Investment and Growth in Europe and in the United States in the Nineties *

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Abstract

Questo lavoro analizza la forte divergenza nel processo di formazione del capitale fra i principali paesi dell'area dell'Euro e gli Stati Uniti negli anni novanta. La stima di una funzione di investimento a livello settoriale indica una rottura nel coefficiente che lega la crescita dello stock di capitale alla domanda sia nei paesi europei sia in quelli Anglo-Sassoni, ma di segno opposto: mentre è diminuito nei primi, è aumentato nei secondi. Questo risultato è in parte attribuibile all'aumento dell'incertezza sulla domanda in Europa e ad una sua riduzione nei paesi Anglo-Sassoni.

The paper analyzes the sharp divergence between capital formation in the leading euro-area countries and the United States in the nineties. We estimate an investment function at the sectoral level and find evidence of a break in the coefficient linking the growth of capital stock to demand in both the euro-area and Anglo-Saxon countries, but of opposite sign: while it declined in the former, it increased in the latter. This result is partly attributable to a rise in demand uncertainty in Europe and to a decrease in the Anglo-Saxon countries in the nineties.

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1 Introduction

One of the major changes in factor markets in the nineties was the sharp divergence between capital formation in the euro-area countries and that in the United States. Between 1990 and 1998 the average rate of growth of total (private and public) gross investment in the euro-area countries decreased by more than half compared with the eighties, while in the United States it nearly doubled. In 1998 the ratio of investment to GDP, calculated at constant prices, had declined to 24 per cent in the former; in the latter, it had risen to 26 per cent (Figure 1).

This contrasts sharply with the situation that prevailed in the early nineties. In 1990, the investment to GDP ratio barely reached 20 per cent in the United States, one of the lowest levels recorded in the post-war period; in the euro-area countries, the ratio was 6 percentage points higher, having increased steadily since the mid-eighties. The United States was seen to be in a structurally weak position compared with the other leading world economies; several authors felt that the most important reason for this weakness was the limited fixed capital formation in the US compared with that of the other industrial economies. The debate which developed between 1990 and 1991 stemmed in part from the fact that the United States was in a rather serious recession in those years, while continental Europe was enjoying strong growth, driven by the prospects of Germany's economic and political unification.

The acceleration of capital formation in the United States and the simultaneous deceleration in Europe in the nineties have often been attributed to the prolongation of the cyclical divergence between the two areas. As a matter of fact, the current expansionary phase of the US economy is not anomalous for its duration or intensity,[1] but rather for the especially high contribution from investment, as evidenced in the 1999 Economic Report of the President.[2] This would suggest that the growth of investment in this decade cannot be entirely explained by that of GDP;[3] analogous considerations may also be put forward for

[1] Previous expansionary phases of comparable duration are those of 1961-1969 and 1982-1990.

[2] Investment contributed about one fourth of the growth of the economy, as against an average of about one seventh in previous expansionary phases in the post-war period.

[3] In this expansionary phase, up to 1998.4, GDP grew on average by 3.1 per cent annually, which was less

the euro area.

Rather surprisingly, the gap between capital formation in the United States and Europe has not been the subject of detailed analyses. In this paper, we propose to fill in part this deficiency, first by presenting some "stylized facts" and then by developing an econometric analysis that will yield some clues to interpreting them. To this end, we have made use of the OECD's ISDB database, which contains annual data, comparable across countries, over long periods of time on value added at constant and current prices, investment and the capital stock for twenty-five productive sectors (see Appendix B). It is worth stressing that all our analyses used the data of the old national accounts for all the countries, so that the revisions and methodological changes recently introduced in the euro-area countries and in the United States are not taken into account.[4]

Our results show that the slowdown in capital formation in continental Europe and the corresponding acceleration in the Anglo-Saxon countries can be explained by a breakdown in the structural relationship between investment and demand: the responsiveness of investment to demand turns out to be substantially lower inEurope and higher in the Anglo-Saxon countries in the nineties compared to the previous fifteen years. We also find that, at least in part, the break of the "accelerator" can be attributed to demand uncertainty, adding a new piece of evidence, based on sectoral data, to the recent growing body of empirical analysis on the relationship between investment and uncertainty. Indeed, once we directly account for uncertainty, the instability of the investment function disappears.

The paper is organized as follows: Section 2 describes the long-term trends in capital formation in the leading industrial economies, utilizing the appropriately updated aggregate data, from the Penn World Table (see Appendix A), and shows that in this decade the value of the (ex-post) ratio between the rate of growth of investment and that of GDP has changed dramatically in the main euro-area countries and in the United States; Section 3 describes the strategy followed and the results of the econometric analysis, which was carried out to verify if the coefficient linking the growth of capital stock to value added (the so-called

than in 1961-1969 (4.8 per cent) and 1982-1990 (3.7 per cent).

[4] At the beginning of 1999, the euro-area countries adopted the ESA95 system of national accounts and in November of the same year the United States also revised their national accounts.

"accelerator") had changed structurally in the nineties in the leading euro-area and Anglo-Saxon countries (the United States, Canada and the United Kingdom); Section 4 explores whether this change can be related to sectoral features of the productive structure or to non-linearities in the relationship between capital formation and expected demand; Section 5 investigates the links between the break in the accelerator and the degree of demand uncertainty; the concluding section summarizes the main results.

2 Capital formation in the leading industrial economies in the post-war period.

Four distinct phases can be identified in the post-war period. In the fifties, the process of capital formation was influenced by the need to rebuild the capital stocks of the countries that suffered the most damage during the second world war. This necessity is the primary reason for the strong growth of gross fixed investment in continental Europe in this period and of the relatively higher ratio of investment to GDP with respect to the United States and the United Kingdom (Table 1 and Figure 1).

In the sixties and up until the onset of the first oil shock, the growth of investment remained strong in continental Europe; in the United States and Canada it accelerated significantly compared with the fifties. In this period, the share of output devoted to capital accumulation increased mainly in Spain and France; it remained essentially unchanged in the United States, the United Kingdom, Canada, Germany and the other European countries, except Italy where it declined significantly.[5]

The subsequent period, to the end of the eighties, was marked by a sharp deceleration in productive activity and investment everywhere; the ratio of investment to GDP declined slightly in all the leading industrial countries except Spain; in the United States, the ratio remained relatively low compared with that of the other countries.[6]

[5] In Italy, the share had reached a very high level in the early sixties, and then declined to that of the other leading European countries.

[6] The "stylized fact" that the ratio of investment to GDP in the United States in the last three decades has always been lower than that of the other industrial countries has been recently contended by Kirova M. and Lipsey R. [17]. They demonstrate that, utilizing a broader definition of "investment" to include

Finally, the nineties were characterized by great change with respect to the previous period. The rate of growth of investment in the United States, about 5 per cent on average, was by far the highest among the industrial nations; it was also a post-war record for the US economy.[7] The most striking aspect is the increase in the reactivity of capital formation to economic growth: the "ex-post" elasticity between investment and GDP rose to nearly 2, from 1 during the period 1974-1990 and from just above 1 during the sixties (Table 1). Comparison with the performance of the euro-area countries is harsh: with the exception of Germany and especially the Netherlands, the rate of growth of investment was by far the lowest in the post-war period; on average it was below 1 per cent. A possible "break" in the relationship between investment and growth may also be detected for these countries, but it is of the opposite sign to that of the United States; in fact, despite an average rate of GDP growth of nearly 2 per cent, investment increased by only 0.6 per cent in the euro area: "ex-post" elasticity is therefore just one third. In France and Italy, low, but positive, growth of GDP is actually linked to a negative average change in investment. Only in the Netherlands is the "ex-post" elasticity equal to 1 and higher than that in the previous period.

