate that a factor of importance omitted in our equations (and correlated with sales changes and profits) has come specifically into play. One might see there the influence of the overall economic climate and of the future prospects of the various industries, which contribute to weaken or reinforce firms expectations in their own sales and profits.

A better insight into the characteristics of our models and their comparative performance in the two periods is provided by the detailed information recorded in Table 5. We have computed in this table the results of applying directly our estimated equations to the average situations in the two periods (two first columns for each country), as well as to the changes between the two of them (third column obtained by difference). Besides the R^2 and the standard errors on the estimated coefficients, this is another way of assessing the explanatory value of a model and the respective contributions of its variables. For these computations, we used the estimates derived from the 10 years average rates (given in Table 3) and the means of the variables for the two periods 1970-73 and 1976-79 (given in Table 1). We thus obtain the direct and indirect accelerator effects (DA and IA lines respectively in the Table 5), and the own profits effects(OP). In order to fully account for our variables of interest, (i.e., average labor and capital growth rates $\overline{DL}$ and $\overline{DC}$, average gross investment and replacement rates $\overline{I/C}$ and $\overline{R/C}$) we are left with residual constants, summing up the independent contributions of all other ignored factors. In an attempt to go one step further, we distinguish in these residuals the part which would correspond to shifting coefficients in our equations, ie.., the variation in the value of the residuals, using the different estimates found for the two periods separately instead of the ones obtained for the overall period. This part we note DCst in Table 5, and the remaining one Cst.

After these necessary explanations on the contents of Table 5, our comments can be straightforward. We shall leave aside the replacement equation, in which the decelerator and profits effects tend to be at best small and offset each other (and thus the "constant" remains most of the story). For the labor, net and gross investment equations, the results are fortunately much more satisfactory. The direct accelerator effects (DA) very often play the largest role, for example in explaining the severe fall in average labor growth or in net and gross investment rates after 1974-75 in France and Germany. The profits effects are in general quite sizeable, even considering only the own effects (OP) and taking apart as we do the indirect accelerator effects (IA), which usually constitute a fair share of the total. As could be expected, the shifting coefficients effects also contribute appreciably to explaining the changes which occurred between the two periods. Finally, in many instances, the constants or residual factors effects (Cst) do not appear as predominant; if they tend to account largely for the average situations in the two periods, they have often enough a more modest role with respect to the changes. It seems fair to conclude that on the whole, for our three samples, the performances of the accelerator profits model in accounting for the changes in labor and investment demands after 1974-75 are not only significant from the statistical point of view but also important in terms of magnitudes (ie., both in terms of variances and of averages).

3.3. Trying to Go Beyond the Accelerator Profits Model

One of the theoretically most important determinants of firm factor demand that we neglect in the accelerator profits model is the relative expected cost of labor and capital. If the firm anticipates that the wage rate will increase more rapidly relatively to the user cost of capital, it will be induced to substitute more capital for labor. Assuming the simplest (standard) assumptions with a Cobb-Douglas production function (and constant returns), the elasticities of the relative cost of labor and capital should be in theory equal to minus the share of capital (in value added, say about -0.3) in the labor demand equation, and to the share of labor (say 0.7) in the capital demand equation. If the production function has an elasticity of substitution between capital and labor σ (and is for example of the Constant Elasticity of Substitution form), the shares should be multiplied by σ and the coefficients reduced in that proportion (say -0.3σ and 0.7σ with σ plausibly less than 1). If the production function is of the type "putty-clay" (the ex-ante production function for each capital vintage being for example Cobb-Douglas), the coefficients should also be reduced and in quite a large proportion (say by a factor of 10). Thus the theoretically expected orders of magnitude of the labor and capital costs elasticities could be extremely different a priori, and their estimation is an empirical issue of great import.

Despite the considerable amount of econometric research that has been done on precisely this issue, there are still doubts and debates among economists about the real importance of factor price elasticities. Although we could construct only very poor proxies of the relevant price variables, we thought worthwhile to explore the matter at the firm level on our data. Unfortunately, the results we get are either insignificant or dubious if significant. As usual, and probably not unfairly in the present instance, the suspicion falls on the data.

Besides the basic problem of observing only the actual values of the variables and not their expected values, our measures of the cost of labor and capital suffer from other shortcomings. Our labor cost variable W is the average labor compensation (total wages and associated social charges) per employee. The wide dispersion in W across firms thus largely corresponds to differences in labor qualifications, in the number of hours worked and of overtime, and only partly reflects the true differences in wages in the labor market. Also, by construction, W will be affected by measurement errors in the number of employees L, and this is a possible cause of a negative spurious correlation between the two. It is also the case that W cannot be computed for the U.S. sample, since most U.S. firms declare their labor cost and material purchases lumped together (in the item "cost of goods sold").

Our proxy for the cost of capital IR reflects only the interest rate component of a proper measure of the user cost of capital; it is computed as total interest expenses divided by total debt. It is thus the apparent average rate of interest paid by the firm, and in an analogous way with W it is only loosely related to the present rates of interest prevailing (at the margin for a given firm) on the financial markets.

