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

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SINTESI

Il contenuto del presente lavoro esprime solamente le opinioni degli autori, pertanto esso non rappresenta la posizione ufficiale della Banca d'Italia

Nel corso degli anni novanta si è registrato un netto divario nel processo di accumulazione fra i paesi dell'area dell'euro, da una parte, e gli Stati Uniti, dall'altra. Tra il 1990 e il 1998 il tasso di crescita medio annuo degli investimenti fissi lordi, pubblici e privati, è stato appena dello 0,8 per cento nei paesi dell'area dell'euro, meno della metà di quello registrato fra il 1974 e il 1990. Sempre negli anni novanta, negli Stati Uniti, esso è più che raddoppiato, sfiorando il 5 per cento e ritornando sui livelli raggiunti negli anni sessanta.

Questo fenomeno viene analizzato stimando una funzione di investimento che permette di stabilire se la caduta del tasso di accumulazione nell'area dell'euro possa essere riconducibile alla dinamica di variabili economiche rilevanti, fra cui la domanda e il tasso di interesse reale, oppure a un cambiamento della relazione fra investimenti e domanda. L'analisi empirica è stata effettuata utilizzando dati settoriali, in quanto ciò consente sia di verificare se siano rilevanti o meno differenze tra le economie considerate nella composizione settoriale degli investimenti, sia di disporre di un sufficiente numero di osservazioni per gli anni novanta.

I risultati delle stime econometriche, condotte su un *panel* non bilanciato di dati relativi a nove paesi, tre anglosassoni (Canada, Regno Unito e Stati Uniti) e sei appartenenti all'area dell'euro (Belgio, Finlandia, Francia, Germania occidentale, Italia e Paesi Bassi), per il periodo 1975-97, possono essere così sintetizzati.

Per entrambi i gruppi di paesi le stime mostrano segni di instabilità all'inizio dello scorso decennio. In particolare, emerge una modifica strutturale del coefficiente della variabile di attivazione (il cosiddetto acceleratore); questo si sarebbe ridotto in misura significativa negli anni novanta rispetto al periodo precedente nei paesi dell'area dell'euro; al contrario, sarebbe nettamente aumentato nei paesi anglosassoni.

L'analisi empirica mostra inoltre che i mutamenti registrati nel coefficiente che lega la crescita del capitale alla domanda non sono riconducibili né alla potenziale non-linearità di questa relazione, né alla particolare composizione settoriale degli investimenti nei paesi

dell'area dell'euro, che si caratterizza rispetto a quella degli Stati Uniti per il maggior peso dei settori manifatturieri rispetto a quelli dei servizi.

Il lavoro esplora, infine, il possibile ruolo dell'incertezza; il legame di quest'ultima con gli investimenti è stato a lungo dibattuto dalla teoria economica senza che siano state tuttora raggiunte conclusioni definitive. I risultati di alcuni recenti lavori empirici mostrano però che un aumento dell'incertezza sulla domanda si traduce, a parità di livello di quest'ultima e delle altre variabili esplicative, in minori investimenti.

Utilizzando come *proxy* dell'incertezza sulla domanda una misura della sua variabilità, si è rilevato che, negli anni novanta, quest'ultima si è ridotta in misura significativa negli Stati Uniti e nel Regno Unito. Al contrario, per i principali paesi dell'area dell'euro gli indicatori segnalano un aumento consistente della variabilità, con la sola eccezione dei Paesi Bassi.

Includendo tra le variabili esplicative della funzione di investimento una misura diretta dell'incertezza, il coefficiente di quest'ultima risulta negativo e significativo per i paesi dell'area dell'euro e statisticamente non diverso da zero per quelli anglosassoni; per entrambi i gruppi di paesi si riduce la significatività e l'entità della modifica, in aumento o in riduzione, dell'acceleratore negli anni novanta.

Sulla base di questi risultati il lavoro conclude che la maggiore variabilità della domanda che ha caratterizzato le economie dell'area dell'euro nello scorso decennio può contribuire a spiegare l'andamento assai deludente degli investimenti in quel periodo.