The situation does not change if we only consider private investment. In the Anglo-Saxon countries, the growth in public investment was extremely modest (less than one per cent) in the nineties and much less than in the eighties. In the United States, the "ex-post" elasticity calculated only with respect to private investment was close to 3. For the euro-area countries, however, comparing the performance of private and public investment is more difficult because a breakdown is not available for all of the countries. However, even considering the fact that public investment expenditure was constrained in most European countries by the need to meet the convergence criteria imposed by the Maastricht Treaty, it

expenditure on consumer durable goods, education, research and development, and also military spending, the investment to GDP ratio in the United States would increase on average by more than 12 percentage points from 1970 to 1989, as against an average increase of about 9 percentage points for the other twelve OECD countries. On the basis of this broader definition, the US ratio would not have been significantly different from the average of that of the other countries and, in the second half of the eighties, it would actually have been higher. In this paper, the theoretical and empirical problems connected with the proper definition and calculation of the capital stock are not explicitly dealt with. For a synthesis, see OECD [18].

[7] The rate of growth of private investment was 5.8 per cent, as against about 2 per cent in the previous period.

is still true that the performance of private investment was much worse than in the previous decade for most of the countries (Ferrando [14]).

The periodization used until now presents some difficulties. In 1990 continental Europe was enjoying a "boom", driven by the prospects of Germany's economic and political unification, but the Anglo-Saxon economies were experiencing a slowdown that turned into a recession in 1991. In order to take into account these major cyclical differences, we also calculated the rates of growth of GDP and investment on quarterly data, starting from the last cyclical peak.[8] In this way, a recession - that of the early nineties - and an expansion - the current one - are included for every country; we also disaggregated investment in machinery, equipment and means of transportation (the category that responds most rapidly to changes in overall economic activity) and construction.[9] The figures in Table 2 confirm what was found earlier. For investment in machinery, equipment and means of transportation, the elasticity with respect to GDP in the three Anglo-Saxon countries is very high, ranging from 2 to 3; it is much lower in the euro-area countries, with values ranging from a maximum of 1.4 in Spain, to 0.5 in Italy[10] and slightly below zero in Germany.

The "stylized fact" that forcefully emerges from this first analysis based on aggregate data is, therefore, the following. In the nineties the process of capital formation sharply decelerated in all the leading euro-area countries, except the Netherlands; however, this phenomenon does not appear to be linked only to low growth. In fact, GDP expanded at a rate that was not dramatically lower than that recorded in the previous period. Moreover, in the United States investment greatly accelerated but the increase in the rate of economic growth was not as pronounced.

[8] The data of the old national accounts was also used for these calculations for all countries. The cyclical turning points were determined by analyzing the cyclical component of GDP as computed by the Hodrick-Prescott filter with parameter $\lambda = 1600$.

[9] Unfortunately, we were not able to distinguish between "structures" and "residential", since this breakdown is not available on a homogenous basis for all countries.

[10] Note the particularly low value for Italy, despite the robust growth of investment fostered by the "Tremonti Law" over the two-year period 1995-96. In the eighties, the average rate of growth of investment in machinery, equipment and means of transport was over 3 per cent, while that of GDP was 2.2 per cent.

3 A structural break in the investment equation in the nineties?

The objective of the econometric analysis presented in this and in the following sections is to verify the "stylized fact" of Section 2. To this aim, we use the OECD's ISDB, which includes data on capital stock, investment and value added comparable across a number of countries and for the most important industrial and service sectors.[11] The sectoral dimension increases the degrees of freedom in the estimation of an investment equation and allows us to test for the presence of a structural break at the beginning of the nineties, which would not be possible with aggregate data only. Though ISDB is a very useful data base, some of its limits must be noted. First, information is only available for six of the euro-area countries: Germany, France, Italy, the Netherlands, Belgium and Finland.[12] Among the leading European countries, Spain is excluded. Another problem is that disaggregated data are not available for unified Germany and the statistics for West Germany and Italy are only available up to 1994.[13] In addition, it is worth noting that the degree of disaggregation available, essentially the 25 branches of the NACE classification, is not sufficient to classify the sectors on the basis of the technological content of the goods they produce.[14]

Our estimates are based on a panel of annual data for the following nine countries: the United States, Canada, the United Kingdom, Germany (western regions), France, Italy, Belgium, the Netherlands and Finland and refer to the sectors available in the ISDB.[15] The data set is an unbalanced panel since not all the information is always available for all the sectors and countries included in the analysis (see Appendix B). The econometric analysis covers the period from the second half of the seventies (1975) to the date of the

[11] We used the latest available version of the ISDB, made public by the OECD in early March 1999.

[12] These countries account for more than 80 per cent of euro-area GDP.

[13] We verified that the data for Italy in the ISDB coincide with those produced by the National Institute of Statistics (Istat). The latest official Istat release on investment and the capital stock, broken down according to the NACE classification, dates back to the summer of 1997 and contains data up to 1994; for a few macro-sectors, data are available up to 1996.

[14] For a brief description of the main features in terms of the sectoral composition of value added and investment in the United States, Germany, France and Italy see Ferrando [14].

[15] The following five sectors were excluded from our estimates: agriculture, construction, services provided by the general government, services provided by non-profit institutions and "other services". The last sector includes investment in residential construction and weighs heavily in all the countries. We excluded these categories since they are characterized by extremely erratic behaviour of both investment and value added. For all the countries in our sample, the sectors that were included in our estimates account for approximately half of total (public and private) gross fixed investment and capital stock.

latest available data.[16] As will be clarified below, because of the estimation procedure we have adopted, each sector-country observation has been treated as an independent unit, say j, so our panel actually has two dimensions.

We started our analysis by estimating a standard investment equation for two separate groups of countries: the euro area and the Anglo-Saxon countries. This division is justified first on geo-political grounds but it also reflects, as will be shown below, distinctive economic features that emerged in the nineties.

We use the standard neoclassical framework (Jorgenson [16]) to empirically derive the investment function. In the absence of adjustment costs, the long-run capital stock for a profit maximizing firm with a constant-returns-to-scale CES technology would be a (non-linear) function of the user cost of capital, r, and the level of demand, Y:

$$K_t^* = \left(\frac{r_t}{a}\right)^{-\gamma} Y_t \tag{1}$$

where a is a constant and $0 < \gamma < 1$ a parameter. In this case, the (gross) investment function would simply be:

$$I_t = K_t^* - K_{t-1} + \delta K_{t-1} = \left(\frac{r_t}{a}\right)^{-\gamma} Y_t - K_{t-1} + \delta K_{t-1} \tag{2}$$

where δ is the depreciation rate. Dividing (2) by K_{t-1} and linearizing around the steady state values $\{r^*, \left(\frac{Y}{K_{t-1}}\right)^*\}$ yields:

$$\frac{I_t}{K_{t-1}} = \theta_0 + \theta_1 \left[\frac{Y_t}{K_{t-1}} - \left(\frac{Y}{K_{t-1}}\right)^*\right] + \theta_2[r_t - r^*] \tag{3}$$

where the θ's are constants. To estimate this model using country-sectoral data, we assumed that steady-state levels can be accounted for using additive year specific effects (λ) and country-sector specific effects (μ). In the presence of adjustment costs, the actual capital stock will not adjust immediately to the desired level; we therefore augmented (3) by the