Because of our growth rate formulation, the additional variables we enter in our equations are the growth rates DW and DR (or log differences of W and

IR). It will be sufficient to report the estimates obtained from the 10 years average rates (the other estimates on yearly rates or on subperiods being neither better nor worse). Table 6 thus gives the estimated labor and capital cost elasticities (and their estimated standard errors) for our four equations and three samples (in a format similar to that of Table 3). We do not reproduce the estimated accelerator and profits effects, since the introduction of the cost variable does not change them much from what they are in Table 3 (i.e., DW and DIR are nearly orthogonal to DQ and PR in our samples). We have been careful to introduce DW and DIR separately in our equations without imposing a priori that their coefficients should be equal. One reason is that only DIR is available in the U.S. sample. But more importantly, as it has been pointed out by Clark and Freeman (1980) and further developed by Dormont (1983), in this way we avoid contaminating one variable with errors of measurement affecting the other one. The cost of capital variable is in fact extremely dispersed and suffers quite probably from very large random errors. Hence we can expect that its estimated elasticity is strongly biased towards 0, while the estimated labor cost elasticity might be more satisfactory.

The results in Table 6 are basically disappointing, and do not call for long comments. Almost all cross price elasticities (i.e., the DW coefficient in the investment equations and the DIR coefficient in the labor equation) are statistically insignificant at the 5% level of confidence. The DW coefficient in the DC equation for Germany is an exception, but has the opposite sign (negative) to what would be expected. It has the right sign (positive) in the R/C equation, but that is dubious because of the way replacement investment is computed in the German sample. The (direct) capital cost elasticities in the investment equations are also insignificant but for the French sample. In this case, the sign is correct (negative) but the magnitude seems small, although random errors in DIR could account for it.

The (direct) labor cost elasticities in the labor equation seem too good to be true. Their magnitude is much larger than expected (-0.8 as against -0.3 if the elasticity of substitution of capital and labor σ is about 1). It seems also inconsistent with the view of labor-capital substitution that the labor cost variable would show up so strongly in the labor demand, and not conversely in the investment demand. One plausible explanation is the existence of measurement errors in our measure DL, which by construction would be (negatively) transmitted to our measure DW. Since the variance of DW is much smaller than that of DL (by a factor of the order of 4), even relatively small errors in DL would lead to relatively large ones in DW. Thus if random errors were responsible for about 20% of the observed variance of DL, they could also be responsible for as much as 80% of the observed variance of DW. Such situation could account for our estimated elasticities of -0.8, even though the "true" coefficients would be zero.[13]

In closing, we should say again, if only by way of taking some comfort, that such inconclusive results in estimating price elasticities in factor demand studies are rather common. It may be also that we have been too pessimistic in considering them. If true, this will be only a small compensation for the (over) optimistic statements which sometimes dress up poor evidence.

IV - FINAL REMARKS

Our present work is just a step in a line or a style of research, which we think to be fruitful and deserving further effort: the analysis of macroeconomic issues using microdata in a comparative setting. The difficulties, however, of this style of research, which combines the problems of individual data studies to those of international comparisons are equal to the promises. Facing such difficulties, one should be specially cautious. This is why we are reluctant to put much emphasis on differences of results between countries, even when they correspond to what could be expected, while we put a priori more faith in finding comparable patterns of results and behavioral similarities. Differences of results may be due, in part or even completely, to errors or discrepancies in the data and to inadequate specifications of the models. On the contrary, it seems implausible to obtain similar results if they were not truly so.

Although comparative macroeconomists are usually more interested in looking at differences between countries, it is fortunate, from what we just say, that we find mainly similarities in our study. Despite the diversity of situations and evolutions of French, German and US manufacturing over the period 1970-79, the labor and investment demand behaviors of large firms in the three countries are in fact largely comparable. This is the main message of the analysis; however, this message should not be overstated. There is still room for interesting differences; even if limited and hard to ascertain, these may be quite important from an economic policy point of view. In particular, as we would expect, the US firms seem to behave in a somewhat more flexible way then their French and German counterparts, the accelerator effects tending to be higher for labor and investment and more rapid for labor in the U.S. than in the other two countries.

Among the many directions in which further work should be done, three must be mentioned here.

The problems of interpreting and specifying the accelerator and profits effects and the permanent-transitory distinction should be investigated further. It would be certainly interesting to pursue the vector autoregressive approach already used in MAIRESSE and SIU (1984). There are also many difficulties, however, with this approach, and unless we put complete faith in a given specification, we are still in a dilemma of choosing a formulation of variables in terms of growth rates or levels.[14] To make more decisive progress would probably need to have some direct notions of the firm expectations about demand and profitability in both the short and long run.

More effort should be devoted to investigating the role of factor prices and to deciding whether our finding of inconclusive evidence is due to the use of poor measures, or because the effects of prices are relatively small and there is little to discover. However, obtaining appropriate measures of labor and capital user costs at the firm level is very problematic. One might think that there is very limited dispersion of true factor prices among firms, at least within industries in a given country. Thus one would use the average macro-prices which can be better specified and estimated. We are not very hopeful though, because this means relying mainly on aggregate time series information, and we know from all the econometric research done at the macro-level that we should foresee mixed results at best.

Specific efforts should be also devoted to the important issue of replacement investment. There is very little work done on this issue, contrary to that of factor prices, one main reason being the lack of information. Since balance sheet data are one of the very few possible sources of relevant information on the subject, detailed analyses should be applied to them.[15] It would be important, for example, to try to make corrections for acquisitions, disacquisitions, and the revaluation of assets, and to be able to separate equipment and structures for long enough periods of study. This seems indeed a painstaking route, but there is no good short cut around it.