INVESTMENT AND GROWTH IN EUROPE AND IN THE UNITED STATES IN THE NINETIES

by Paola Caselli*, Patrizio Pagano* and Fabiano Schivardi*

Abstract

The paper analyses the sharp divergence in the nineties between capital formation in the main euro-area countries, on the one hand, and the United States, on the other. We have used data from the OECD's International Sectoral Data Base (ISDB), which includes data comparable across a certain number of industrial countries for the most important manufacturing and service sectors on capital stock, investment and value added. Our econometric estimates of an investment function indicate the presence of structural instability at the beginning of the nineties and, in particular, a break in the coefficient that links the growth of capital stock to value added for both the euro-area countries and the Anglo-Saxon countries.This result does not seem to be related either to sectoral characteristics or to non-linearities in the relationship between capital formation and expected demand but is partly attributable, at least for the euro-area countries, to the greater demand uncertainty in the nineties compared with the previous period.

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1. Introduction[1]

One of the major changes that occurred in factor markets in the nineties was the sharp divergence between capital formation in the euro-area countries, on the one hand, and the United States, on the other. 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 a 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 in the former to 24 per cent, while in the latter it had risen to 26 per cent (Fig.1).

This picture contrasts sharply with that prevailing in the early nineties. In 1990, the investment/GDP ratio barely reached 20 per cent in the United States, one of the lowest levels recorded during the post-war period, while that of the euro-area countries, 6 percentage points higher, had steadily increased since the mid-eighties. In that period the United States came to be seen as being in a structurally weak position compared with the other leading world economies; several authors saw in the limited fixed capital formation in comparison with the other industrial economies as the most important reason for this weakness. The debate which developed between 1990 and 1991 stemmed in part from the fact that in those years the United States was hit by a rather serious recession, 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 this decade have often been attributed to the prolongation of the cyclical divergence between the two areas. As a matter of fact, so far the current expansionary phase of the US economy is not anomalous for its duration or intensity,[2] but rather for the especially high contribution from investment, as evidenced in the 1999 Economic Report of the President.[3] This would suggest that, at first glance, the growth of investment in this decade

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[2] Previous expansionary phases of comparable duration to the current one are those of 1961-1969 and 1982-1990.

[3] Investment contributed about one fourth of the growth of the economy, as against an average of about one

cannot be entirely explained by that of GDP;[4] analogous considerations can also be put forward for the euro area.

Rather surprisingly, till now, 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 of this deficiency, first by presenting some "stylized facts" and then by developing an econometric analysis that will yield some clue 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 analysis was developed using the data of the old national accounts for all the countries, so that it does not take into accounts the revisions and methodological changes recently introduced in the euro-area countries and in the United States.[5]

The paper is organized as follows: Section 2 describes the long-term trends in capital formation in the leading industrial economies, utilizing the aggregate data, appropriately up-dated 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 an econometric analysis that was carried out in order to verify whether there was a structural change during the nineties in the coefficient that links the growth of the capital stock to value added (the so-called "accelerator") in the main countries of the euro area and in the Anglo-Saxon countries (the United States, Canada and the United Kingdom); in Section 4 we explore 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.

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seventh in previous expansionary phases in the post-war period.

[4] In this expansionary phase, up to 1998.4, GDP grew on average by 3.1 per cent, less than in 1961-1969 (4.8 per cent) and 1982-1990 (3.7 per cent).

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

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 cause of 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 rather strong in continental Europe; in the United States and in 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.[6]

The subsequent period, until the end of the eighties, was marked everywhere by a sharp deceleration in productive activity and investment; 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 to that of the other countries.[7]

Finally, the nineties are characterized by a very sharp change with respect to the previous period. The rate of growth of investment in the United States, about 5 per cent on average, is by far the highest among the industrial nations; it is also a record for the US economy during the post-war period.[8] The most striking aspect is the increase in the reactivity of capital formation

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[6] In Italy, after having reached a very high level in the early sixties, the share declined to that of the other leading European countries.

[7] 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 Lipsey and Mirova (1998). They demonstrate that, utilizing a broader definition of "investment" to include expenditure on consumer durable goods, education, research and development, and also military spending, the ratio to GDP 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 (1993).

[8] The rate of growth of private investment was 5.8 per cent, with respect to about 2 per cent in the previous period.

to economic growth: the “ex-post” elasticity between investment and GDP has risen to nearly 2, from values below 1 during the period from 1974-1990 and values 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 is by far the lowest in the post-war period; on average it is below 1 per cent. For these countries too, a possible “break” in the relationship between investment and growth can be detected, but it is of the opposite sign to that in the United States; in fact, despite an average rate of GDP growth of nearly 2 per cent, investment increased by just 0.6 per cent in the euro area: “ex-post” elasticity is therefore just one third. In France and Italy, a 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.