[16] Though most of the data are available from the early seventies, we chose to exclude the first oil shock from the econometric analysis owing to the dramatic effects it had on capital accumulation in almost all the industrial countries.

lagged dependent variable. Thus, the basic regression we run can be written as:

$$i_{j,t} = \alpha_0 + \alpha_1 i_{j,t-1} + \alpha_2\, y_{j,t} + \alpha_3\, r_{j,t} + \lambda_t + \mu_j + \nu_{j,t} \tag{4}$$

where: $i_{j,t}$ is the ratio of gross investment at time t to the gross capital stock at time $t-1$ in unit j; $y_{j,t}$ is the ratio of value added at time t to the gross capital stock at time $t-1$ in unit j; $r_{j,t}$ is a measure of the user cost of capital at time t and in unit j; λ_t are time dummies, μ_j are unit dummies and $\nu_{j,t}$ is an error term. By introducing μ_j, we are able to control for country-sector differences in the intercept of our equation; with λ_t we are able to control for shifts in the intercept over time, under the hypothesis that these shifts are not country-specific. As will be demonstrated below, the year dummies are particularly important in our analysis. Value added is a proxy for the demand expected by investors;[17] since data are not available for all countries and for all sectors on the user cost of capital, this variable is approximated with a measure of the real interest rate.[18] For each country this is calculated by deflating the respective long-term nominal interest rate using the average five-year change in the value added deflator of each sector; in this way, a variable that captures both national and sectoral characteristics can be obtained. The main results presented here would not change if the real interest rate were set equal for all sectors in each country and calculated on the basis of an average indicator of inflation (for example, the total value added deflator).

Although one could argue that $y_{j,t}$ is an endogenous variable, with sectoral data at two digit level the assumption of the exogeneity of value added may be maintained.[19] However,

[17] This is an obvious shortcut; this choice, however, can be rationalized on the ground that investment observed at time t was planned at time $t-1$ on the basis of demand expected at time t by fully rational investors.

[18] Note that the user cost of capital, c, is given by:
$c = \frac{(1-B)}{(1-\tau)} q(i + \delta - \pi)$
where τ and B represent the tax rate and investment incentives, respectively, i is the nominal interest rate, π is the expected rate of change of output prices and q is the ratio of capital goods prices to output prices. Thus our simplification implies that the term $\frac{(1-B)}{(1-\tau)} q$ is constant and that δ is sufficiently small. As regards the relative price of capital goods with respect to final goods, q, we verified that, at the aggregate level, it shows a downward trend in our estimation period common to all countries. Therefore, the effects of this variable, though not explicitly taken into account in equation (4), are however captured by the time dummies, λ_t.

[19] Relaxing this assumption does not significantly change the results.

in (4), the lagged dependent variable, $i_{j,t-1}$, is a function of the individual effects, so that the OLS estimator is biased and inconsistent. Therefore, to estimate this dynamic regression model we rely on the GMM estimator system suggested by Arellano and Bover [2], Blundell and Bond [4] and Arellano and Bond [2] that combines equations in first differences and equations in levels. In the former, due to the differentiation, unit specific effects μ_j (i.e. country-sector effects in our sample) have been eliminated. Therefore, in these equations, if there is no serial correlation in the time-varying component of the error term, endogenous variables lagged two or more periods are valid instruments. The absence of serial correlation is tested by examining the first-differenced residuals: if the disturbances are not serially correlated, there should be evidence of significant negative first order serial correlation and no evidence of second order serial correlation in the differenced residuals[20]. Finally, if the variables are mean stationary, then lagged differences can be used as instruments in the equations in levels. The set of instruments used in each of the regressions presented below is reported in the notes to the corresponding table and the validity of instruments has been checked via a Sargan-Hansen test of over-identifying restrictions.[21] As standard in the literature, in the tables we present two step estimates with one step standard errors, since the asymptotic standard errors for the two-step estimators can be unreliable in finite samples (Bond et al. [5]). Standard errors and test statistics are robust to heteroskedasticity.

Before commenting on the results, one clarification is necessary. The number of observations available for the Anglo-Saxon countries is relatively small (less than half those available for the euro-area countries); with the GMM-system estimator too many instruments relative to the cross-section size of the sample might generate a small sample overfitting bias (Arellano and Bond, [2]) and reduce the power of the Sargan-Hansen test to detect any instrument invalidity. To limit this problem, we used a minimal set of instruments. This caveat must be borne in mind for the rest of the paper; it also implies that we are less confident about the conclusions drawn from our analysis for the Anglo-Saxon countries than

[20] The test-statistics are based on the standardized average residual autocovariances and are asymptotically distributed as $N(0,1)$ under the null hypothesis of no autocorrelation.

[21] The Sargan test is distributed as a χ^2 with degrees of freedom equal to the number of instrumental variables minus the number of parameters.

for the euro-area countries.

Results are reported in Table 3. All the explanatory variables, including the real interest rate, have the expected sign and are significant, both for the euro area and the Anglo-Saxon countries. The estimates of the year dummies for the euro-area countries (not reported here) are all negative after 1991, with the exception of 1995. Only the estimate for 1993 is statistically different from zero; this result seems quite reasonable since in 1993 there was a rather deep recession in continental Europe.[22] The values of the tests indicate that the instruments we used are valid (Sargan test) and that our residuals display the expected serial correlation pattern; in fact, the first-differenced residuals present a significant negative first order serial correlation and there is no evidence of second order serial correlation. As already mentioned, however, test statistics indicate that the estimates are less reliable for the Anglo-Saxon countries: in particular, the high p-value for the Sargan-Hansen test might indicate overfitting.[23]

As we have shown in Section 2, the European countries recorded a substantially weaker process of capital formation in the nineties, but the growth rate of output was only marginally weaker than that recorded in the previous period. This slowdown can be explained either by the dynamics of other variables, namely the real interest rate, or by a structural change in the nineties in the value of some parameters of the investment equation. By referring to (4), this second possibility may be rationalized in two different ways: first, it could be the case that the investment function has simply recorded a downward shift (i.e. a permanent decrease in the value of α_0); second, the value of α_1, α_2, or α_3 could have changed.

Formal tests of instability of the coefficients, not reported for brevity, show that the investment equation is indeed characterized by a structural break in the nineties stemming from a change in the parameter that links investment to demand (α_2), while no changes can

[22] The values of the year dummies are expressed as deviations from that of 1976.

[23] For the Anglo-Saxon countries, we have estimated the equation in column [2] also with the traditional (non-system) GMM procedure, where only the lagged levels of the endogenous variables are used as instruments of the equation in first difference. Also in this case we have used a minimal set of instruments. We obtain a p-value of the Sargan test of 0.463, that is considerably below 1. All the variables maintain their expected sign and are still significant; in particular the coefficient of the "break" is still positive and significant.

be detected in the parameters of the other regressors.[24] Moreover, we also find evidence that the break occurred at the beginning of the nineties.[25] Therefore we rewrite (4) as:

$$i_{j,t} = \beta_0 + \beta_1 \, i_{j,t-1} + \beta_2 \, y_{j,t} + \beta_3 r_{j,t} + \beta_4 D_{91} y_{j,t} + \lambda_t + \mu_j + \nu_{j,t} \tag{5}$$

where D_{91} is a dummy variable that takes the value 1 after 1991 and 0 before.

In Table 3, column [2] and [4] report the results obtained by running the regression in equation (5). For the euro-area countries, column [2] shows that β_4 is significant and negative; for the Anglo-Saxon countries the results are qualitatively very similar, except that β_4 is now positive. Note that the coefficients on the lagged dependent variable, and the real interest rate do not change with respect to those reported in column [1] and [3] respectively.