TABLE 1 : MEANS AND STANDARD DEVIATIONS ( ) OF THE MAIN VARIABLES IN THE FRENCH (N = 307), GERMAN (N = 145) AND US (N = 422) SAMPLES, FOR THE WHOLE PERIOD 1970-79 AND THE THREE SUBPERIODS 1970-73, 1974-75, 1976-79. CORRESPONDING AGGREGATE ESTIMATES FOR MANUFACTURING AS A WHOLE AS CONCERNS LABOR AND OUTPUT GROWTH RATES.

VARIABLES in %	FRANCE				GERMANY				U.S.A.			
	70-79	70-73	74-75	76-79	70-79	70-73	74-75	76-79	70-79	70-73	74-75	76-79
Labor rate of growth DL	0.6 (8.8)	3.1 (9.7)	- 0.5 (8.9)	- 1.3 (6.9)	- 1.4 (9.7)	0.4 (10.0)	- 5.2 (8.1)	- 1.4 (9.6)	1.5 (11.6)	2.4 (12.1)	- 3.4 (12.2)	3.0 (10.1)
Capital rate of growth or net investment rate DC	4.6 (10.3)	8.0 (10.1)	5.1 (9.9)	1.0 (9.5)	2.0 (6.1)	4.5 (6.2)	1.1 (4.6)	- 0.2 (5.6)	4.5 (9.5)	5.7 (9.5)	3.7 (9.0)	3.7 (9.5)
Gross investment rate I/C	8.9 (8.2)	11.7 (9.4)	8.2 (7.1)	6.5 (6.4)	7.1 (5.4)	9.1 (6.1)	5.8 (3.6)	5.8 (4.7)	8.4 (5.8)	8.8 (6.2)	8.1 (5.5)	8.3 (5.6)
Replacement rate R/C	4.3 (7.3)	3.6 (5.6)	3.1 (7.2)	5.5 (8.6)	5.2 (2.7)	4.6 (1.7)	4.7 (2.3)	6.0 (3.4)	3.9 (7.0)	3.0 (6.7)	4.4 (6.5)	4.6 (7.5)
Sales rate of growth DQ	4.7 (14.0)	8.6 (12.5)	- 1.4 (16.6)	3.8 (12.6)	1.8 (12.3)	4.4 (11.9)	- 2.9 (13.5)	1.6 (11.4)	3.6 (12.9)	5.4 (12.5)	- 4.9 (14.0)	5.9 (10.6)
Profit rate PR	19.7 (16.3)	22.3 (16.8)	19.7 (16.0)	17.1 (15.6)	11.0 (8.4)	13.5 (9.0)	10.1 (7.5)	9.0 (7.5)	25.5 (19.7)	26.8 (21.4)	23.4 (19.8)	25.2 (17.7)
Labor productivity rate of growth (DQ-DL)	4.1	5.5	- 0.9	5.1	3.2	4.0	2.3	3.0	2.1	3.0	- 1.5	2.9
Corresponding aggregate DQ	4.0	6.3	- 0.9	4.0	2.7	4.5	- 4.2	4.4	2.3	3.2	- 6.4	5.8
Corresponding aggregate DL	0.1	1.9	- 0.7	- 1.2	- 1.1	0.4	- 4.7	- 0.8	0.1	- 0.7	- 4.5	3.2
Corresponding aggregate (DQ-DL)	3.9	4.4	- 0.2	5.2	3.8	4.1	0.5	3.6	2.2	3.9	- 1.9	2.6

TABLE 2 : ESTIMATES OF THE LABOR, NET INVESTMENT, GROSS INVESTMENT AND REPLACEMENT EQUATIONS FOR THE FRENCH, GERMAN AND US. SAMPLES - ESTIMATES ON YEARLY RATES FOR THE WHOLE PERIOD 1970-79

Parameter Estimates (Standard Errors)	DL equation			DC equation			I/C equation			R/C equation		
	FR	GE	US	FR	GE	US	FR	GE	US	FR	GE	US
DQ ( )	0.291 (0.011)	0.305 (0.021)	0.424 (0.013)	0.184 (0.014)	0.115 (0.012)	0.166 (0.011)	0.101 (0.011)	0.116 (0.011)	0.051 (0.007)	- 0.083 (0.010)	0.001 (0.006)	- 0.115 (0.010)
DQ_{-1} ( )	0.091 (0.010)	0.125 (0.020)	0.044 (0.012)	0.111 (0.012)	0.094 (0.011)	0.090 (0.011)	0.069 (0.010)	0.095 (0.011)	0.060 (0.007)	- 0.042 (0.010)	0.001 (0.006)	- 0.030 (0.009)
DQ_{-2} ( )	0.038 (0.010)	0.005 (0.019)	0.020 (0.011)	0.096 (0.012)	0.086 (0.011)	0.076 (0.010)	0.069 (0.009)	0.078 (0.010)	0.043 (0.006)	- 0.027 (0.009)	- 0.008 (0.006)	- 0.034 (0.008)
DQ_{-3} ( )	0.055 (0.010)	0.008 (0.018)	0.015 (0.011)	0.074 (0.012)	0.060 (0.010)	0.079 (0.010)	0.045 (0.009)	0.048 (0.010)	0.042 (0.006)	- 0.029 (0.009)	- 0.013 (0.005)	- 0.037 (0.008)
PR ( )	- 0.034 (0.017)	- 0.017 (0.046)	0.210 (0.011)	- 0.027 (0.020)	- 0.004 (0.026)	0.134 (0.010)	0.058 (0.016)	- 0.009 (0.025)	0.108 (0.006)	0.085 (0.016)	- 0.005 (0.013)	- 0.026 (0.008)
PR_{-1} ( )	0.106 (0.016)	0.115 (0.044)	- 0.113 (0.010)	0.172 (0.020)	0.187 (0.025)	0.043 (0.009)	0.117 (0.016)	0.118 (0.024)	0.027 (0.006)	- 0.055 (0.015)	- 0.069 (0.013)	- 0.016 (0.008)
R^2	0.285	0.200	0.419	0.208	0.333	0.286	0.248	0.256	0.318	0.063	0.149	0.090
RSE	7.42	8.66	8.87	9.20	4.96	8.02	7.12	4.67	4.82	7.09	2.50	6.72
Σ DQ	0.475	0.443	0.503	0.465	0.355	0.411	0.284	0.337	0.196	- 0.181	- 0.019	- 0.216
Σ PR	0.072	0.098	0.097	0.145	0.183	0.177	0.175	0.109	0.135	0.030	- 0.074	- 0.042
Total Accelerator Effect	0.525	0.498	0.626	0.572	0.461	0.630	0.425	0.399	0.361	- 0.147	- 0.061	- 0.268