This picture would not change if we considered only private investment. In the Anglo-Saxon countries, in the nineties, the growth of public investment was extremely modest (less than one per cent), and much less than that recorded in the eighties. In this decade, in the United States, the “ex-post” elasticity calculated with respect to private investment alone was close to 3. For the euro-area countries, the comparison between the performance of private and public investment is more difficult because the breakdown is not available for all the countries. However, even considering that public investment expenditure was constrained in most European countries by the need to meet the convergence criteria imposed by the Maastricht Treaty, it is still true for most countries that the performance of private investment was much worse than in the previous decade (Ferrando, 1999).

The periodization used until now presents some difficulties, however. 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.[9] In this way, a recession - that of the early nineties - and an expansion - the current one - are included for every country; we have also disaggregated investment in machinery, equipment and means of transportation, which is the category that responds most

[9] Also for these calculations we used the data of the old national accounts for all countries. The cyclical turning points were determined by analysing the cyclical component of GDP as computed by the Hodrick-Prescott filter.

rapidly to changes in overall economic activity, and construction.[10] The figures in Table 2 confirm what was found earlier. Referring to investment in machinery, equipment and means of transportation, the elasticity with respect to GDP is very high, between 2 and 3, in the three Anglo-Saxon countries; on the contrary, it is much lower in the euro-area countries, with values ranging from a maximum of 1.4 for Spain, to 0.5 for Italy,[11] and to slightly negative for 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 main euro-area countries, except the Netherlands; however, this phenomenon does not appear to have been linked only to low growth. In fact, GDP expanded at a rate that was not dramatically lower than that recorded in the previous period. At the same time, in the United States a very significant acceleration in investment accompanied a not particularly pronounced increase in the rate of economic growth.

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" illustrated in Section 2. To this aim, we have used the OECD's ISDB, which includes data comparable across a certain number of countries and for the most important industrial and service sectors on capital stock, investment and value added.[12] The sectoral dimension increases the degrees of freedom in the estimation of an investment equation and allows 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 quite useful data base, some of its limits must be noted. First, information is not available for all the euro-area countries, but for only six of them: Germany, France, Italy, the Netherlands, Belgium and Finland.[13] Among the leading European countries, Spain is excluded. Another problem is that

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

[11] Note the particularly low value for Italy, despite the robust growth of investment, encouraged 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 had been more than 3 per cent, while that of GDP 2.2 per cent.

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

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

disaggregated data are not available for unified Germany and the statistics for West Germany and Italy are only available up to 1994.[14] In addition, it is worth keeping in mind that the degree of disaggregation available, essentially the 25 branches of the NACE classification, is not sufficient to classify our sectors on the basis of the technological content of the goods they produce.[15]

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.[16] 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 covered the period from the second half of the seventies (1975) to the date of the latest available data.[17] As will be made clear 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, first of all, justified on geo-political grounds, but, as will be clarified below, it also reflects some distinctive economic features that these countries showed in this decade.

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[14] We have verified that the data for Italy in the ISDB coincided with those produced by the National Institute of Statistics (Istat). The latest official Istat release on investment and the capital stock, disaggregated 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.

[15] For a brief description of the main features in terms of sectoral composition of value added and investment with reference to the United States, Germany, France and Italy see Caselli, Pagano, Schivardi (1999) and Ferrando (1999).

[16] 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 branches 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 the total - public and private - gross fixed investment and capital stock.

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

In the absence of adjustment costs, the long-run capital stock for a profit maximixing firm with a constant-returns-to-scale CES technology would be a (nonlinear) function of the user cost of capital, c, and the level of demand, Y:

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

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

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

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

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

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). Because in the presence of adjustment costs the actual capital stock will not adjust immediately to the desired level, we augmented (3) by including the 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; $i_{j,t-1}$ is the same variable defined at time $t-1$; $y_{j,t}$ 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 and 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, while 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 made clear below, the year dummies are particularly important in our analysis. Value added is a proxy for the demand

expected by investors;[18] 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.[19] For each country this was 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).

In (4), the lagged dependent variable, $i_{j,t-1}$, is a function of the individual effects, so that the OLS estimator of (4) is biased and inconsistent. First differencing the model - and using lagged differences or twice lagged levels as instruments - would solve the problem, provided that the residuals are not serially correlated. However, this method leads to consistent but not necessarily efficient estimates of the parameters of the model, since it implies the loss of information about the parameters of interest in the levels of the variables. Furthermore, Blundell and Bond (1998) show that, in models with lagged dependent variables, the first differenced estimator can be biased because of weak instrumenting and that these biases can be reduced by including the levels equations in the system estimator.