This analysis shows that in both groups of countries the instability of our investment equation stems from a change in the parameter that links investment to expected demand, the so-called "accelerator". These results therefore suggest that the divergence of the two groups of countries could be due to a structural change in the response of capital accumulation to demand, leading to a pronounced deceleration of investment in the euro-area countries and to a sharp acceleration in the Anglo-Saxon countries.

4 The role of sectoral composition and nonlinearities

The next step is to investigate the source of the break found in the previous section. A first conjecture could be that it is somehow related to the sectoral composition of the productive structure of the two groups of countries. One could argue that the weak accumulation in the euro-area countries was related to their specialization in manufacturing rather than services.[26] Since manufacturing sectors are more cyclical and tend to respond more quickly to changes in expected demand than services, one could expect that once the sectors were

[24] Formal tests of instability of all the coefficient are reported in Caselli P., Pagano P. and Schivardi F. [7].

[25] We estimated (4) recursively for each of the two groups of countries. The results show that 1991 is the first year in which the estimate of β_2 falls outside the confidence bands prevalent in the eighties, suggesting that the break occurred then.

[26] See Ferrando A. [14] for a description of the sectoral productive structure in the leading countries.

split into manufacturing and services, the negative break in the euro-area countries would be even sharper for the former, but that there would not be any break at all for the latter. This, however, does not seem to be fully supported by the data. As shown in Table 4, the value of the accelerator and of the (negative) break is indeed higher for manufacturing sectors, but services also recorded a significant negative break in the nineties;[27] actually the percentage reduction in the value of the accelerator was nearly the same for the two groups of sectors. The results for the Anglo-Saxon countries are qualitatively very similar, with the value of the accelerator for both manufacturing and services increasing by roughly equal percentages. Contrary to the euro-area countries, the value of the accelerator and that of the (positive) break are higher for services than for manufacturing in the Anglo-Saxon countries.

As already mentioned, beginning in the early nineties economic activity decelerated in the euro-area countries, but it accelerated in the Anglo-Saxon countries; thus, the break in the accelerator could be explained by a nonlinear relationship between capital formation and demand. In fact, investment might react proportionally more to substantial changes in demand because of the presence of fixed costs related to capital accumulation or to the indivisibility of capital goods (Caballero and Engle [6]). First we tested this hypothesis by introducing a quadratic term, y_t^2, in (5) but it turned out to be not significant for both groups of countries. We then tried a second strategy: for the euro-area countries we split the sectors into two groups of ten, according to the average growth rate of value added recorded after 1991 compared with that recorded before. For the euro-area countries, it turned out that the *low growth* sectors are those in which the rate of change of value added declined by at least 2.2 percentage points with respect to the previous period; for the Anglo-Saxon countries, the *high growth* sectors are those for which it increased by at least 0.8 percentage point.[28] We conjecture that, in the euro area, the sectors that experienced

[27] We actually split all the sectors into manufacturing and "other"; thus services also includes mining and quarrying and electricity, gas and water. We checked the robustness of our results by running another equation where the sectors were split into services and "other" and we obtained the same results.

[28] For the euro area the *low growth* sectors mainly include manufacturing sectors, apart from financial services and wholesale and retail trade; they account for 45-50 per cent of the value added of all the sectors considered in our estimates. For the Anglo-Saxon countries the *high growth* sectors account for 30-35 per cent of the value added. Six of the ten sectors coincide: wholesale and retail trade, chemical products and

a drastic deceleration in demand reacted by decelerating capital accumulation even more, while in the remaining sectors the response of investment to expected demand remained similar to that experienced before 1991.[29] On the contrary, in the Anglo-Saxon countries, the sectors in which the rate of growth of demand sharply increased reacted by accelerating investment even more.

However, here again, the results do not support our initial conjecture (see Table 4). For the euro-area countries, the value of the accelerator is, as it should be, very similar for the two subgroups before 1991; after that year, both subgroups recorded a negative break, which was even sharper for the sectors in which the rate of growth of demand did not significantly decline; moreover, the coefficient of the break estimated for the other subgroup is barely significant. The results for the Anglo-Saxon countries are also very similar, with the difference that in this case the high-growth sectors seem to record a larger break.

Overall, this line of investigation did not prove very fruitful, since it was not very helpful in explaining the break in the accelerator. So far, this phenomenon does not seem to be associated either with the productive structure prevailing in the two groups of countries or with the changes in the growth rate of demand which characterized the nineties. The fact that the break is not explained by sectoral composition is also indirectly supported by considering that the euro-area countries present a rather heterogeneous specialization pattern among themselves; hence, it would be difficult to attribute the break indicated by our estimates to some common feature of the productive structure of the countries in our panel.

5 The role of demand uncertainty

A growing body of theoretical and empirical literature has stressed the relevance of uncertainty in the process of capital formation. In particular, the literature on investment under

four branches of machinery and equipment.

[29] This kind of nonlinear response may be razionalized by assuming that, at the end of the eighties, the former sectors were accumulating capital stock under the assumption that demand would grow in the future at the same pace as it had in the past; so when demand decelerated a few years later, excess capacity had to be unloaded.

uncertainty predicts investment threshold behaviour. Abel and Eberly [1] show that, in a model with partial irreversibility, the investment thresholds can be represented by the standard "user cost of capital" plus a positive "real option term" at the investment threshold and less a positive "real option term" at the disinvestment threshold. In this framework investment takes place only when the marginal revenue product of capital hits the upper threshold and disinvestment only takes place when it hits the lower threshold. These thresholds are functions of the degree of uncertainty, irreversability and also the state of expected demand; in particular, for given level of expected demand and degree of irreversability, the theory predicts that the thresholds are increasing in uncertainty about demand; then, an increase in demand uncertainty causes a reduction in investment.[30] To test this hypothesis, the specification of the investment function (5) should be modified to include an interaction term between uncertainty and demand, $\sigma_t y_t$.[31]

We first explored the link between demand uncertainty and the break in the accelerator by calculating several indicators of demand variability for the four leading euro-area countries and the Anglo-Saxon countries.[32] A rather surprising picture emerged (Table 5): in the Anglo-Saxon countries, with the exception of Canada, there was a significant reduction in the variability of demand in the nineties; all the indicators, both backward and forward looking, point to this fact; in the euro-area countries the results indicate an increase in variability in Germany, France and Italy; the Netherlands once again seems to behave differently, recording a rather significant decrease.

The increase in demand uncertainty thus seems to be another possible reason for the sluggish process of accumulation in Europe in the nineties. To test this hypothesis we

[30] A similar approach can also be found in Dixit A. and Pindyck R. [9] and in Pyndyck R. and Solimano A. [21]. For a comprehensive survey of the literature on investment and uncertainty see Guiso L. and Parigi G. [15].

[31] By estimating an investment equation similar to (4) on data derived from the sample of Italian firms of the Bank of Italy's investment survey, Guiso L. and Parigi G. [15] find a significant negative effect of uncertainty on capital formation. Bloom N. et al. [3] using a panel of UK firm data find that uncertainty reduces firms' sensitivity to demand in the short run, while the effect disappears in the long run. Empirical evidence on the effects of volatility from various sources on capital accumulation is also reported in Pindyck R. and Solimano A. [21].