TABLE 3 : ESTIMATES OF THE LABOR, NET INVESTMENT, GROSS INVESTMENT, REPLACEMENT EQUATIONS FOR THE FRENCH, GERMAN and US SAMPLES - ESTIMATES ON AVERAGE RATES OVER THE WHOLE PERIOD 1970-1979.

Parameter Estimates (Standard Errors)	DL equation			DC equation			I/C equation			R/C equation		
	FR	GE	US	FR	GE	US	FR	GE	US	FR	GE	US
$\overline{DQ}$ ( )	0.582 (0.033)	0.680 (0.066)	0.762 (0.027)	0.548 (0.051)	0.331 (0.091)	0.672 (0.035)	0.349 (0.049)	0.326 (0.056)	0.349 (0.035)	- 0.199 (0.048)	- 0.005 (0.054)	- 0.323 (0.038)
$\overline{PR}$ ( )	0.052 (0.011)	0.024 (0.039)	0.042 (0.008)	0.088 (0.017)	0.202 (0.054)	0.087 (0.011)	0.136 (0.017)	0.069 (0.034)	0.088 (0.011)	0.048 (0.016)	- 0.133 (0.033)	0.001 (0.012)
R^2 RSE	0.858 1.99	0.824 2.18	0.876 1.98	0.768 3.09	0.785 3.00	0.787 2.52	0.820 2.98	0.771 1.85	0.717 2.52	0.674 2.94	0.692 1.79	0.454 2.73
Total Accelerator Effect	0.642 (0.032)	0.698 (0.059)	0.824 (0.025)	0.650 (0.049)	0.484 (0.085)	0.800 (0.033)	0.518 (0.050)	0.378 (0.051)	0.479 (0.033)	- 0.145 (0.045)	- 0.106 (0.051)	- 0.322 (0.033)

TABLE 4 : ESTIMATES OF THE (DIRECT AND TOTAL) ACCELERATOR EFFECTS AND PROFITS EFFECTS FOR THE LABOR, NET INVESTMENT, GROSS INVESTMENT AND REPLACEMENT EQUATIONS ON THE FRENCH, GERMAN AND U S SAMPLES. ESTIMATES ON YEARLY AND AVERAGE RATES FOR THE TWO SUBPERIODS : 1970-73 AND 1976-79.

Type of Estimates	Subperiods	DL EQUATION FR	DL EQUATION GE	DL EQUATION US	DC EQUATION FR	DC EQUATION GE	DC EQUATION US	I/C EQUATION FR	I/C EQUATION GE	I/C EQUATION US	R/C EQUATION FR	R/C EQUATION GE	R/C EQUATION US
Yearly Rates	70-73												
	Σ DQ	0.51	0.51	0.57	0.40	0.36	0.41	0.32	0.38	0.21	- 0.08	0.02	- 0.20
	Σ PR	0.08	0.08	0.08	0.18	0.21	0.18	0.20	0.15	0.13	0.02	- 0.06	- 0.04
	Tot.Acc.	0.57	0.56	0.67	0.56	0.48	0.64	0.50	0.47	0.38	- 0.05	- 0.01	- 0.26
	76-79												
	Σ DQ	0.41	0.32	0.54	0.33	0.33	0.46	0.07	0.31	0.22	- 0.25	- 0.02	- 0.24
	Σ PR	0.10	0.12	0.11	0.11	0.07	0.16	0.15	-0.01	0.13	0.04	- 0.08	- 0.03
	Tot.Acc.	0.47	0.37	0.67	0.40	0.36	0.66	0.20	0.30	0.38	- 0.20	- 0.06	- 0.28
Average Rates	70-73												
	DQ	0.61	0.71	0.79	0.38	0.19	0.55	0.32	0.24	0.29	- 0.06	0.05	- 0.26
	PR	0.05	-0.03	0.04	0.13	0.25	0.10	0.16	0.17	0.09	0.03	- 0.08	- 0.01
	Tot.Acc.	0.66	0.69	0.84	0.50	0.31	0.69	0.46	0.32	0.42	- 0.04	- 0.01	- 0.27
	76-79												
	DQ	0.37	0.50	0.70	0.25	0.24	0.44	0.10	0.18	0.22	- 0.15	- 0.06	- 0.21
	PR	0.09	0.09	0.07	0.09	0.10	0.10	0.12	-0.00	0.10	0.03	- 0.10	0.00
	Tot.Acc.	0.42	0.53	0.78	0.31	0.27	0.56	0.18	0.18	0.34	- 0.13	- 0.09	- 0.22

