The cyclical behaviour of inventories: European cross-country evidence from the early 1990s recession.*

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Abstract

This paper employs data for a panel of firms from France, Italy and the UK to study the effect of the recession of the early '90s on inventory investment, controlling for cyclical fluctuations at the firm level. The results clearly show some common patterns across countries, pointing to the relevance of financial factors (namely, the level of leverage) in propagating initial recessionary shocks. Moreover, Italian firms, especially if "small and young", seem more likely to suffer from a reduction in the value of collateralizable assets possibly originated by restrictive policy actions.

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1. Introduction

Recent work in macroeconomics has emphasized the role of credit market imperfections in propagating original disturbances from various sources, amplifying their real effects. In the present paper we address this issue by providing novel microeconometric evidence from a largely unexploited data-set on balance sheets of European firms. We focus on three countries, France, Italy and the United Kingdom, studying the cyclical behavior of inventories, since they are likely to be the component of firms' assets most responsive to financial pressure and general adverse macroeconomic conditions. The recent launch of the European Monetary Union (EMU) provides additional interest to our investigation, which might yield important insights on the differences and similarities in the channels of monetary transmission across European countries now experiencing a common monetary policy.

The paper is organized as follows. The next section provides a brief discussion of the relevant literature on financial factors and cyclical fluctuations and spells out the motivation of our work. Section 3 describes the data used (additional details on the construction of the final panels of firms are provided in the Appendix). Section 4 presents the empirical specifications of the inventory equations and discusses methodological issues. Section 5 is the core of the paper, where empirical results are presented both for the full samples and for groups of firms partitioned according to proxies for the degree of access to capital markets.The main conclusions are summarized in the final Section 6.3

2. Motivation and related literature

Theoretical research has framed the issue of the effects of capital market imperfections on real economy fluctuations within the "principal-agent" view of credit markets, studying how endogenous changes in the agency cost of lending over the business cycle are responsible for amplifying the real impact of initial shocks, giving rise to a "financial accelerator" effect (see Bernanke, Gertler and Gilchrist, 1996, 1999, for overviews). Informational asymmetries between lenders and borrowers make external finance, if not fully collateralized, more expensive than internal sources of funds. This external finance premium compensates lenders for evaluation and monitoring activities and its size is negatively correlated with borrowers' net worth (the sum of net liquid assets and the collateral value of fixed assets). Negative shocks to net worth reduce the amount of internal finance available to borrowers, at the same time increasing the premium on external finance: these effects reinforce each other and determine sharp reductions in the borrowers' level of investment and production.

Empirical work on these issues has taken several directions. One strand of literature, initiated by Fazzari, Hubbard and Petersen (1988) and surveyed by Schiantarelli (1995) and Hubbard (1998), focused on the potential effects of financial constraints on firms' investment expenditure adding proxies for the availability of internal funds to investment equations. A related literature concentrated on the "lending channel" of monetary policy transmission, giving a primary role to the response of bank loan supply in the face of monetary tightening (see, among others, Bernanke and Blinder (1992), Kashyap, Stein and Wilcox (1993), Oliner and Rudebusch (1995)) using time-series data on aggregate credit and bank loans during monetary policy restrictions. Such time-series studies have gradually acknowledged the fundamental identification problems encountered in the interpretation of aggregate, macroeconomic data. In fact, empirical work on the dynamic effects of monetary policy carried out using mainly Structural Vector Autoregressive (VAR) techniques suffers from a fundamental identification problem: a decline of bank loans following a monetary policy restriction does not necessarily reflect a squeeze in loan supply but might well be endogenously driven by a fall in loan demand. In the latter case there would not be a specific role for banks in the transmission of monetary policy shocks. Even results from the analysis of changes in the composition of firms' external finance between bank loans and commercial paper (Kashyap, Stein and Wilcox, 1993, for the US) are not conclusive if a monetary contraction causes a general shift of all forms of credit from small to large firms: a decline in the bank-loan share might be observed in aggregate data, with no substitution away from bank debt at the firm level, only because large firms typically rely less heavily on bank debt than small firms (Oliner and Rudebusch (1995)).

Two main insights emerge from this earlier literature. First, even if there is scant evidence in favor of a "lending channel", a broader "credit channel", perfectly consistent with the financial accelerator view, might be at work, whereby (maybe policy-induced) increases in market interest rates cause an increase in the premium for external debt of all sorts charged on at least certain classes of borrowers. Second, any convincing evidence of a specific role of financial market imperfections must come from empirical research focusing on the differential response of agents to recessionary shocks: identification must be achieved through agents' heterogeneity (Gilchrist and Zakrajšek (1995)).

Taking this lead, the recent empirical literature has focused on firms' behaviour, mainly in the US, following two empirical approaches. Using time-series data on firms disaggregated by size class (as a proxy for capital market access), Gertler and Gilchrist (1994) provide substantial evidence of differential behaviour of small versus large firms over the business cycle and in response to monetary policy tightening. Overall, small firms experience a deeper contraction than large

firms in a wide variety of variables, including sales and inventories. Broadly similar results are reported also by Oliner and Rudebusch (1996) and Bernanke, Gertler and Gilchrist (1996). However, also non-financial reasons may explain the observed differential behaviour among firms, especially for sales, if size is correlated to other characteristics which are relevant to firms' cyclical behaviour. For example, if small firms are concentrated in sectors with more cyclical product demand or are marginal suppliers to other, maybe larger, firms or to the market, they may well be more severely hit by recessions than large firms.

To control for alternative shocks and different adjustment mechanisms among firms, some recent studies use microeconomic firm-level data.[1] Kashyap, Lamont and Stein (1994) provide a case-study of the behavior of inventory accumulation focusing on the 1982 recession and using a cross-section of US firms. Their main finding is that inventory investment of firms without access to public capital markets is significantly liquidity-constrained during the recessionary episode. Gilchrist and Zakrajšek (1995) and Bernanke, Gertler and Gilchrist (1996) analyse firm-level data for US manufacturing firms, confirming the findings of substantial cross-sectional differences between borrowers with different possibilities of financial market access.

Our work contributes to the latter strand of empirical literature, providing a case-study of inventory investment behavior during the recession experienced in the early '90s by several European countries including France, Italy and the UK. As Figure 1 shows, in 1993 the rate of change of GDP was negative in France (-1.3%) and Italy (-0.9%), whereas in the UK recession reached its trough in 1991 (-1.5%). Industrial production followed the same pattern with even more pronounced fluctuations. In all countries industrial production decreased for three consecutive years: from 1991 to 1993 for France and Italy (more sharply in the former country), with the most serious decline in 1993 (-4.6% and -2.4% respectively), and from 1990 to 1992 in the UK, with the sharpest fall in 1991 (-5%). In Italy, industrial production decreased also in 1996 by 1%. The main recessionary episode in the early '90s follows in all countries a tightening of monetary policy, occurred in France and Italy in the second half of 1992 and the first quarter of 1993 and in the UK between the end of 1990 and the beginning of the following year. Other policy actions may have accompanied, if not induced, the recession, especially in Italy where also a severe fiscal contraction occurred in those years (and occurred again in 1996, when a fiscal policy tightening was required to fulfill EMU entry conditions).