[32] The backward looking indicators of variability include the coefficient of variation of the rate of growth, with respect to the previous quarter, of domestic demand net of inventories and public consumption, and of aggregate demand (i.e. the same variable plus exports); the forward looking indicator of variability is the standard deviation of the expected short-term trend in industrial production (see Appendix B).

chose the following two-step strategy. First, we followed an indirect approach and divided the sectors into two groups: those for which the variability of demand increased from 1991 onwards and those for which it decreased. As a measure of demand variability we considered the standard deviation of the rate of growth of sectoral value added. The analysis was carried out separately for the euro area and the Anglo-Saxon countries (see Appendix B for more details). For the euro-area countries, the standard deviation only increased in four sectors; it remained unchanged in six sectors and it decreased in the remaining ten. The first four sectors are: agricultural and industrial machinery, metal products, transport equipment and financial services; in each country they account for 15-20 per cent of the value added of all the sectors included in our empirical analysis At first, this might seem at odds with the previous findings concerning demand variability at the aggregate level (see Table 5). It should be stressed, however, that the two measures are not directly comparable: first, here we use annual rather than quarterly data; second, fewer data are available at sectoral level after 1991, so that we are obviously underestimating variability in many cases since we are not able to consider a complete economic cycle after 1991.[33] For the Anglo-Saxon countries, in accordance with the previous findings at aggregate level, we found that the variability sharply declined for almost all the sectors.

Our "a priori" is that once the sectors have been divided between those in which uncertainty increased and those in which it decreased, the coefficient β_4 should be greater, in absolute value, for the former in the euro-area countries; actually, if uncertainty is the "true" cause of the structural break, we might even expect a positive sign for the latter. For the Anglo-Saxon countries we expect exactly the opposite. To test this conjecture, we estimated the equations reported in Table 6.

We divided our sample into two subgroups (for each of the two groups of countries), according to whether or not variability increased in the nineties. For the euro-area countries, the results confirm our "a priori": we found that the absolute value of the break is higher for the first group; for the others, it is not only lower but also not significantly different

[33] This is particularly true for Italy and Germany, for which data are available up to 1993-1994; hence, for these two countries we have only one observation belonging to the upswing after the recession of 1992-1993.

from zero. The estimates of the coefficient of y_t before 1991 are very similar for both groups of sectors, as they should be, given that the sectors were classified based on events that occurred after 1991. For the Anglo-Saxon countries our findings are also as expected: the positive coefficient of the break is to be higher for the subgroups of sectors where variability declined; moreover, for the other subgroup it is not statistically different from zero.

In general, we interpret these first results as consistent with the claim that increased uncertainty might have played a role in changing the relationship between capital formation and demand in the nineties, particularly for the euro-area countries.

The second step of our strategy was to follow a direct approach. In fact, if demand uncertainty is one of the determinants of the break in the accelerator, then introducing direct measures of uncertainty into (5) should reduce the significance of β_5 and/or its absolute value. Of course, it is difficult to identify a satisfactory proxy of uncertainty in our case. First, we would like a measure that captures investors' forward-looking expectations; second, we need a sector-specific as well as country-specific measure. Because of problems of data availability, we had to compromise and choose a forward-looking indicator that is country-specific but not sector-specific. Specifically, our measure of demand uncertainty is given by the standard deviation, within each year, of the expected short-term trend in industrial production derived from national surveys (see Appendix B). This choice can be partially rationalized by our previous findings (see Section 4) that sectoral characteristics do not seem to have played a crucial role in the break in the accelerator in the nineties. Large swings of our indicator, within a given year, mean that a relative large proportion of firms have shifted from positive/negative to negative/positive expectations about future demand. We claim that this situation indicates higher uncertainty, as perceived by producers, compared with one in which the proportion of firms expecting positive (or negative) demand remains broadly constant.

Accordingly (5) was modified as follows:

$$i_{j,t} = \beta_0 + \beta_1\, i_{j,t-1} + \beta_2\, y_{j,t} + \beta_3\, r_{j,t} + \beta_4\, y_{j,t}\, D_{91} + \beta_5 \sigma_t y_{j,t} + \lambda_t + \mu_j + \nu_{j,t} \qquad (6)$$

where σ_t represents our indicator of demand uncertainty. As mentioned before, we follow Guiso and Parigi [15] and introduce σ_t interacted with $y_{j,t}$.

Table 7 reports the estimates of (6) for the two groups of countries. For the euro-area countries β_5 turns out to be negative, as expected, and highly significant, confirming previous results from the literature (Guiso and Parigi [15]; Bloom et al. [3]).The break is still negative, but smaller in absolute value (see Table 3) and not significant. Results for the Anglo-Saxon countries are less clear-cut: while the uncertainty term turns out to be not significant, the break is still positive, but much smaller than before and hardly significant.

To summarize, the results are rather encouraging. We claim that (increased) uncertainty played a role in the observed sharp deceleration of capital accumulation in Europe, though this is probably only a part of the explanation. For the Anglo-Saxon countries, there is clear econometric evidence that the value of the accelerator increased, and that uncertainty might have payed a role, even if the limited size of the sample requires some more caution in interpreting the results.

6 Concluding remarks

This paper shows that the relationship between capital formation and productive activity profoundly changed in the nineties in both the euro-area countries and the Anglo-Saxon countries. In the euro area, the economy grew at rates that were only slightly below those recorded in the period from the first oil shock to the end of the eighties, yet growth in investment was very weak, at times even negative. To the contrary, in the Anglo-Saxon countries, especially in the United States, growth in investment was very strong and even exceeded expectations based on the growth of the economy, which was also very high.

The econometric estimates reported in the previous sections show the presence of structural instability at the beginning of the nineties in both groups of countries; in particular, there was a break in the coefficient linking capital accumulation to value added. This phenomenon does not seem to be related either to the sectoral composition of the productive structure or to a nonlinear relationship between investment and expected demand. Rather, we find evidence that the structural breaks could be linked to the changes in economic

uncertainty which, with opposite signs, characterized the two macro areas we study. This indicates that the role of uncertainty in explaining the slowdown in capital accumulation in Europe and its acceleration in the US is worth further consideration. In particular, given the problems related to the measurement of uncertainty, it would be important to check if the results are robust to the use of other measures of uncertainty, such as those obtained from the behavior of the stock market indexes or from direct surveys with the entrepreneurs.

A Appendix

A.1 The aggregate data

The aggregate analysis in the first section of this paper was based on the Penn World Table data series (Mark 5.6), which cover the period 1950-1992 for all the countries considered.

The database was extended to 1998 using the rates of change published by the European Commission ([11] and [12]) for the individual variables (population, GDP, investment, etc.).

As regards the data on Germany, the Penn World Table series were used until 1990 for the western regions; from 1991 onwards, the series were extended using the rates of change of the corresponding aggregates for unified Germany. This methodology has the advantage of avoiding the introduction of discontinuities in the series; however, it has the obvious drawback that, in the nineties, the levels of the variables are not comparable with the official German data.

The series for the Euro-11 were constructed by summing, in levels, those of the eleven participating countries (including Luxembourg).

This methodology of aggregation is justified by the fact that all the series refer to phenomena "in real terms", expressed in thousands of units (population) or in constant 1985 dollars. It is important to note that in the Penn Tables, data in national currencies are converted into dollars using the corresponding PPPs for 1985 and not the nominal exchange rates of the same year.

A.2 Sectoral data and measures of demand variability

Sectoral data

The source of the sectoral data is the "International Sectoral Data Base" (ISDB) prepared by the OECD and documented in OECD [19]. The database contains variables at current prices expressed in national currencies and at constant prices expressed both in national currencies and in 1990 dollars for the main sectors of the economy according to the ISIC classification. Table B1 lists these sectors and the period for which the data are available for each country and sector.