TABLE 5 : CONTRIBUTIONS OF THE LABOR, NET INVESTMENT, GROSS INVESTMENT AND REPLACEMENT EQUATIONS IN EXPLAINING THESE VARIABLES FOR THE FRENCH, GERMAN AND US SAMPLES, DURING THE TWO SUBPERIODS 1970-73 AND 1976-79, AND IN EXPLAINING THEIR CHANGES BETWEEN THESE TWO SUBPERIODS.

		FRANCE			GERMANY			U.S.A.		
		70-73	76-79	Δ	70-73	76-79	Δ	70-73	76-79	Δ
DL	DA	5.0	2.2	- 2.8	3.0	1.1	- 1.9	4.1	4.5	0.4
	IA	0.5	0.2	- 0.3	0.1	0.0	- 0.1	0.3	0.4	0.1
	OP	0.7	0.7	0.0	0.2	0.2	0.0	0.8	0.7	- 0.1
	DCst	0.2	- 0.2	- 0.4	0.2	0.3	0.1	0.2	0.3	0.1
	Cst	- 3.3	- 4.2	- 0.9	- 3.1	- 3.0	0.1	- 3.0	- 2.9	- 0.1
	$\overline{DL}$	3.1	- 1.3	- 4.4	0.4	- 1.4	- 1.8	2.4	3.0	0.6
DC	DA	4.7	2.1	- 2.6	1.5	0.5	- 1.0	3.6	4.0	0.4
	IA	0.9	0.4	- 0.5	0.7	0.2	- 0.5	0.7	0.8	0.1
	OP	1.1	1.1	0.0	2.0	1.6	- 0.4	1.6	1.4	- 0.2
	DCst	- 0.5	- 1.1	- 0.6	0.4	- 1.0	- 1.4	- 0.2	- 1.1	- 0.9
	Cst	1.8	- 1.5	- 3.3	0.3	- 1.5	- 1.8	0.0	- 1.4	- 1.4
	$\overline{DC}$	8.0	1.0	- 7.0	4.5	- 0.2	- 4.7	5.7	3.7	- 2.0
I/C	DA	3.0	1.3	- 1.7	1.4	0.5	- 0.9	1.9	2.1	0.2
	IA	1.5	0.5	- 1.0	0.2	0.1	- 0.1	0.7	0.8	0.1
	OP	1.5	1.8	0.3	0.7	0.5	- 0.2	1.7	1.4	- 0.3
	DCst	0.4	- 1.1	- 1.5	1.1	- 0.8	- 1.9	- 0.3	- 0.5	- 0.2
	Cst	5.3	4.0	- 1.3	5.7	5.5	- 0.2	4.8	4.5	- 0.3
	$\overline{I/C}$	11.7	6.5	- 5.2	9.1	5.8	- 3.3	8.8	8.3	- 0.5
R/C	DA	- 1.7	- 0.8	0.9	0.0	0.0	0.0	- 1.7	- 1.9	- 0.2
	IA	0.5	0.2	- 0.3	- 0.9	- 0.4	0.5	0.0	0.0	0.0
	OP	0.6	0.6	0.0	- 0.9	- 0.8	0.1	0.0	0.0	0.0
	Dcst	0.8	- 0.1	- 0.9	1.0	0.1	- 0.9	0.0	0.7	0.7
	Cst	3.4	5.6	2.2	5.4	7.1	1.7	4.7	5.8	1.1
	$\overline{R/C}$	3.6	5.5	1.9	4.6	6.0	1.4	3.0	4.6	1.6

TABLE 6 : PARAMETER ESTIMATES OF ADDITIONNAL COST VARIABLES IN THE LABOR, NET INVESTMENT, GROSS INVESTMENT, REPLACEMENT EQUATIONS FOR THE FRENCH, GERMAN AND US SAMPLES. ESTIMATES ON AVERAGE RATES OVER THE WHOLE PERIOD 1970-79.

Parameter Estimates (Standard Errors)	DL equation			DC equation			I/C equation			R/C equation		
	FR	GE	US	FR	GE	US	FR	GE	US	FR	GE	US
$\overline{DW}$ ( )	- 0.818 (0.079)	- 0.830 (0.085)	-	- 0.167 (0.142)	- 0.431 (0.146)	-	0.020 (0.138)	- 0.155 (0.092)	-	0.188 (0.136)	0.275 (0.088)	-
$\overline{DIR}$ ( )	- 0.034 (0.019)	- 0.014 (0.018)	0.014 (0.008)	- 0.098 (0.034)	- 0.001 (0.030)	0.017 (0.011)	- 0.068 (0.033)	0.010 (0.019)	0.013 (0.011)	0.031 (0.033)	0.011 (0.018)	- 0.004 (0.011)
R^2	0.897	0.891	0.877	0.775	0.804	0.787	0.822	0.782	0.717	0.677	0.718	0.454
RSE	1.71	1.69	1.98	3.05	2.89	2.52	2.97	1.82	2.52	2.53	1.74	2.73

Appendix I - The Robustness of estimates to the measurement of of investment and capital stock