Therefore, to estimate this dynamic regression model we rely on the GMM estimator system suggested by Arellano and Bover (1995) and by Blundell and Bond (1998) 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

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[18] This is an obvious short-cut; 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.

[19] 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, q is the ratio of capital goods prices to output prices. Thus our simplification implies to assume 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 have checked that, at the aggregate level, it shows a downward trend in our estimation period which is common to all countries. Therefore, the effects of this variavle, not explicitly taken into account in equation (4), is however captured by the time dummies, λ_t.

instruments.[20] Finally, if the variables are mean stationary, then lagged differences of the variables can be used as instruments in the equations in levels.

We perform this system estimation with DPD98, which extends the procedure proposed by Arellano and Bond (1991). The set of instruments used in each regression presented below is reported in the notes to the corresponding table. The validity of instruments has been checked via a Sargan test of over-identifying restrictions.[21] Table 3 reports the results obtained by estimating (4) with the system GMM estimator; standard errors and test statistics are robust to heteroskedasticity.[22] Note that in the estimation of the equations in levels we do not explicitly allow for fixed effects since this would disproportionately expand the number of parameters to be estimated.

Before commenting on the results in Table 3, two clarifications are needed. *First*, note that 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 one could end up using too many instruments relative to the cross-section size of the sample causing a small sample overfitting bias (Arellano-Bond, 1998). To avoid this problem, we used a minimal set of instruments in the differenced equation and stacked set of instruments in the level equations. This may give us less precise coefficient estimates, but should increase the power of the Sargan test in detecting any instruments validity. This *caveat* has to be borne in mind for the rest of the paper and also implies that we are less confident about the conclusions that can be drawn from our analysis for the Anglo-Saxon countries than for the euro-area countries. *Second*, although one could argue that $y_{j,t}$ itself is an endogenous variable, we think that with sectoral data at two digit level the assumption of exogeneity of value added can be mantained.[23]

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[20] 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.

[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.

[22] Following Bond et al. (1999), we present only the one-step results, since the asymptotic standard errors for the two-step estimators can be unreliable in finite samples.

[23] We have experimented with specifications relaxing this assumption, obtaining similar results.

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. Note that the value of the lagged dependent variable is significantly lower for the euro-area countries, suggesting that our estimates are worse for the Anglo-Saxon countries; tipically, a high coefficient on the lagged-dependent variable indicates that the equation is misspecified. The estimates for the year dummies for the euro-area countries (not reported here) are all negative after 1991, with the exception of 1995. Only that related to 1993 is statistically different from zero; this result seems quite reasonable since in 1993 continental Europe registered a rather sharp recession.[24]

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 (see note 20); in fact, the first-differenced residuals present a significant negative first order serial correlation and there is no evidence of second order serial correlation.[25]

As we have shown in Section 2, in the nineties European countries recorded a substantially weaker process of capital formation, compared to a growth rate of output only marginally weaker than that recorded in the previous period. This slowdown can be explained either by the evolution 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 could 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, a change in the value of α_1, α_2, α_3 could have occurred.

In order to test this, we modified equation (4) as follows:

$$i_{j,t} = \beta_0 + \beta_1\, i_{j,t-1} + \beta_2\, y_{j,t} + \beta_3 r_{j,t} + \beta_4 D_{91} i_{j,t-1} + \beta_5 D_{91} y_{j,t} + \beta_6 D_{91} r_{j,t} + \lambda_t + \mu_j + \nu_{j,t} \tag{5}$$

where D_{91} is a dummy variable that takes the value 1 after 1991 (i.e. starting in 1992) and 0 before. If the estimates of β_4, β_5 and β_6 prove to be significantly different from zero, we could claim that there was a structural break in our equation. Note that the possibility of a permanent decrease in the value of the constant had already been taken into account in (4) by the year dummies, λ_t.

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

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

Table 4 reports the results obtained by running the regression in equation (5).[26] For the euro-area countries, column $[1]$ shows that only β_5 is significant and negative, while β_4 and β_6 are negative, but not significant. If we drop β_4 from our regression (column $[2]$) we still get β_5 significant and negative and β_6 negative; when we drop β_5, β_4 and β_6 are negative, but not significant. We also run two other regressions with β_4 and β_6 only; in both cases they turned out not to be significant. For the Anglo-Saxon countries the results are qualitatively very similar, except that β_5 is now positive; β_4 is always negative, but not significant; β_6 is positive (column $[1]$) and negative (column $[3]$). Also in this case when we kept only β_4 or β_6 they turned out not to be significant.