The OECD adopts the following abbreviations for the sectors:

BMA	Metal products, except machinery and transport equipment
BMI	Basic metal industries
CHE	Chemicals, rubber and plastic products
EGW	Electricity, gas, water
FNS	Financial institutions and insurance
FOD	Food, beverages and tobacco
HOT	Restaurants and hotels
MAI	Agricultural and industrial machinery
MEL	Electrical goods
MID	Mining and quarrying
MIO	Office and data processing machines and precision instruments
MNM	Non-metallic mineral products
MOT	Other manufacturing industries
MTR	Transport equipment
PAP	Paper and paper products, printing and publishing
RWH	Wholesale and retail trade
SOC	Community, social and personal services
TEX	Textiles, clothing, leather and footwear industries
TRS	Transport and communication services
WOD	Wood and wood products, including furniture

The variables used in the estimates are: gross value added at constant prices; gross fixed investment at constant prices; and gross capital stock at constant prices. All the variables were converted from the respective national currencies into 1990 dollars by applying purchasing power parities for GDP and gross fixed capital formation calculated and published by the OECD. In addition, in order to construct an indicator of the real interest rate, the deflator of sectoral value added was used; this was obtained as the ratio of value added at current prices, expressed in national currencies, to that at constant prices.

For the United States, the gross capital stock data are only available to 1993; therefore, they have been updated by using the rate of change of the net capital stock, which is available to 1996.

Note that in the ISDB investment and capital stock are broken down by proprietor branch but not by type; so investment includes all the capital goods - machinery, equipment, transport equipment and construction - accumulated in a given year by a specific productive sector.

Measures of demand variability

The sectoral standard deviations for the two sub-periods before and after 1991 were constructed in two steps: first, the standard deviation of the rate of growth of sectoral value added was calculated for each country and for each sub-period; second, a weighted average of the national values was calculated for each sector and for each sub-period; the weights used were the number of available observations for each country.

The direct measure of demand uncertainty was calculated from the expected short-term trends in industrial production, based on surveys conducted, on a monthly basis, in each country by the respective national institutes (for Italy, ISAE). This indicator reports the balance between positive and negative responses by manufacturing firms, expressed in percentage terms. We computed, within each year, the standard deviation of this indicator and used it as a proxy of uncertainty. This measure is therefore equal for all sectors, although

it varies over time and across countries. Large swings of this indicator, within a given year, mean that a relative large proportion of firms have shifted from positive/negative to negative/positive expectations about future demand. We claim that this situation indicates higher uncertainty, as perceived by producers, compared with one in which the proportion of firms expecting positive (or negative) demand remain constant.

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Table 1

GDP AND TOTAL GROSS INVESTMENT IN THE LEADING INDUSTRIAL COUNTRIES
(average percentage changes)

Periods / Countries	1951-1960		1961-1973		1974-1990		1991-1998	
	Y	I	Y	I	Y	I	Y	I
United States	3.0	1.0	4.2	4.8	2.3	2.3	2.6	4.9
Canada	4.0	3.3	5.5	5.6	3.1	4.7	2.2	2.6
United Kingdom	2.8	7.7	3.2	4.6	2.0	1.4	1.8	0.8
Euro 11	5.8	7.8	5.3	5.7	2.4	1.5	1.8	0.6
Germany (1)	7.9	9.2	4.4	4.1	2.1	1.0	2.1	1.1
France	4.7	5.9	5.6	7.5	2.3	1.4	1.6	-0.3
Italy	6.0	9.7	5.4	4.5	2.8	1.5	1.2	-0.4
Spain	6.0	7.1	7.4	10.8	2.6	2.7	2.0	1.2
The Netherlands	4.3	4.8	5.2	5.5	2.2	0.9	2.6	2.6

Source: based on Penn World Table (1994) and EU Commission (1998a and 1998b) data. Old national accounts. See Appendix A.

(1) Up to 1991, western regions.

Table 2

INVESTMENT GROWTH SINCE THE LAST CYCLICAL PEAK IN THE LEADING INDUSTRIAL COUNTRIES

Countries (1)	GDP (2)	Gross fixed investment (2)	
		Construction	Machinery and equipment (3)
United States (1989.3)	2.5	1.6	6.6
Canada (1989.1)	2.0	0.1	5.9
United Kingdom (1988.4)	1.7	0.6	3.2
Germany (1991.1)	1.5	1.1	-0.2
France (1990.1)	1.4	-1.1	0.6
Italy (1990.1)	1.1	-1.7	0.6
Spain (1990.3)	2.0	1.0	2.7
The Netherlands (1990.4)	2.5	1.8	2.6

Source: based on ISTAT and OECD data (old national accounts).

(1) The dates in parentheses are the last cyclical peaks selected on the basis of the cyclical component of GDP as computed by the Hodrick-Prescott filter. (2) Average percentage changes from the last cyclical peak to the latest available data, at annual rates. The last available quarter was 1998.1 for the United Kingdom, 1998.3 for Italy and the Netherlands, 1998.4 for Spain, France and the United States, and 1999.1 for Germany and Canada.

(3) And transport equipment.

Table 3

BASELINE CASE

(dependent variable: ratio of gross investment to lagged gross capital stock, i_t)

	EURO		ANGLO-SAXON	
	[1]	[2]	[1]	[2]
y_t	0.0080 (0.0021)	0.0090 (0.0021]	0.0065 (0.0016)	0.0060 (0.0017)
$D_{91}*y_t$		-0.0074 (0.0026)		0.0159 (0.0043)
i_{t-1}	0.7664 (0.0539)	0.7663 (0.0533)	0.8674 (0.0519)	0.8669 (0.0515)
r_t	-0.0174 (0.0072)	-0.0180 (0.0072)	-0.0253 (0.0135)	-0.0243 (0.0133)
Sargan: p-value	0.720 [100]	0.690 [100]	0.996 [39]	1.000 [39]
LM(1): p-value	0.000 [102]	0.000 [102]	0.003 [43]	0.003 [43]
LM(2): p-value	0.449 [100]	0.431 [100]	0.074 [43]	0.084 [43]
Observations	1837	1837	805	805

Notes: Asymptotically robust standard errors are reported in parentheses below the coefficients. Estimation by GMM-SYSTEM using DPD98 package one-step standard errors. A full set of time dummies is included; "Sargan" is a Sargan-Hansen test of the over-identifying restrictions; "LM(k)" is the test for the presence of k-th order serial correlation in the first differenced residuals; degrees of freedom of test statistics are in square brackets below p-values. For the Euro countries instruments are i_{t-2} to i_{t-4} in the equations in first-differences and Δi_{t-1} to Δi_{t-2} in the equations in levels; For the Anglo-saxon countries instruments are i_{t-2} in the equations in first-differences and Δi_{t-1} in the equations in levels.