Since our measures of investment and capital stock were different in the German sample and in the two other samples, it seemed particularly useful to investigate the sensitivity of our estimates to the differences in these measures. It was simplest to compute alternative measures on a strictly comparable basis for all three samples. Investment was taken as the change in net plant plus depreciation charges (as was already the case for the German sample) and capital stock was estimated according to the standard application of the permanent inventory method under the assumption of a constant rate of replacement δ. Under this assumption the distinction between replacement and depreciation (and that between net and gross capital stock) vanishes in principle. Hence, we thought more appropriate to adopt a relatively large value for the constant rate δ of .10, which makes our measure of capital stock closer to the notion of a net capital stock, and has the practical advantage of giving less importance to the choice of the initial benchmark capital stock. As the benchmark capital, we took simply the reported book value of net plant at the beginning of 1967, multiplied by what seemed an appropriate factor of adjustment.

In fact, both the choice of the factor of adjustment and that of the constant rate δ in plausible ranges have little impact on our estimates of the investment equation. Estimates of the accelerator and profits effects for the three samples (on yearly and average growth rates over the whole period) are given in Table A1. By comparing them to the corresponding estimates in Tables 2 and 3 in the text, it is apparent that they yield a fairly similar picture. On the whole they tend to be closer to the estimates of the net investment equation (rather than the gross investment equation) and somewhat more comparable for our three country samples.

Table A1: Estimates of the (gross and net) investment equation using alternative measures of investment and capital for the French, German and US. samples. Estimates on yearly and average rates for the whole period.

	DC and I/C equation		
	FR	GE	US
Estimates on yearly rates			
Σ DQ	0.376	0.442	0.368
Σ PR	0.148	0.136	0.130
Total Accelerator Effects	0.515	0.558	0.589
Estimates on average rates			
Σ DQ	0.546	0.430	0.609
Σ PR	0.078	0.085	0.071
Total Accelerator Effects	0.661	0.525	0.763

Appendix II - Estimates of the Total Accelerator Effects with Different Lag Specifications

As was noted in the text, before adopting a specification with three lags for sales growth rates (and one for profit rates) we experimented with a number of different specifications. Table A2 presents the various estimates of the total accelerator effects obtained when using no lags (only the current value DQ), five lags (DQ, $DQ_{-1}, \ldots DQ_{-5}$) and geometrically decreasing lags in the first auto-regressive form (i.e., introducing the one lag endogenous variable, DL_{-1} or DC_{-1} or I/C_{-1} or R/C_{-1}, in addition to DQ, as an explanatory variable). For the ease of comparison, Table A2 repeats also the corresponding estimates on yearly rates with three lags (last line of Table 2) and on average growth rates (last line of Table 3). It is generally clear that for the four equations and three countries our three lag estimates of the total accelerator effects do not differ much from the five lags estimates, both types of estimates being sizeably larger than the no lag estimates, and being smaller with some exceptions than the average rates estimates. It is also interesting to note that the estimates obtained with the autoregressive specification are practically the same as the no lag estimates.

TABLE A2 : ESTIMATES OF THE TOTAL ACCELERATOR EFFECTS USING DIFFERENT LAG SPECIFICATIONS FOR THE LABOR, NET INVESTMENT, GROSS INVESTMENT AND REPLACEMENT EQUATIONS ON THE FRENCH, GERMAN AND U.S. SAMPLES. ESTIMATES OVER THE WHOLE PERIOD 1970-79 EXCEPT THE FIVE LAGS ESTIMATES ON PERIOD 1972-79 .

	DL equation			DC equation			I/C equation			R/C equation		
	FR	GE	US	FR	GE	US	FR	GE	US	FR	GE	US
Estimates on yearly rates :												
- No lag	0.28	0.29	0.54	0.18	0.11	0.24	0.12	0.11	0.11	-0.06	-0.00	-0.13
- Autoregressive	0.30	0.30	0.52	0.22	0.20	0.28	0.16	0.15	0.18	-0.06	-0.05	-0.10
- Three lags	0.53	0.50	0.63	0.57	0.46	0.63	0.43	0.40	0.36	-0.15	-0.06	-0.27
- Five lags	0.54	0.48	0.63	0.69	0.52	0.66	0.50	0.39	0.41	-0.19	-0.13	-0.25
Estimates on Average rates :	0.64	0.70	0.82	0.65	0.48	0.80	0.52	0.38	0.48	-0.15	-0.11	-0.32

Appendix III - The Distinction Between Permanent and Transitory Effects

The differences between the estimates computed from yearly growth rates and the estimates based on average growth rates can be interpreted in terms of the differences between permanent and transitory (accelerator and profits) effects. We shall provide here an elementary formalization of such interpretation, allowing us to compute illustrative orders of magnitude under extreme assumptions. Trying to be less simplistic would imply a more appropriate specification of the permanent-transitory distinction. Clearly this is an important issue. If one had a proper model, one would want to estimate it directly, and would not need to consider differences in yearly and average growth rates estimates.