An additional motivation for our cross-country analysis is provided by the

[1] Alternatively, other studies use time-series data on firms disaggregated by geographical region (Carlino and De Fina (1998) for the US) or by sector (Dedola and Lippi (2000) for the US and four large European economies).

current debate on the effects and transmission channels of the common monetary policy in the EMU area (see Guiso, Kashyap, Panetta and Terlizzese (1999) for a comprehensive survey of empirical results). A detailed analysis of firms' inventory response to adverse macroeconomic conditions may be useful in order to understand the specific channels of monetary policy transmission in each EMU country, providing valuable information on potential asymmetries of ECB's policy actions. The evidence so far available, mainly based on large-scale national macroeconomic models or smaller-scale structural VAR systems, does not yield a consistent set of results on the differences and similarities in the monetary transmission channels across countries. Disaggregated, firm-level data seem more likely to deliver harder evidence on this issue, since they exploit the advantage of much more variability in firms' behaviour at the cross-sectional level than at the cross-country level.

To this aim, we use a panel of French, Italian and UK firms and look first at the behaviour of inventories during the recession of the early '90s both in aggregate and for different classes of firms.[2] Inventories are the real component of firms' assets that is likely to be more responsive to financial constraints; in fact, the financial pressure caused by a negative shock affects all firms' assets, but the relative lower liquidation and adjustment costs of inventories determine their potentially larger response to recessionary shocks.

3. Data description

We use annual balance sheet data at the firm level for three large European economies (France, Italy and the United Kingdom), obtained from Amadeus, a commercial data-bank containing (unconsolidated and/or consolidated) balance sheet information on European firms.[3] Using data from a common source should guarantee a reasonable degree of comparability across countries with partly different accounting practices and classifications of elementary balance sheet items. Available data start in 1989 for France and the UK, and in 1991 for Italy; the end of the sample is 1997 for all countries.

A balanced panel has been constructed by considering only those firms in the manufacturing sector with continuous observations on the relevant variables throughout the sample period. To avoid outliers, firms with anomalous observations on our crucial variables (sales, inventories and our various measures of

[2] Also Bond, Elston, Mairesse and Mulkay (1997) provide a cross-country study of a panel of European firms, analyzing the role of financial factors in affecting firms' investment behaviour, but with no specific focus on recessionary episodes.

[3] Higher frequency data (e.g. quarterly as in the empirical analysis of US firms by Carpenter, Fazzari and Petersen (1994, 1998)) , though more desirable to capture the interaction between cyclical inventory fluctuations and financial factors, are unavailable for most European countries.

financial pressure) have been discarded.[4] Overall, our sample contains data from around 6000 firms (2093 from Italy, 2254 from France and 1560 from the UK), for a total of almost 49000 observations.[5] For comparison, the scant empirical evidence on inventory behavior in European countries is either based on smaller panels of publicly traded UK companies (Guariglia, 1999, 2000) or on time series aggregates of small and large Italian firms (Rondi, Sack, Schiantarelli and Sembenelli, 1998). Cross-country comparisons of inventory investment are not available, whereas Bond, Elston, Mairesse and Mulkay (1997) provide a cross-country analysis of firms' fixed investment behavior in the '80s using data from 361 Belgian firms (quoted and non-quoted), 1365 French firms (quoted and non-quoted) , 228 quoted German firms, and 571 UK firms (consolidated and quoted), with remarkable size heterogeneity, due to the larger average size of German and UK firms.

Basic descriptive statistics on the distribution of firms in the sample by size (measured by real sales) are reported in Table 1 for the whole time period and for the initial year in each sample. The data shows that the size distribution of French and Italian firms is quite similar, and only in the sample for the UK there is a greater proportion of relatively large firms.[6] Besides having broadly comparable numbers of firms and size distributions across countries, our sample has the advantage of including both quoted and nonquoted firms, therefore covering also the lower tail of the overall firms' size distribution in each country where most firms are unlisted.

Additional descriptive statistics, reported in Table 2, concern the variables we use below in the empirical analysis: inventories (as a ratio to sales), and three measures of financial pressure, such as leverage (the ratio of short- and long-term debt to total liabilities, i.e. debt and shareholders' funds), short-term leverage (the ratio of short-tern debt to total liabilities), and debt maturity (the ratio of short-term debt to total debt). On average in the sample period Italian firms display a higher leverage measures (both total and short-term), whereas the debt maturity indicator is quite similar across countries. Finally, also the distribution of the inventories to sales ratio is similar across countries, with Italy displaying slightly higher values.

[4] The *Appendix* provides more details on the treatment of the data and some discussion of our sample building strategy.

[5] In preliminary work, also a sample of German firms had been constructed from the same data source. Data for only 325 firms are available and the size distribution is not comparable with the other three countries in the sample (e.g. the median German firm has real sales three times as large as the median UK firm). We therefore decided to exclude German firms from our investigation.

[6] This may be partly due to the presence for about 50% of UK firms only of their consolidated balance sheets (see the Appendix for details).

For each country, our analysis of firms' inventories behavior is carried out first using all firms in the sample. Then, we focus on the differential behaviour of firms with different capital market access. This should be useful to capture additional responses to recessionary shocks, since firms with more difficulties in raising funds on the market should be more severely affected in periods of downturn in economic activity. In order to capture differential financial market access, we partition the sample in each country according to two criteria. The first is based on the previously described *size* distribution: we partition firms in each country into two dimensional classes ("large" and "small" firms) using a common size threshold of 20 millions ECU at 1990 prices (which is close to the lowest median firm size among the three countries), applied to the distribution of real sales in the first year of the sample (1989 for France and the UK, 1991 for Italy). Therefore, we do not allow firms to move from one dimensional class to the other during the period. Though somewhat restrictive, this choice may be justified both by the relatively short time span analysed (9 years at most) and by our focus on a specific episode occurring toward the beginning of the sample period.[7] As discussed by Gertler and Gilchrist (1994), firm size is a reasonable proxy for capital market access since it is strongly correlated with factors, such as the degree of idiosyncratic risk, the availability of collateral and the existence of a bond rating, more directly relevant in determining the existence and magnitude of the premium on external finance.[8]

We also partition firms in each country according to their *age*, as revealed by the year of foundation: firms with more than 10 years of age in 1989 are defined as "old" and those with less then 10 years as "young". In so doing, again we do not allow firms to transit from young to old during the sample period.[9] Age may capture better than size the firms' track record, a relevant information in determining the availability and cost of external finance. This may be particularly true for Italy, where many small firms are relatively old and have developed over time long-run relationships with financial intermediaries (typically, commercial banks), overcoming informational problems.[10] We note here that working with a

[7] The dimensional split among firms may be obtained using other criteria: e.g. by using the median of the real sales distribution in each country as the threshold or by defining those firms in the upper third of the size distribution as "large" and those in the lower third as "small" (in the following empirical analysis we experimented with both such alternative split criteria and found qualitatively very similar results).