Table 4

SECTORAL COMPOSITION: MANUFACTURING VERSUS OTHER SECTORS AND HIGH VERSUS LOW GROWTH SECTORS

(dependent variable: ratio of gross investment to lagged gross capital stock, i_t)

	EURO		ANGLO-SAXON	
	[1] Manufacturing versus others	[2] High versus low-growth sectors	[1] Manufacturing versus others	[2] High versus low-growth sectors
$y_{t,A}$	0.0123	0.0090	0.0040	0.0054
	(0.0021)	(0.0021)	(0.0011)	(0.0023)
$D_{91}*y_{t,A}$	-0.0109	-0.0080	0.0069	0.0127
	(0.0028)	(0.0026)	(0.0036)	(0.0052)
$y_{t,B}$	0.0083	0.0093	0.0060	0.0060
	(0.0020)	(0.0026)	(0.0018)	(0.0017)
$D_{91}*y_{t,B}$	-0.0053	-0.0055	0.0136	0.0075
	(0.0027)	(0.0030)	(0.0060)	(0.0036)
i_{t-1}	0.7495	0.7675	0.8868	0.8640
	(0.0534)	(0.0533)	(0.0542)	(0.0521)
r_t	-0.0219	-0.0177	-0.0212	-0.0254
	(0.0074)	(0.0073)	(0.0129)	(0.0134)
Sargan: p-value	0.752	0.717	1.000	1.000
	[100]	[100]	[39]	[39]
LM(1): p-value	0.000	0.000	0.003	0.003
	[102]	[102]	[43]	[43]
LM(2): p-value	0.410	0.421	0.080	0.079
	[100]	[100]	[43]	[43]
Observations	1837	1837	805	805

Notes: Asymptotically robust standard errors are reported in parentheses below the coefficients. Estimation by GMM-SYSTEM using DPD98 package one-step standard errors. A full set of time dummies is included; "Sargan" is a Sargan-Hansen test of the over-identifying restrictions; "LM(k)" is the test for the presence of k-th order serial correlation in the first differenced residuals; degrees of freedom of test statistics are in square brackets below p-values. In column 1, "A" stands for "manufacturing" and "B" for "other sectors"; in column 2, "A" stands for "high-growth sectors" and "B" for "low-growth sectors". For the Euro countries instruments are i_{t-2} to i_{t-4} in the equations in first-differences and Δi_{t-1} to Δi_{t-2} in the equations in levels; For the Anglo-saxon countries instruments are i_{t-2} in the equations in first-differences and Δi_{t-1} in the equations in levels.

Table 5

MEASURES OF DEMAND VARIABILITY

Countries	Industrial production expectations (1)			Domestic demand net of stockbuilding (2)			Domestic demand net of stockbuilding and public consumption (2)			Aggregate demand (2)		
	(3)	(4)	(4)/(3)	(3)	(4)	(4)/(3)	(3)	(4)	(4)/(3)	(3)	(4)	(4)/(3)
United States	17.9	12.4	0.69	1.06	0.93	0.88	1.18	0.94	0.79	0.98	0.78	0.80
Canada	16.5	17.8	1.08	1.03	1.63	1.59	1.20	1.79	1.49	0.99	1.03	1.04
United Kingdom	17.5	15.1	0.86	1.80	1.30	0.72	1.75	1.61	0.92	1.90	1.09	0.58
Germany (5)	9.4	11.5	1.22	2.23	2.85	1.27	2.38	3.24	1.36	1.66	1.62	0.98
France	11.5	13.1	1.14	0.99	1.48	1.50	1.20	2.07	1.73	0.96	1.37	1.43
Italy	14.3	11.4	0.79	0.73	3.07	4.23	0.86	3.41	3.96	0.92	1.86	2.03
The Netherlands	6.7	5.9	0.88	3.04	1.07	0.35	3.68	1.18	0.32	2.30	0.73	0.32

Source: based on OECD and national data (old national accounts).

(1) Standard deviation of the indicator of short-term industrial production expectations. - (2) Coefficient of variation of the rate of change on the previous quarter. - (3) From 1976 to the last cyclical peak (see Table 2). - (4) From the last cyclical peak to the latest available data (see Table 2). - (5) Up to 1991, western regions.

Table 6

CAPITAL FORMATION AND UNCERTAINTY: INDIRECT APPROACH

(dependent variable: ratio of gross investment to lagged gross capital stock, i_t)

	EURO	ANGLO-SAXON
$y_{t,high}$	0.0096 (0.0023)	0.0050 (0.0015)
$y_{t,low}$	0.0101 (0.0026)	0.0062 (0.0018)
$D_{91}*y_{t,high}$	-0.0086 (0.0026)	0.0066 (0.0040)
$D_{91}*y_{t,low}$	-0.0028 (0.0029)	0.0110 (0.0046)
i_{t-1}	0.7112 (0.0519)	0.8617 (0.0530)
r_t	-0.0232 (0.0075)	-0.0236 (0.0134)
Sargan: p-value	0.739 [102]	1.000 [39]
LM(1): p-value	0.000 [102]	0.003 [43]
LM(2): p-value	0.459 [100]	0.087 [43]
Observations	1837	805

Notes: Asymptotically robust standard errors are reported in parentheses below the coefficients. Estimation by GMM-SYSTEM using DPD98 package one-step standard errors. A full set of time dummies is included; "Sargan" is a Sargan-Hansen test of the over-identifying restrictions; "LM(k)" is the test for the presence of k-th order serial correlation in the first differenced residuals; degrees of freedom of test statistics are in square brackets below p-values For the Euro countries instruments are i_{t-2} to i_{t-4} in the equations in first-differences and Δi_{t-1} to Δi_{t-2} in the equations in levels; For the Anglo-saxon countries instruments are i_{t-2} in the equations in first-differences and Δi_{t-1} in the equations in levels.

Table 7

CAPITAL FORMATION AND UNCERTAINTY: DIRECT MEASURES OF DEMAND VARIABILITY

(dependent variable: ratio of gross investment to lagged gross capital stock, i_t)

	EURO	ANGLO-SAXON
y_t	0.0153 (0.0030)	0.0060 (0.0012)
$D_{91}*y_t$	-0.0035 (0.0027)	0.0031 (0.0044)
σ_t*y_t	-0.0815 (0.0293)	-0.0009 (0.0206)
i_{t-1}	0.6968 (0.0618)	0.9011 (0.0445)
r_t	-0.0311 (0.0074)	-0.0259 (0.0150)
Sargan: p-value	0.761 [102]	1.000 [78]
LM(1): p-value	0.000 [102]	0.004 [43]
LM(2): p-value	0.382 [100]	0.057 [43]
Observations	1803	778

Notes: Asymptotically robust standard errors are reported in parentheses below the coefficients. Estimation by GMM-SYSTEM using DPD98 package one-step standard errors. A full set of time dummies is included; "Sargan" is a Sargan-Hansen test of the over-identifying restrictions; "LM(k)" is the test for the presence of k-th order serial correlation in the first differenced residuals; degrees of freedom of test statistics are in square brackets below p-values. For the Euro countries instruments are i_{t-2} to i_{t-3} and σ_{t-2} in the equations in first-differences and $\Delta\ i_{t-1}$ and $\Delta\sigma_{t-1}$ in the equations in levels; For the Anglo-saxon countries instruments are i_{t-2} and σ_{t-2} in the equations in first-differences and Δi_{t-1} and $\Delta\sigma_{t-1}$ in the equations in levels.