To illustrate the distinction between permanent and transitory effects, it is enough to look at a simple regression; a straightforward generalization to the multivariate case would not be very difficult. We abandon the usual equation:

$$(1) \qquad y_{it} = a\, x_{it} + \varepsilon_{it} \,,$$

where y_{it} is the labor or capital growth rate for the firm i in year t, x_{it} is the corresponding sales growth rate or the profit rate, ε_{it} is the usual perturbation or error term, and a measures the total accelerator or profits effects. Instead we consider the following equation:

$$(2) \qquad y_{it} = a^{P}\, x^{P}_{it} + a^{T}\, x^{T}_{it} + \varepsilon_{it}$$

where x^{P}_{it} and x^{T}_{it} are respectively the permanent and transitory components of

x_{it}:

$$x_{it} = x^p_{it} + x^T_{it}$$

a^p and a^T measuring the corresponding permanent and transitory coefficients.

Since x^p_{it} and x^T_{it} are unobservable, we cannot estimate the true model (2), but only the equation (1). It is thus necessary to make specific assumptions in order to identify x^p_{it} and x^T_{it}, and to retrieve estimates of a^p and a^T.

First, we shall assume, as if by definition, that the permanent and transitory components are independent. Second, we shall assume that their (own) serial correlation are respectively large and negligible, say: 0.7 and 0, or even as a limiting case: 1.0 and 0. A serial correlation of 1 might seem quite unrealistic, since it would imply $x^p_{it} = x^p_i$. Note however, that this might not be too different from assuming that $x^p_{it} = \Sigma\, a_j\, x_{it-j}$, as we implicitly often do in practice. Trying to proceed explicitly and more rigourously would lead us to a vector autoregressive setup as in Mairesse and Siu (1984).

As a direct consequence of the second assumption, the variance of the permanent component $(x^p_{it})^2$ will be reduced in a smaller proportion than that of the transitory component $(x^T_{it})^2$, when we go from yearly growth rates to average growth rates, say over 10 years (i.e., from 1970 to 1979). And therefore from the observed reduction in the total variance: $(x_{it})^2 = (x^p_{it})^2 + (x^T_{it})^2$, we can in principle deduce the permanent and transitory variances themselves, or their shares p^p and p^T in the total variance $(p^p + p^T = 1)$.

To be more precise, we must distinguish the case of sales and that of profits. The case of sales is somewhat less straightforward than it would seem, since our distinction between transitory and permanent components applies more appropriately to the level of sales or log sales X_{it}, while the variable entering in our model is the change in sales, or $x_{it} = DX_{it}$. If the serial correlation of permanent sales X^p_{it} is one, it is zero for the permanent changes x^p_{it} and hence the permanent variance $(x^p_{it})^2$ is reduced by a factor of 10 when considering 10 years averages. If the serial correlation of transitory sales X^T_{it} is zero, the first order correlation of the transitory changes x^T_{it} is -0.5, and the higher order correlations are zeros, then it is easy to see that the transitory variance $(x^T_{it})^2$ is reduced by a factor of 100 for the 10 years averages. The reduction of the total variance (x^2_{it}) that we observe in fact for our three samples is in a factor of roughly 12 to 14. This reduction thus corresponds to shares of the permanent and transitory variances of sales changes of about 75 and 25 percent respectively (i.e., such that $p^p/10 + p^T/100 = 1/13$).

The case of profits is more direct. The serial correlation of permanent profit rates $(x_{it})^p$ being one, the permanent variance $(x^p_{it})^2$ is not reduced in taking averages. The serial correlation of transitory profit rates (x^T_{it}) being zero, the transitory variance $(x^T_{it})^2$ is reduced by a factor of 10 by going to 10-year averages. The observed reduction in total variance is actually about 1/2, and thus corresponds to shares of the permanent and transitory variances on the order of 50 percent (such that $p^p + p^T/10 = 1/2$).

Knowing the respective shares of the permanent and transitory components, we can easily derive estimates of the permanent and transitory coefficients a^p a^T, from the (least squares) estimates of the usual coefficient a on both the yearly and 10 years average growth rates, say $\hat{a}$ and $\tilde{a}$. More precisely, we can write the two following equations in a^P and a^T:

$$p^P a^P + p^T a^T = \hat{a} \quad \text{and} \quad \bar{p}^P a^P + \bar{p}^T a^T = \tilde{a}$$

where $\bar{p}^P$ and $\bar{p}^T$ are the shares of permanent and transitory variances for the averages growth rates which can be obtained from the corresponding shares for the yearly growth rates p^P and p^T :

$$\bar{p}^P = p^P/(p^P + p^T/10) \quad \text{and} \quad \bar{p}^T = (p^T/10)/(p^P + p^T/10) \quad .$$

It is clear that for small enough p^T (and for averages over a long period such as 10 years), the permanent coefficient a^P will be practically equal to that estimated on averages, even if the transitory coefficient a^T is important. It is clear also that if a^P is larger than a^T, then the estimate based on annual data (or first differences) will be in general smaller than the estimate based on average rates (or long differences), and conversely. As we see in this study, sales changes and profits in the accelerator profits model are good examples of these two cases.

FOOTNOTES

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1. For other examples, see Z. GRILICHES and J. MAIRESSE (1983, 1984), Ph. CUNEO and J. MAIRESSE (1984).

2. The French, German and U.S. samples are built from the information respectively available from the data bank of the Credit National, that of the Institute für Gesellschafts-und-Wirtschaftswisseunschaften, and from the Standard and Poor's Industrial Compustat. Details on the construction and the cleaning of these three samples, as well as on the definition and measurement of the variables, can be found in three companion studies on productivity and profitability in each country: B. DORMONT, J.M. CHANUT and J. MAIRESSE, (1984 and 1985).