[8] Moreover, splitting the sample by firm size as a way of identifying crucial effects is a widely used technique in the literature on investments and financial constraints (Hubbard (1998), Schiantarelli (1995)).

[9] Deveraux and Schiantarelli (1989) define as "old" the UK *quoted* firms with at least 12 years of age; Carpenter and Rondi (2000) classify as "old" those Italian firms with more than 15 years of age.

[10] Furthermore, as suggested by Carpenter and Rondi (2000), the peculiar ownership structure of a large fraction of Italian firms, based on long-lasting family control, represents a constraint

balanced panel may bias the results against finding significant differences between firms of different size if smaller or younger firms are more likely to default due to adverse financial conditions during recessions.

Applying the size and age criteria to our samples produces four groups of firms whose main features are described in Table 3. Each cell in panel A of the table reports the number of firms, the average size (as measured by real sales) over the whole sample period, and the average age in years measured in 1989. In all countries there is a sizeable dispersion of firms across different groups. In particular, the number of firms in the off-diagonal cells (including the "small and old" and the "large and young" firms) is around 46% in France, 53% in Italy and even 38% in the UK, where the "large and old" firms are a big share of the overall sample (55%). We conclude that the partition into "size" and "age" classes provides significantly different information on firms and may capture their ability to access capital markets in a different (and complementary) fashion. Then, using both split criteria in the empirical analysis can yield valuable additional information. As for firms' dimension, our common cut-off across countries produces a size split broadly consistent with some of the main features of national industrial structures: "small" firms, which amount to only 35% in the UK, are 47% in France and 56% in Italy, reflecting a well-known peculiarity of the Italian manufacturing sector. Moreover, more than one third of Italian firms are "young", against less than 20% in both other countries. The fraction of "young" firms is higher in the "small" category than in the "large" group in France and in the UK (around 20% compared with around 15%) but not in Italy (34% against 35%). The average age (in 1989) of "young" firms is uniform across countries (4-5 years), whereas the average age of the "old" firms ranges from 26 in Italy to 45 in the UK, with French firms in between (36).

Panel B of Table 3 reports the (whole period) average of inventories and leverage measures for the four firms' groups in each country. In all samples firms display remarkably similar structural features across groups. This similarity ensures that potential different behavior of firms belonging to distinct groups cannot simply be attributed to their different asset/liability structure. Only the "small and young" (S/Y) group shows some systematic differences in the leverage distribution, consistent across all three leverage measures.

Finally, Figure 2 focuses on the dynamics of our main variables of interest showing for each country the rate of change of the median of the distribution of sales and inventories (measured in real terms) over the sample period. Both variables display a strongly procyclical dynamics, with slightly more pronounced fluctuations for inventories in France and, to a lesser extent, in the UK. This firm-level evidence is broadly consistent with the stylized facts on aggregate inventory

on firms' growth, reducing the correlation between size and age.

behavior reported by Ramey and West (1999).

4. Empirical specification

In this section we motivate the specification of the estimated inventory equation and briefly discuss relevant estimation issues.

We estimate the following general autoregressive distributed lag model for inventories and sales (as discussed e.g. by Blinder and Maccini (1991)), augmented by financial variables as in Carpenter, Fazzari and Petersen (1994, 1998) and Guariglia (1999):

$$inv_{it} = \beta_1 inv_{it-1} + \beta_2 sales_{it} + \beta_3 sales_{it-1} - \beta_4 lev_{it-1} + \alpha_i + \alpha_t + \varepsilon_{it} \qquad (4.1)$$

where the dependent variable is the (log of) the end-of-period stock of real inventories (inv_{it}), $sales_{it}$ is (the log of) real sales and lev_{it-1} denotes (the log of) firm i's leverage as measured at the begining of period t. The error term in the equation includes a firm-specific fixed effect (α_i) which captures any time-invariant influence of unobservable variables on individual firms' behavior due, e.g., to different storage costs and rate of obsolescence across firms, a time effect (α_t), and an idiosyncratic component (ε_{it}). Guariglia (1999) estimates an error-correction version of equation (4.1), with additional dynamics, on UK data. For the US, Carpenter, Fazzari and Petersen (1994) derive a similar equation from a structural model with stock adjustment and a buffer-stock role for inventories, and interpret the estimated coefficients accordingly. For the purposes of this paper, lagged inventories and current and lagged sales may be considered simply as control variables, allowing to test for the relevance of financial factors; we therefore do not attribute a structural interpretation to the first three estimated coefficients.

The leverage term is included in the equation to test whether inventory investment is sensitive to balance sheet variables proxying for the degree of financial pressure (in the empirical analysis below we use all our previously defined measures as indicators of financial pressure). Other variables capturing the same effect are commonly employed in the literature, namely the beginning-of-period stock of liquid assets (cash and marketable securities) as in Kashyap, Lamont and Stein (1994), the coverage ratio (the ratio of pre-tax and pre-interest earnings to total interest payments, interpretable as the flow counterpart of leverage, see Nickell and Nicolitzas 1999) as in Guariglia (1999) and Carpenter, Fazzari and Petersen (1998), and particularly cash flow as in Carpenter, Fazzari and Petersen (1994, 1998). Since our data set does not allow for construction of a reliable cash flow measure for all countries, we use (total and short-term) leverage as a proxy for financial pressure. We believe that leverage may nevertheless be a suitable variable to consider for two main reasons. First, cash flow may also contain information

on firms' future profitability not fully accounted for by the sales variable (even though inventories should react more to short-term profit expectations likely to be more closely correlated to sales); in turn this would determine an upward bias in the cash flow estimated coefficient. Second, cash flow and sales may be highly collinear, making it difficult to estimate relevant coefficients with precision.[11] Both problems are less likely to apply to a leverage measure.

Controlling for sales allows us to interpret the estimated α_t as evidence of fluctuations in inventories in addition to the firm-level business cycle. These additional effects may well be an important part of a financial propagation mechanism amplifying the impact of recessionary shocks and restrictive policy actions. Indeed, in the time period under study all countries suffered from a pronounced demand-driven cyclical downturn at least partly attributable to restrictive monetary and fiscal policies; however, from the perspective of this paper, the identification of the structural source of shocks originating the recessionary episode is not a crucial issue. The time dummies then capture the common cyclical response of inventory investment during recession which is independent from the firm-specific sales' fluctuations.[12]

4.1. Estimation issues

In order to remove the firm-specific effect all equations are estimated in first differences. A constant term is kept in estimation to allow for a possible time trend in the levels of the dependent variables. The estimation period is therefore 1991-1997 for France and the UK and 1993-1997 for Italy, since two observations are lost by lagging the variables and by constructing first differences. Estimation is carried out by the Generalized Method of Moments (GMM) using twice or more lagged variables in levels as appropriate instruments for the transformed lagged dependent variables. The assumption of no serial correlation in ε_{it} is essential for the consistency of the GMM estimator; if the disturbances are not serially correlated there should be evidence of first-order serial correlation in differenced residuals but no evidence of second-order correlation (see Arellano and Bond 1991, 1998). For this reason in Tables 4 and 5 we report the results of first-order and second-order residual serial correlation tests (m_1 and m_2 denote the p-values of the relevant test statistics) and the Sargan tests of over-identifying restrictions. In all equations we also allow for the sales variables to be predetermined, using

[11] Moreover, the lack of data on "cash" held by firms in our data set precludes the computation of a reliable measure of liquid assets. For the same reason, we could not construct a measure of "net leverage" by subtracting cash and other liquid assets to both total debt and total liabilities.