Table B1

DATA USED IN THE ECONOMETRIC ANALYSIS

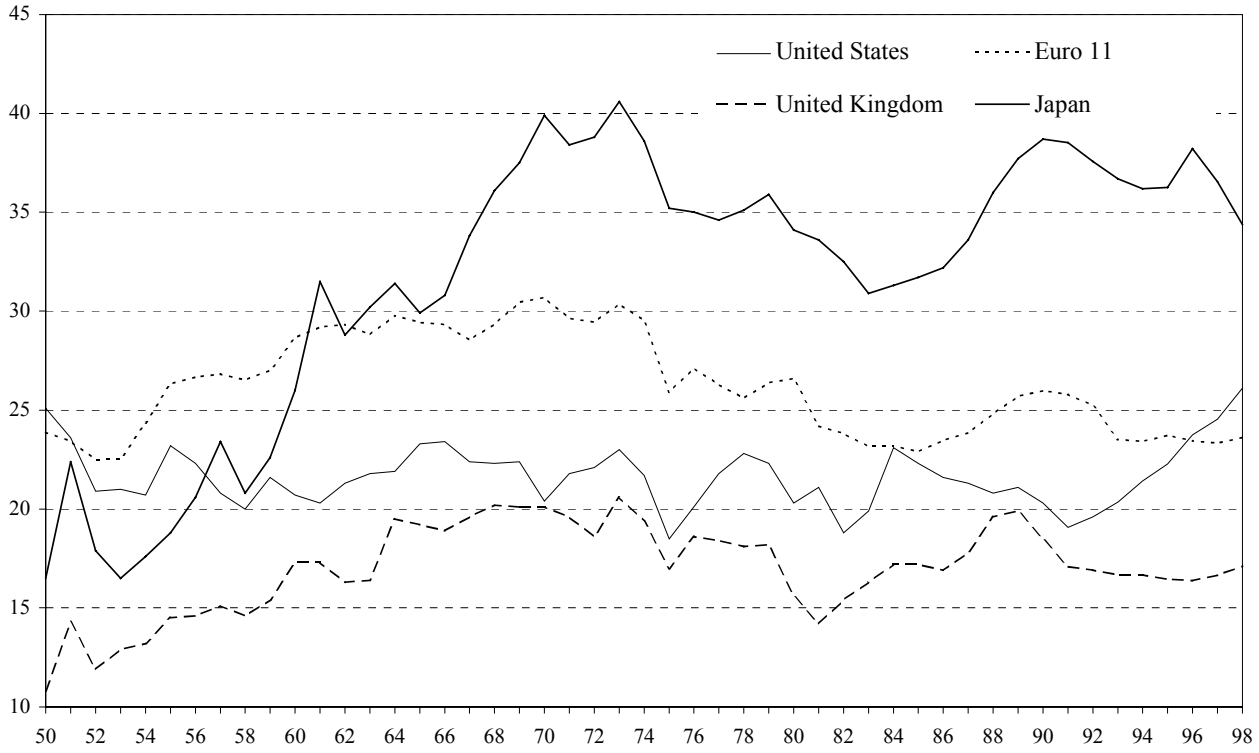
Sectors	BEL	FIN	FRA	ITA	NLD	WGR
BMA	—	1987-1996	1976-1995	1977-1994	—	1976-1993
BMI	1977-1996	1976-1996	1976-1997	1976-1994	1988-1994	1976-1993
CHE	1977-1996	1976-1996	1977-1997	1976-1994	1988-1994	1976-1993
EGW	1977-1996	1976-1996	1976-1997	1976-1994	1976-1994	1976-1993
FNS	1977-1996	1976-1994	1976-1997	1976-1994	—	1976-1993
FOD	1977-1996	1976-1996	1976-1997	1976-1994	1988-1994	1976-1993
HOT	1977-1996	1976-1996	1977-1997	1977-1994	—	1976-1993
MAI	—	1987-1996	1976-1995	1977-1994	1988-1991	1976-1993
MEL	—	—	1976-1995	1977-1994	1988-1992	1976-1993
MID	—	1976-1996	1976-1997	—	1976-1995	1976-1993
MIO	—	—	1976-1995	1977-1994	—	1976-1993
MNM	1977-1996	1976-1996	1977-1997	1976-1994	1988-1994	1976-1993
MOT	1977-1996	1976-1996	—	1977-1994	—	1976-1993
MTR	—	1987-1996	1976-1995	1976-1994	1988-1992	1976-1993
PAP	1977-1996	1976-1996	1976-1997	—	1988-1994	1976-1993
RWH	1977-1996	1976-1996	1976-1997	1977-1994	—	1976-1994
SOC	1977-1996	1976-1996	1977-1997	1976-1994	—	1976-1993
TEX	1977-1996	1976-1996	1976-1997	1976-1994	1988-1994	1976-1993
TRS	1977-1996	1976-1996	1977-1997	1977-1994	1984-1995	1976-1993
WOD	—	1976-1996	1977-1997	—	—	1976-1993

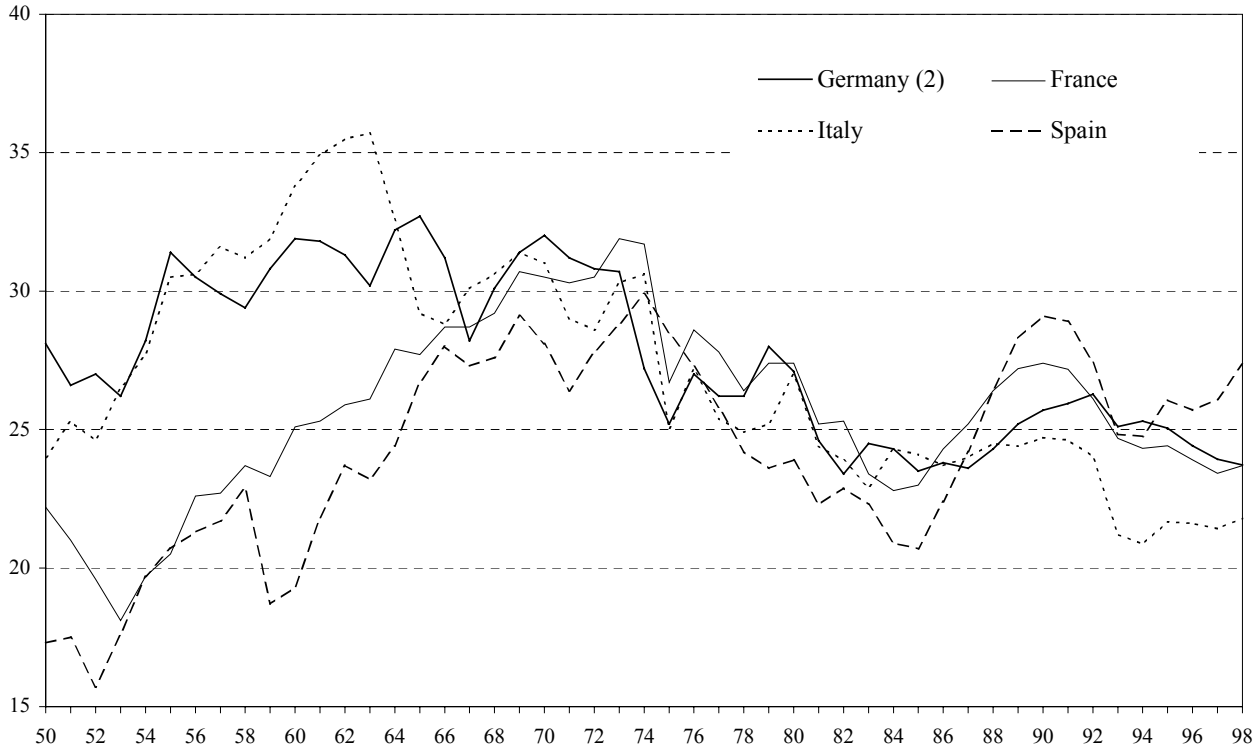
BEL = Belgium, CAN = Canada, FIN = Finland, FRA = France, UK = United Kingdom, ITA = Italy, NLD = The Netherlands, USA = United States, WGR = Germany (western regions).

Figure 1

RATIO OF GROSS FIXED INVESTMENT TO GDP (1)

(percentage values)





Source: based on Penn World Table (1994) and EU Commission (1998a and 1998b) data. See Appendix A.

(1) At constant prices. - (2) Up to 1991, western regions.