3. To be precise, for France and the U.S., C_t is computed as reported gross plant times $P(72)/P(t-AA_t)$, where P is the price deflator for investment and AA_t the average age of gross plant. AA_t is computed as the ratio of accumulated depreciation to gross plant (1 minus the ratio of net plant to gross plant) divided by an assumed average service life of 16 years. This supposes straight line depreciation. In the case of France, the ratio of accumulated depreciation

to gross plant is itself corrected to take into account that the fiscal lengths of life used to compute depreciation as reported in the firms accounts are much shorter than the actual service lives. Gross plant has been taken at the beginning of the fiscal year, which for a number of firms does not coincide with the calendar year. It does not seem from previous work that this timing problem has any real impact on our type of results.

4. Only net plant is reported in the book accounts of our German firms, and thus we could not use the gross plant measure.

5. We used deflators for both sales and investments at the level of a classification in 16 manufacturing industries for the three countries (i.e., almost the two digit industrial breakdown in the U.S.). Using more detailed deflators, as we tried in previous work, does not seem to matter much.

6. We experimented also with not adjusting for inventory change, and with gross profits after taxes and interest expenses, which should provide a better measure of the "flow of funds" available for investment. On the whole, the results were very similar. The correction for taxes and interest expenses appeared to improve slightly the fit of our investment equations. However, since interest expenses were missing for a number of U.S. firms, we preferred not to reduce our sample size and kept the before taxes and interest measure.

7. Thus, by construction, the measures of gross and net investment rates differ only by the constant replacement rate, and hence there is no point in analysing them separately.

8. By definition we have exactly: $R_t/C_t = I_t-(C_{t-1}-C_t)/C_t$. In fact, we have measured R/C by the difference I/C - DC, where DC computed as the log difference is only an approximation to the rate of growth of C. We have checked, however, that this approximation led only to insignificant differences in our R/C estimated equation. We chose to present the results for the R/C = I/C - DC measure just for the sake of coherence, so that this definitional or accounting identity would strictly hold for the estimates in our tables.

9. Actually using industry dummies instead of a constant has only a minor impact on our estimates. Using year dummies in addition, or even using specific year dummies for each industry (i.e., 10×16 = 160 of them for the whole period 1970-79) has not much influence either. In principle, having industry dummies with no time dummies, as we did, should mean that a firm in reaching its investment and labor demand decisions takes into account not only its own relative situation within its sector but also the general evolution of the economy. In the same vein, another experiment that we could have tried would have been to distinguish the firm expectations about their own sales and from those about the industry sales. Instead of year dummies for each industry, we could have used as additional variables in our equations the industry sales growth rates (i.e., the weighted averages of firm growth rates).

10. For an interesting recent survey on econometric models of investment, which relates the accelerator profits model to other models (i.e., Jorgensonian neoclassical and cost of adjustment type models, Tobin's q and disequilibrium approach models) see P. ARTUS and P.A. MUET (1984).

11. The choice of the time-series type estimates versus the cross sectional type estimates is equivalent to considering investment and labor change equations rather than capital stock and labor equations. This choice between the two type of estimates or the two sorts of specifications is a very profound issue that we leave aside here. This is not simply a problem of heteroscedasticity, as it is often thought, since in this case whatever the choice we would expect to get consistent estimates. The two approaches lead, in fact, to very different estimates. Cross sectional estimates of the total accelerator effects (i.e. total or between-firm estimates on log L or log C equations) are typically of about 1.0, while, as we shall see, the time series estimates are about 0.5 to 0.6 based on yearly growth rates and 0.6 to 0.7 based on average growth rates. The proper within estimates that we also computed but do not present are usually quite close to the average growth rates estimates. An accelerator effect of 1.0 makes a priori more sense, if we interpret it as being exactly the reciprocal of the scale elasticity of the underlying production function (in the simplest model for a cost minimizing firm). On the other hand, a value less than 1.0 is more sensible if we consider that the estimated effect depends also on the elasticity of sales expectations relatively to observed past sales. As we already explained, this is this line of thought that we pursue here.

12. There are of course exceptions to such robustness of regressions analyses. For an example see CUNEO and MAIRESSE (1984), in which it is shown that the double counting of R-D in the available measures of labor and physical capital, in spite of its limited magnitude, results in sizeable biases in the cross-sectional estimates of R-D capital stock elasticity.

13. Let the true model be $DL^* = f\ DW^* + e$, in which DL^* and DW^* are the true changes in labor and wages, and in which we omit the other explanatory variables for simplicity (and because they are nearly orthogonal). Suppose that v is a random uncorrelated error in the observed DL : $DL = DL^* + v$, the measured DW will be: $DW = DW^* - v$, and the estimated equation: $DL = f\ DW + e + (1 + f)v$. Thus the error in variable bias of the least square estimate $\hat{f}$ of f will be $-(1 + f)\ \mathrm{var}\ (v)/\mathrm{var}\ (DW)$, and even for a true $f = 0$ we could have $\hat{f} \sim -0.8$.

14. The extended accelerator model in MAIRESSE and SIU is a four variable autoregressive model with equations for the stock market rate of return, the sales growth rate, the physical investment and R-D investment growth rates. Thus, the choice of formulations in terms of growth rates or levels is carried one degree further by considering the rate of change of investment (i.e., the rate of acceleration of the capital stock), rather than its level (i.e., the rate of change of the capital stock).

15. For two such studies, see ATKINSON and MAIRESSE (1978), and BOSSHARDT and MAIRESSE (1980).

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