This analysis shows that in both group of countries the instability of our investment equation arises from a change in the parameter that links investment to expected demand, the so-called "accelerator". Therefore (5) can be rewritten as:

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

The results obtained by regressing (6) are reported in Table 5. As was already clear in Table 4, for the euro countries a fall in the accelerator did occurr; the estimates of β_4 indicate that the value of the accelerator almost halved in the nineties. In the Anglo-Saxon countries the reverse occurred; in this case the value of the accelerator in this decade is three times that of the previous period.[27]

These results therefore suggest that the diverging paths in 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.

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[26] These results are obtained by instrumenting only the lagged dependent variable.

[27] We also checked the year in which the break in the accelerator occurred by estimating (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. In performing these estimates we did not use the GMM estimator system but a 2SLS approach. We also estimated equation (6) for both groups of countries and computed fitted values for the variable i_j, starting from 1992 onwards, using the estimate of β_2 (i.e. up to 1991), while for the other estimates we used all the information in the sample, including year dummies. In figure 2 the fitted and the actual values are plotted for both the pre and the post-1991 period, showing that using the pre-1992 estimates of β_2 produces a significant overprediction of capital accumulation for the Euro-area countries and an even more consistent underprediction for the Anglo-Saxon countries.

4. The role of sectoral composition and non linearities

The next step is to investigate the source of the break found in the previous section. A first conjecture could be that it somehow related to the sectoral composition of the productive structure in the two groups of countries. One could argue that the weak accumulation which took place in the euro-area countries had something to do with their specialization in manufacturing rather than services.[28] Since manufacturing sectors are more cyclical and tend to respond more quickly than services to changes in expected demand, one could expect that, once sectors are split between manufacturing and services, the negative break for the euro-area countries should be sharper for the former, while for the latter we should not record any break. This explanation, however, does not seem to be fully supported by the data. As shown in Table 6 though the value of the accelerator and of the (negative) break is higher for manufacturing sectors, services also recorded a significant negative break in the nineties;[29] actually the percentage reduction in the value of the accelerator was more or less the same in the two groups of sectors. The results for the Anglo-Saxon countries are qualitatively very similar with a roughly equal percentage increase in the value of the accelerator in both manufacturing and services.[30] Contrary to what was found for the euro-area countries, here the value of the accelerator and that of the (positive) break is higher for services than for manufacturing.

As was shown before, from the beginning of the nineties economic activity decelerated in the euro-area countries, while it accelerated in the Anglo-Saxon countries; so the break in the accelerator could therefore be explained by a nonlinear relationship between capital formation and demand. In fact, investment could react proportionally more to substantial changes in demand, because of the presence of fixed costs related to capital accumulation or to indivisibility of capital goods (Caballero and Engle, 1999). First we tested this hypothesis by introducing a quadratic term, y_t^2, in (6), but this turned out not to be significant for either group of countries. We also followed a different strategy: for the euro-area countries we split the

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[28] See Caselli, Pagano and Schivardi (1999) and Ferrando (1999) for a description of the sectoral productive structure in the main countries.

[29] We actually split all the sectors between manufacturing and "others", thus adding to services also mining and quarrying and electricity, gas and water. We checked the robustness of our results by running another equation where the sectors were split between services and "others" and we got the same results.

[30] Note that the coefficient of the break for services is hardly significant.

sectors into two groups of ten, according to the average growth rate of value added recorded after 1991 compared to that recorded before. It turned out that for the euro-area countries the *low growth* sectors are those that experienced a decline in the rate of change of value added of at least 2.2 percentage points with respect to the previuos period, while for the Anglo-Saxon countries the *high growth* sectors are those that registered an increase of at least 0.8 percentage points.[31] Our conjecture is that, in the euro area, the sectors that experienced a drastic deceleration of demand reacted by decelerating their capital accumulation even more, while in the remaining sectors the response of investment to expected demand should have remained similar to that experienced before 1991.[32] On the contrary, in the Anglo-Saxon countries, the sectors which experienced a strong increase in the rate of growth of demand should have reacted by accelerating their investment even more.