[12] If forward-looking firms are subject to common shocks to sales, so that current sales matter also because they predict the future, the time effect α_t might also pick up a common component in future expected sales not captured by the coefficients on current and lagged sales.

twice or more lagged values as instruments.[13] In the following section results for the aggregate samples and for four groups of firms, resulting from the joint application of our two splitting criteria (dimensional and age), are reported.

5. Results

Results from the estimation of inventory equations (4.1) are shown in Tables 4 and 5. Table 4 shows results for the aggregate samples and Table 5 reports for each country results for our four subsamples of firms: "large and old", "large and young", "small and old" and "small and young". For each equation estimated coefficients are reported together with their standard errors; moreover, the p-values of test statistics for first- and second-order residual serial correlation (m_1 and m_2) are displayed. In addition, w_t denotes the p-value of the statistic (with a $\chi^2(6)$ distribution for France and the UK and a $\chi^2(4)$ distribution for Italy) testing the joint significance of the time dummies α_t. The estimated values for the time dummies with 95% confidence intervals are plotted against time in Figure 3 for the aggregate sample, for the years 1991-1996 for France and the UK and 1993-1996 for Italy. When estimation is carried out on firms' subsamples, the four sets of estimated α_t's are portrayed in Figure 4.

Time dummies coefficients measure the percentage deviation of the dependent variable in each year from its value in 1997, after controlling for the behaviour of sales and for the effect of the leverage measure. Moreover, since a constant term is included in (first-difference) estimation, a linear time trend effect (if present) is removed from the magnitude of the estimated coefficients. Such trend could capture gradual improvements in inventory management (e.g. the diffusion of a "just-in-time" technology). Year 1997 has been chosen as a benchmark for the evaluation of time effects since it is the last observation in the sample and because in that year the growth rates of GDP and industrial production were fairly close in the countries as shown in Figure 1. For all countries the baseline specification in (4.1) has been expanded by introducing an additional variable constructed by interacting each financial variable (either lev_{it-1}, $stlev_{it-1}$ or mat_{it-1}, denoting total leverage, short-term leverage and debt maturity respectively) with a dummy variable R_{it} taking the value of 1 in 1991-1992-1993 for France, in 1993 and 1996 for Italy and in 1991 and 1992 for the UK. This new variable is designed to test

[13] It is well known that in dynamic panel data models where the autoregressive parameter is large and the number of time series (N) is small, the first difference GMM estimator suffers from finite sample bias and poor precision, as shown in simulation studies, e.g. Blundell and Bond (1998). However, this is unlikely to be a problem in our case since N is very large, ranging from 1560 to 2254 in the aggregate estimates. In fact, Blundell and Bond (1998) find that the sample bias becomes negligible for $N = 500$ and a true autoregressive parameter around 0.8.

whether the disciplining role of debt is stronger in recession.

The aggregate results in Table 4 show a similar coefficients' pattern on the sales and lagged inventories variables across countries. When the error-correction restriction (as in Guariglia (1999)) is imposed in estimation of (4.1), it is always strongly rejected on the aggregate data (and in the majority of disaggregated estimates). The tests on the residuals show the expected first-order serial correlation and detect some evidence of second-order correlation only for the UK sample. However, the Sargan tests reveal some problems with the instruments used in the equations for France and the UK. The set of time dummies is always statistically significant at the 1% level and again the coefficients' time pattern (Figure 3) shows a marked cyclical behaviour in all countries, after controlling for firm-specific fluctuations in sales and beginning-of-period financial pressure. The magnitude of this effect is -8% in France in 1993 and around -2-3% for the UK in 1991 and for Italy in 1993. In this latter country, the inventory decumulation is much stronger in 1996 (-9%). The effect of the three financial pressure measures is consistently negative and strongly statistically significant in all countries, with a larger magnitude in Italy (more evidently so for the total leverage and debt maturity measures). In the aggregate samples the only additional recessionary effect is found for Italy when the total leverage variable is used. To gauge the quantitative importance of this effect we performed a very simple experiment. We computed for each country the impact on inventories of a leverage increase from 0.55 (approximately the first quartile of the overall distribution of firms in our sample) to 0.75 (approximately the third quartile). According to our estimates, this increasing leverage implies a reduction in inventories of 11.5% for the UK, 10.3% for France and 20.5% (21.1% in recessionary years) for Italy.

Table 5 shows the results of the inventory equations estimated on the four available size/age firms' groups, using the leverage as a measure of financial pressure. Rather confortingly, there is no evidence of second-order serial correlation in all subsamples at the 5% significance level. Moreover, the Sargan tests reject our choice of instruments only in three out of twelve subsamples. The strong negative effect of leverage is confirmed also for all subsamples, with no appreciable difference across firms' groups in France and, to a lesser extent, in the UK,[14] whereas in Italy the "large and old" firms display a smaller leverage effect with respect to the other three groups. In addition, only for the "small and young" Italian firms the sensitivity to financial pressure is magnified in recession years, with a negative and statistically significant estimated coefficient on the interaction variable

[14]The only exception is the subsample of "large and young" UK firms, which shows a larger coefficient on leverage compared to the other subsamples. However, this result has to be taken with caution given both the limited sample size (159 firms) and the suspicious difformity in the magnitude of other coefficients.

$lev_{it-1} * R_t$.

Finally, as can be seen from Figure 4, the pattern of the time dummies α_t is broadly consistent across different firms' groups in all countries, with the partial exception of the "large and young" UK firms. As suggested by Gertler and Gilchrist (1994), if small or young firms use more flexible production technologies, a more pronounced reduction in inventories may not be due to financial factors but simply to a greater possibility of quickly adjusting inventories when production needs change. Allowing for different coefficients also on the variables capturing technological features (sales and lagged inventories) as well as different time trends, we explicitly take account of this possibility when splitting the sample into four groups of firms.

To assess the robustness of the above results we employed also our two additional measures of firms' financial pressure, namely short-term leverage and debt maturity, obtaining results not substantially different from those reported above. Moreover, given the annual frequency of our data, we used also a different specification for the recession dummy, focusing on the "worst" year for each country. We therefore defined R_t as taking the value of 1 only in 1993 for France and Italy and only in 1991 for the UK. Moreover, a second-order autoregressive specification has been estimated, to evaluate whether the pattern of time dummies displayed in Figures 3 and 4 is attributable to functional-form misspecification. Both extensions of the basic model yielded results not appreciably different from the ones reported in Tables 4 and 5. Finally, we also reestimated our model without imposing the logarithmic transformation on the financial variables, and obtained qualitatively very similar results.

In conclusion, our results show that a leverage measure is able to capture financial pressure effects in all countries, which are stronger in Italy where smaller and younger firms seem to be hit more sharply in recessions. Moreover, in the aggregate, inventories display a procyclical pattern in excess of what is explained by firm-specific fluctuations in sales and this sensitivity is of a sizeable magnitude especially in France and Italy. On the whole, the empirical results suggest that although a common pattern clearly emerges, some interesting differences can also be found. In particular, cross-country differences in inventory behavior seem to be more pronounced than differences between firms grouped by size and age within each country, with the notable exception of smaller and younger Italian firms.

6. Conclusions

The main conclusion from our empirical analysis on firm-level data for three large European economies in the early '90s is that in all countries, during the recessionary episode, firms reduced inventories significantly beyond the level justified

by the cyclical behaviour of sales. To the extent that this recession was triggered by monetary policy tightening, these findings may support the broad "financial accelerator" view of the monetary transmission mechanism. Moreover, a significant negative effect of the level of leverage is found on inventories in all countries and in all subsamples within each country. This in turn suggests that all types of firms respond to financial pressures by reducing the level of inventories. However, besides these common patterns, also some differences both across countries and within each country between various classes of firms (with a different access to financial markets) seem to emerge. In particular we find strong evidence that the leverage effect on inventories is significantly larger for Italian firms; in addition, this effect is enhanced in recessions for the sizeable group of "smaller and younger" Italian firms. From the European Monetary Union perspective, our evidence points towards broadly similar firms' responses to financial pressures, but with sizeably different magnitude across countries.

Clearly additional work on these issues is needed. For example, a more complete picture of the effects of recessions on firms' behavior could be obtained by the investigation of the cyclical reaction of other items on both sides of firms' balance sheet (in particular trade credit, net trade debt, fixed investment and short- and long-term debt) and by considering potential cross-country differences in firms' cyclical behavior at the sectoral level. Even though empirical work in this area is at present somewhat hampered by the limited availability of more exhaustive European firm-level data sets, it ranks high in our research agenda.

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Appendix

The data used in this paper is obtained from the cd-rom version of the Amadeus databank produced by Bureau Van Dijk (BVD, hereafter). Each cd-rom contains (unconsolidated and/or consolidated) balance sheet information on European manufacturing firms for the 5 most recent years for which data were available at the time of publication. To broaden our sample period we made use of two different cd-roms covering respectively the 1989-93 (but only 1991-93 for Italy) and 1993-97 periods.

To build our panels the following initial procedures have been followed. First, firms located in France, Italy and the UK were identified separately in each cd-rom and (unconsolidated and/or consolidated) balance-sheet data were extracted. Second, balance sheet data coming from the two cd-roms were merged by using the BVD identification number as key variable and by exploiting the 1993 data (available in both cd-roms) as a further consistency check. Third, since in a limited number of cases both the unconsolidated and the consolidated versions of the balance-sheets were available, the latter one was discarded. Fourth, only firms for which balance sheets (possibly with missing values) were available for the whole sample period, that is 1989-97 for France and the UK and 1991-97 fo Italy were kept into the panel. We are more than aware that the choice of imposing a balanced structure to our panel might introduce a sample selection bias. However, given the characteristics of our data source, the only available alternative choice would have been to include also those firms present in the second (1993-97) but not in the first (1989-93) cd-rom (being small the number of firms present in the first but not in the second cd-rom). However, this sample building strategy would have introduced a different, and possibily more serious, sample selection bias. In addition, it would have not been very helpful in the estimation of the leverage effect in recession, since data on recessionary years are concentrated in the first cd-rom. As it can be seen in Table A1, after these initial procedures we were left with 2751 firms (and therefore 24759 firm-year obervations) for France, 2581 firms (and 18067 obervations) for Italy and 2869 firms (and 25821 observations) for the UK.

The second step consisted in removing from the initial samples firms with missing values for the variables used in the econometric estimates. In particular we kept into these restricetd panels only firms for which the following balance sheet variables were available in each year: stocks recorded at book value (var6), shareholders funds (var11), non-current liabilities (var14), current liabilities (var17), total shareholders funds and liabilities (var21), and turnover (var25). We also asked the data to satisfy the obvious equality: var21=var11+ var14+var17. After dealing with the missing value problem, our initial samples dropped by 17.2% (from 2751 to 2277) for France, by 5.1% (fron 2581 to 2450) for Italy and by 39.1% (from 2869 to 1748) for the UK. The higher fall in the UK sample can be almost entirely attributed to the lack of the turnover variable for a larger number of firms.

Final samples were obtained by applying two different trimming procedures to our intermediate samples. First we removed from each intermediate sample firms with extreme observations of the stock to turnover ratio (var6/var25). Operationally, firms with at least one observation above the 0.99 or below the 0.01 quantile were excluded. The purpose of this procedure is to exclude firms with anomalously high/low levels (in proportion to total sales) of the dependent variables in our estimated equations. Second, we adopted a very similar procedure for the logarithmic first differences of all variables used in estimation: stocks (var6), turnover (var25), leverage ((var14+var17)/var21), short-term leverage (var17/var21), and maturity (var17/(var17+var14)). Operationally, firms with at least one observation above the 0.999 or below the 0.001 quantiles were excluded. In this case, the purpose is to exclude from the sample firms with very high growth rates in absolute value. After the two trimming procedures our samples further reduced to 2093 firms (and 18837 observations) for France, 2254 (and 15778 observations) for Italy and 1560 (and 14040 observations) for the UK.

Finally, in Table A2 firms are split according to a number of criteria. In particular both the French and the Italian panels are made exclusively by unconsolidated balance sheet data whereas for the UK 47.3% of the data represent consolidated figures. This might explain, at least partially, why the proportion of large firms - defined as firms with real sales larger than 20 million Ecus in the first sample year - is higher (64.9%) for the UK compared with France (51.7%) or Italy (43.7%). On the basis of the "year of foundation" variable, Italian firms turn out to be younger than their British and French counterparts. In fact the proportion of firms older than 10 years in 1989 is 65.8% for Italy which has to be compared with much higher figures for the UK (82.7%) and France (80.9%). Finally, according to the information provided by BVD, the proportion of firms listed on the Stock Exchange is very limited for Italy (0.78%) and France (1.48%). Only the UK sample shows a sizeable proportion of listed firms (16.0%), hampering the possibility of using the listed/non-listed status as an alternative candidate to proxy for the degree of capital market access.

Table A1. Sample Building Procedures

	Initial sample	Intermediate sample	Final sample
France	2751	2277	2093
Italy	2581	2450	2254
United Kingdom	2869	1748	1560

Table A2. Firms splits (%)

	Consolidation	Size (large)	Age (old)	Quotation
France	0.00	51.74	80.89	1.48
Italy	0.00	43.74	65.75	0.71
United Kingdom	47.31	64.94	82.69	16.28

Table 1
Descriptive statistics on real sales

	France	**Italy**	**UK**
Number of firms	2093	2254	1560
Number of obs.	18837	15778	14040
Sample period	1989-97	1991-97	1989-97

Statistics on **real sales**:

	France		**Italy**		**UK**	
	1989-1997	1989	1991-1997	1991	1989-1997	1989
Mean	60.00	58.27	52.09	47.51	224.36	226.06
Distribution:						
first quartile	13.50	12.55	14.24	12.52	16.81	16.01
median	21.98	20.78	20.61	17.86	30.97	29.52
third quartile	48.44	46.74	36.96	31.45	78.51	74.97

Note: sales are measured in millions of ECUs at constant exchange rates and constant prices (base year: 1990)

Table 2
Descriptive statistics on inventories and leverage measures
(whole sample)

	France	**Italy**	**UK**
Inventories			
Mean	0.134	0.174	0.133
Distribution:			
first quartile	0.072	0.092	0.073
median	0.118	0.149	0.123
third quartile	0.177	0.227	0.179
Leverage			
Mean	0.634	0.734	0.588
Distribution:			
first quartile	0.519	0.650	0.454
median	0.647	0.760	0.591
third quartile	0.762	0.844	0.725
Short-term leverage			
Mean	0.498	0.558	0.452
Distribution:			
first quartile	0.371	0.436	0.322
median	0.492	0.566	0.432
third quartile	0.618	0.683	0.565
Debt maturity			
Mean	0.786	0.753	0.779
Distribution:			
first quartile	0.700	0.663	0.667
median	0.818	0.774	0.831
third quartile	0.907	0.864	0.930

Note: "inventories" are expressed as a ratio to sales; "leverage" is computed as the ratio of total debt (short- and long-term) to total liabilities (debt and shareholders' funds); "short-term leverage" is computed as the ratio of short-term debt to total liabilities; "debt maturity" is computed as the ratio of short-term debt to total debt.

Table 3
Panel A. Sample composition by size and age

		France			Italy			UK		
		Large	Small	Tot.	Large	Small	Tot.	Large	Small	Tot.
Old	number of firms	903	790	1693	638	844	1482	854	436	1290
	size (mill. ECU)	99.5	14.4	59.8	107.4	16.2	55.5	366.4	16.0	247.9
	age (years)	39	33	36	29	24	26	48	39	45
Young	number of firms	180	220	400	348	424	772	159	111	270
	size (mill. ECU)	115.7	15.8	60.8	80.0	17.2	45.5	177.1	18.0	111.7
	age (years)	4	4	4	5	5	5	4	5	5
Tot.	number of firms	1083	1010	2093	986	1268	2254	1013	547	1560
	size (mill. ECU)	102.2	14.7	60.0	97.8	16.6	52.1	336.7	16.4	224.4
	age (years)	33	27	30	20	17	19	41	32	38

(Table 3/cont.d)

Panel B. Descriptive statistics for firms' groups
(mean and standard deviation in brackets)

		L/O	L/Y	S/O	S/Y
France	Inventories	0.134 (0.090)	0.146 (0.095)	0.135 (0.093)	0.121 (0.093)
	Leverage	0.622 (0.172)	0.647 (0.170)	0.634 (0.172)	0.669 (0.157)
	Short-term leverage	0.486 (0..171)	0.492 (0.177)	0.504 (0.167)	0.530 (0.170)
	Debt maturity	0.781 (0.157)	0.761 (0.175)	0.796 (0.145)	0.793 (0.159)
Italy	Inventories	0.175 (0.126)	0.180 (0.130)	0.174 (0.123)	0.169 (0.122)
	Leverage	0.720 (0.151)	0.732 (0.142)	0.732 (0.144)	0.763 (0.148)
	Short-term leverage	0.540 (0.166)	0.543 (0.173)	0.556 (0.166)	0.601 (0.182)
	Debt maturity	0.742 (0.139)	0.736 (0.159)	0.754 (0.142)	0.781 (0.156)
UK	Inventories	0.135 (0.079)	0.128 (0.080)	0.133 (0.083)	0.125 (0.083)
	Leverage	0.580 (0.185)	0.616 (0.172)	0.576 (0.202)	0.653 (0.187)
	Short-term leverage	0.441 (0.175)	0.475 (0.171)	0.455 (0.184)	0.484 (0.173)
	Debt maturity	0.771 (0.189)	0.779 (0.184)	0.802 (0.175)	0.756 (0.195)

Table 4
Inventory equations
Aggregate results
(dependent variable: inv_{it}; standard errors in parentheses)

	France	Italy	UK	France	Italy	UK	France	Italy	UK
inv_{it-1}	0.337	0.512	0.365	0.346	0.520	0.369	0.346	0.525	0.382
	(0.059)	(0.057)	(0.114)	(0.060)	(0.057)	(0.114)	(0.061)	(0.057)	(0.114)
sales_{it}	0.614	0.480	0.691	0.625	0.435	0.728	0.643	0.371	0.646
	(0.146)	(0.197)	(0.262)	(0.148)	(0.196)	(0.269)	(0.147)	(0.197)	(0.263)
sales_{it-1}	0.244	0.242	0.165	0.238	0.215	0.164	0.228	0.224	0.220
	(0.119)	(0.127)	(0.160)	(0.121)	(0.127)	(0.172)	(0.120)	(0.127)	(0.167)
lev_{it-1}	-0.315	-0.564	-0.283						
	(0.035)	(0.063)	(0.037)						
lev_{it-1}*R_t	0.014	-0.044	0.007						
	(0.022)	(0.022)	(0.025)						
stlev_{it-1}				-0.135	-0.247	-0.203			
				(0.021)	(0.030)	(0.028)			
stlev_{it-1}*R_t				0.007	-0.027	-0.002			
				(0.017)	(0.016)	(0.020)			
mat_{it-1}							-0.043	-0.160	-0.058
							(0.021)	(0.031)	(0.030)
mat_{it-1}*R_t							-0.016	-0.019	-0.004
							(0.022)	(0.027)	(0.046)
m_1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
m_2	0.47	0.09	0.03	0.47	0.10	0.03	0.45	0.10	0.03
$Sargan$	0.01	0.18	0.01	0.01	0.24	0.01	0.01	0.06	0.01
w_t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Note: sample period: 1991-1997 for France and the UK; 1993-1997 for Italy. All models are estimated in first differences. Time dummies are included in all equations both as regressors and as instruments. Standard errors (robust to heteroscedasticity) are reported in parentheses. Instruments: $lev\,(stlev, mat)_{it-2}, ...,\ sales_{it-2}, ...\ m_1$ and m_2 are tests for first- and second order residual serial correlation, asymptotically distributed as $N(0,1)$ under the null of no serial correlation. w_t is a Wald test for the joint significance of the time dummies (for all tests p-values are reported).

Table 5
Inventory equations: subsample results
(dependent variable: inv_{it}; standard errors in parentheses)

Panel A: France

	Subsample:			
	Large/Old	**Large/Young**	**Small/Old**	**Small/Young**
inv_{it-1}	0.308	0.472	0.334	0.401
	(0.072)	(0.076)	(0.070)	(0.137)
sales_{it}	0.585	0.669	0.480	0.855
	(0.309)	(0.202)	(0.167)	(0.318)
sales_{it-1}	0.121	0.170	0.189	-0.185
	(0.190)	(0.218)	(0.133)	(0.178)
lev_{it-1}	-0.297	-0.261	-0.288	-0.314
	(0.060)	(0.097)	(0.062)	(0.099)
lev_{it-1}*R_t	0.051	0.060	-0.027	-0.023
	(0.042)	(0.071)	(0.025)	(0.071)
m_1	0.00	0.00	0.00	0.00
m_2	0.69	0.11	0.40	0.29
Sargan	0.01	0.28	0.11	0.24
w_t	0.16	0.48	0.00	0.57

Panel B: Italy

	Subsample:			
	Large/Old	**Large/Young**	**Small/Old**	**Small/Young**
inv_{it-1}	0.519	0.397	0.531	0.399
	(0.101)	(0.120)	(0.095)	(0.100)
sales_{it}	0.498	0.804	0.044	0.757
	(0.353)	(0.329)	(0.205)	(0.425)
sales_{it-1}	0.150	0.579	0.231	-0.128
	(0.232)	(0.245)	(0.164)	(0.233)
lev_{it-1}	-0.349	-0.598	-0.638	-0.503
	(0.109)	(0.152)	(0.109)	(0.127)
lev_{it-1}*R_t	0.053	0.001	-0.030	-0.107
	(0.038)	(0.050)	(0.037)	(0.052)
m_1	0.00	0.00	0.00	0.00
m_2	0.30	0.06	0.56	0.25
Sargan	0.21	0.47	0.71	0.63
w_t	0.00	0.02	0.00	0.23

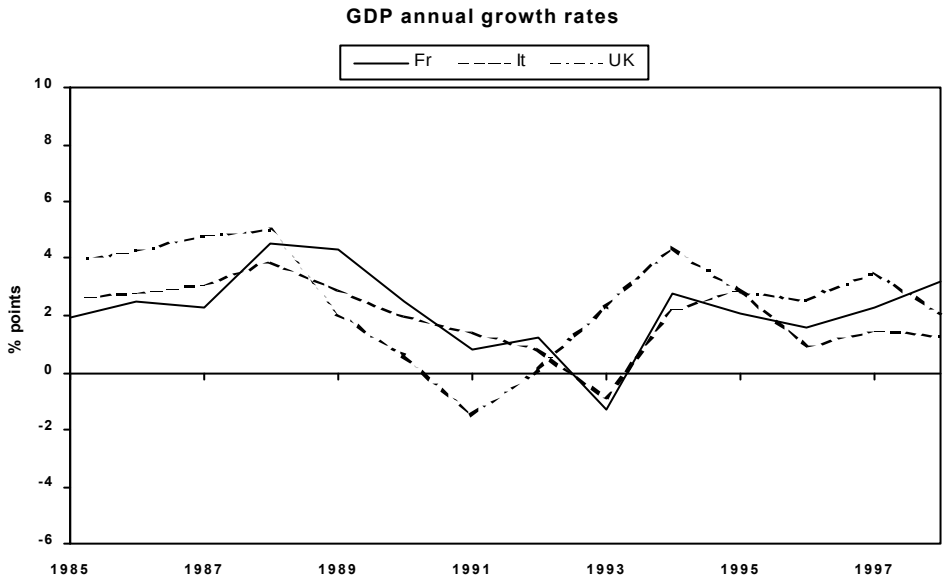
(Table 5/cont.)

Panel C: UK

	Subsample:			
	Large/Old	**Large/Young**	**Small/Old**	**Small/Young**
inv_{it-1}	0.138	0.563	0.162	0.149
	(0.108)	(0.080)	(0.152)	(0.082)
sales_{it}	0.287	1.279	0.828	0.853
	(0.237)	(1.163)	(0.413)	(0.404)
sales_{it-1}	0.234	-0.250	-0.083	0.008
	(0.151)	(0.240)	(0.157)	(0.283)
lev_{it-1}	-0.159	-0.608	-0.229	-0.198
	(0.051)	(0.201)	(0.060)	(0.102)
lev_{it-1}*R_t	-0.031	-0.004	-0.008	-0.008
	(0.022)	(0.099)	(0.055)	(0.069)
m_1	0.00	0.02	0.00	0.00
m_2	0.70	0.33	0.54	0.37
Sargan	0.00	0.66	0.02	0.66
w_t	0.00	0.00	0.00	0.19

Note: see Table 4. Instruments: $inv_{it-2}, ..., sales_{it-2}, ..., \Delta lev_{it-1}, \Delta(lev_{it-1} * R_t)$

Figure 1
Annual growth rates of GDP and industrial production (1985-1998)



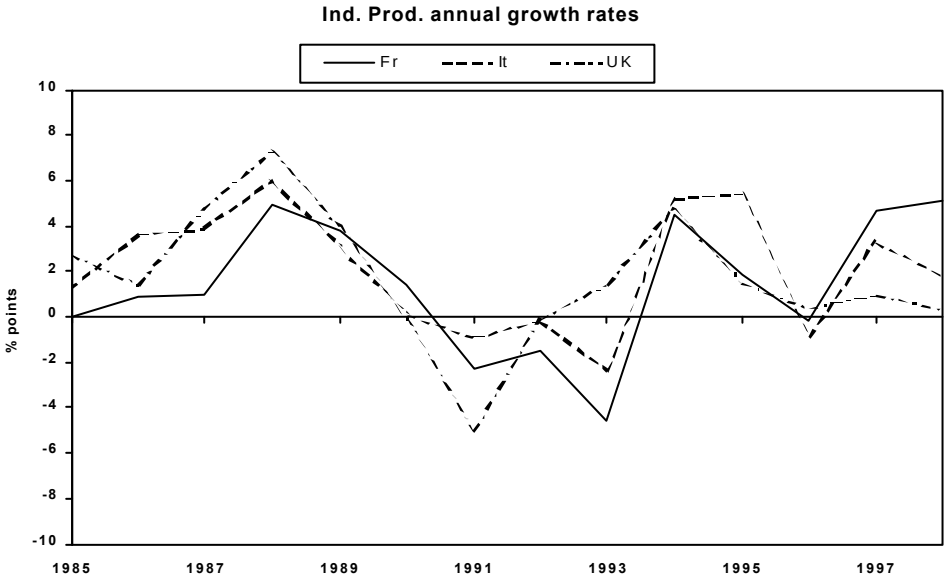


Figure 2
Real growth rates of sales and inventories (medians)

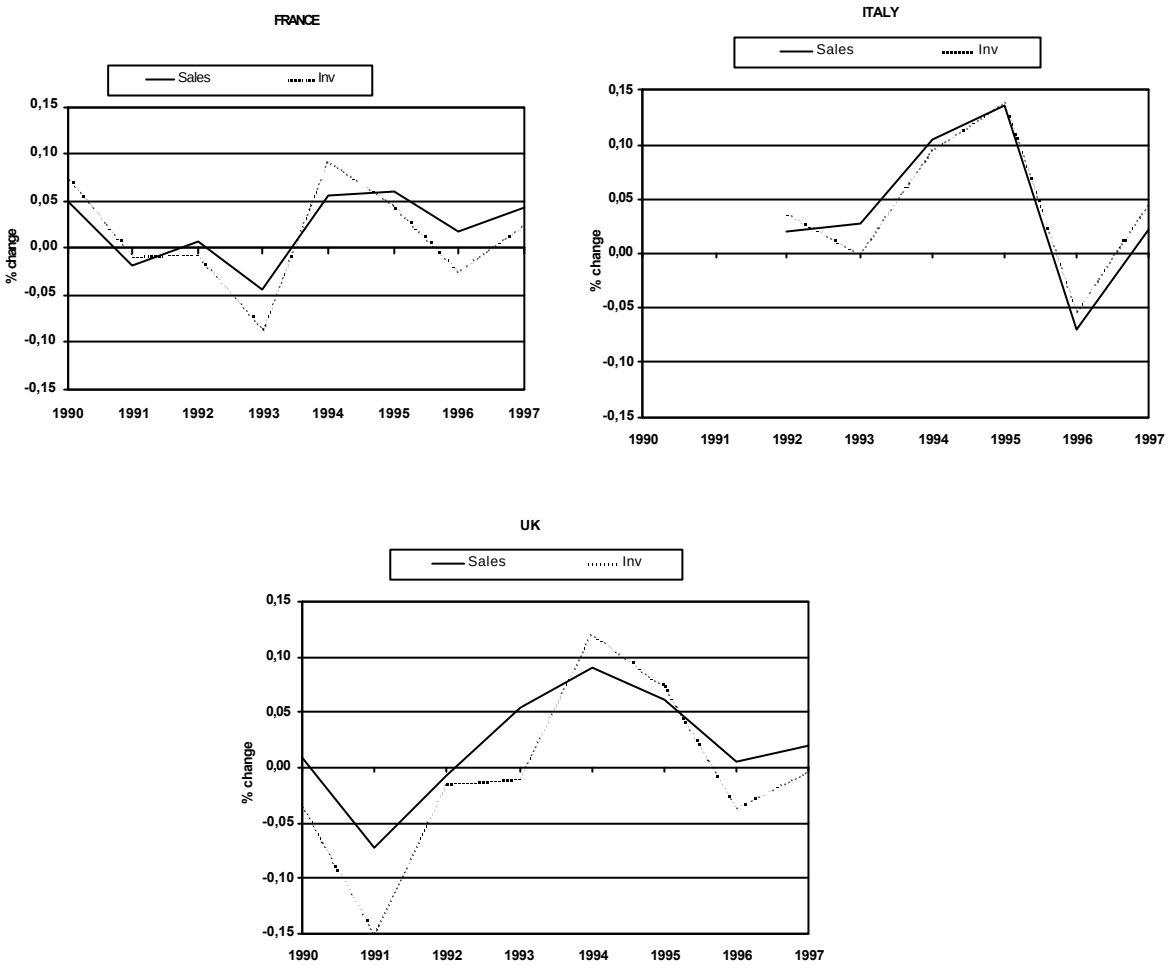


Figure 3
Coefficients on time dummies in equations for inventories
(with 95% confidence intervals)

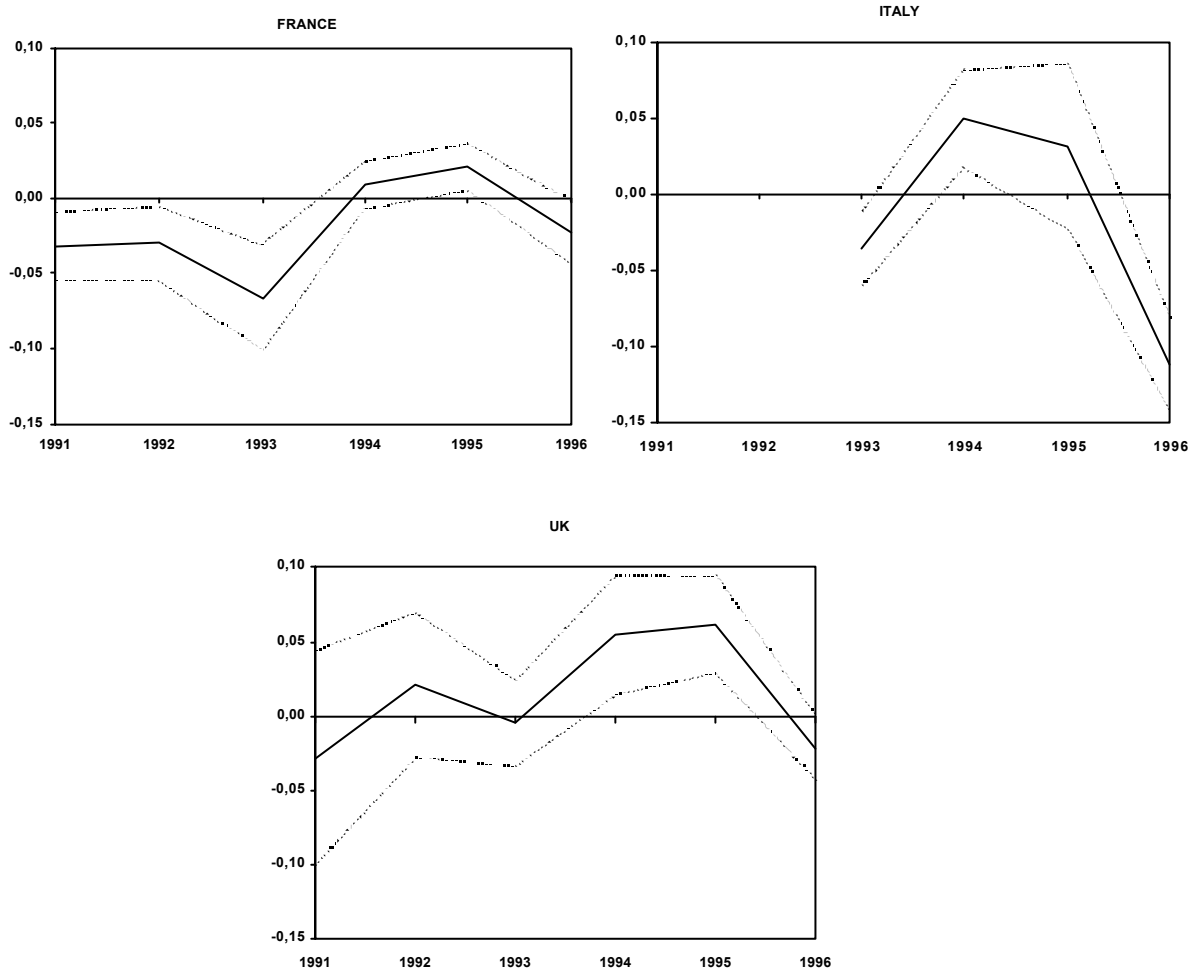


Figure 4
Coefficients on time dummies in equations for inventories for subsamples of firms