However, here again, the results do not support our initial conjecture (see Table 6). For the euro-area countries, the value of the accelerator is, as it should be, very similar for the two subgroups before 1991; however, after then, both recorded a negative break, which was even sharper for the sectors that did not experience a significant reduction in the rate of growth of demand; note also that the coefficient of the break estimated for the other subgroup is hardly significant. The results for the Anglo-Saxon countries are even more difficult to interpret: first, we found two values of the accelerator very different for the two subgroups before 1991 (in one case the coefficient is not significant and with the wrong sign); second, the positive value of the break is higher for those sectors whose value added growth did not increase substantially in this decade.

Overall, this line of investigation did not prove very fruitful, since it did not help very much 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 this decade with respect to

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[31] For the euro area the *low growth* sectors include mainly manufacturing sectors, apart from financial services and wholesale and retail trade; they cover 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 cover 30-35 per cent of the value added. Six sectors out of ten coincide: wholesale and retail trade, chemical products and four branches of machinery and equipment.

[32] This kind of nonlinear response can 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 in the past; so when a few years later the deceleration of demand materialized they had to get rid of excess capacity.

the previous period. 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 (Eurostat, 1999 and Bugamelli, 1999), so that 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. The predictions of the theory, however, are not unequivocally established and the sign of the investment-uncertainty relationship has still to be solved on empirical grounds. If investment is characterized by a certain degree of irreversibility, firms operate in a context of monopolistic competition and investor are neutral with respect to risk, then the theory predicts that the threshold value of the return to capital that "triggers" investment positively depends on uncertainty. In particular, irreversibility implies that this value is increasing in uncertainty about demand; so, for any given level of expected demand, an increase in demand uncertainty causes a reduction in investment. To test this hypothesis, the specification of the investment function (6) should be modified by including an interaction term between uncertainty and demand, $\sigma_t y_t$.[33]

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.[34] A rather surprising picture emerged (Table 7): 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 seems again to behave differently, recording a rather significant decrease.

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[33] For a comprehensive survey of the literature on investment and uncertainty see Guiso and Parigi (1999). 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, they find a significant negative effect of uncertainty on capital formation.

[34] 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 expected short-term trend in industrial production (see Appendix B).

The increase in uncertainty about demand thus seems to be another possible reason for the sluggish process of accumulation in Europe in this decade. To test this hypothesis we chose the following two-step strategy. In a first phase 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). The results of this division are reported in Figure 3. First, note that for the euro-area countries, only four sectors recorded an increase in the standard deviation, six recorded a stable value and the remaining ten a decrease. The first four sectors are: agricultural and industrial machinery, metal products, transport equipment and financial services; they represent in each country 15-20 per cent of the value added of all the sectors included in our empirical analysis At first glance, this might seem at odds with the previous findings concerning demand variability at the aggregate level (see Table 7). It should be stressed, however, that the two measures are not directly comparable: first because here we use annual rather quarterly data, second because less 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.[35] For the Anglo-Saxon countries, we find a sharp decline in variability that applies to almost all sectors, in accordance with the previous findings at aggregate level.

Our "a priori" is that, once the sectors have been split between those in which uncertainty increased and those in which it decreased, for the euro-area countries the coefficient β_4 should be greater, in absolute value, for the former; 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 contrary. To test this conjecture, we estimated three different equations (see Table 8) First, we divided our sample into two subgroups (for each of the two groups of countries), according to whether variability increased in the nineties (column $[1]$); a second split was made by adding the sectors where the variability did not decrease very much (column $[2]$);[36] finally, we split the sectors into three groups, according to whether the

[35] This is particularly true for Italy and Germany whose data end in 1993-1994, so that for these two countries we have only one observation belonging to the upswing after the recession of 1992-1993.

[36] The limit was actually set at 0.9.

variability increased, did not change very much or declined (column [3]). For the euro-area countries, the results confirm our "a priori": in all three equations, we found that the absolute value of the break is higher for the first group, while for the others, not only it is lower, but also not significantly different from zero. It is also worth stressing that in all three equations the estimates of the coefficient of y_t before 1991 are very similar for all the groups of sectors as it should be, given that sectors were classified according to what happened after 1991. For the Anglo-Saxon countries our findings are less clear cut, but encouraging: as expected, the positive coefficient of the break tends to be higher for the subgroups of sectors where variability declined, though there is a tendency for these coefficient to lose significance.

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 next part of the strategy is to follow a direct approach. In fact, if demand uncertainty is one of the determinants of the break in the accelerator, introducing direct measures of uncertainty in (6) should reduce the significance of β_4 and/or its absolute value. Of course, it is difficult to identy a satisfactory proxy of uncertainty in our case. First of all, we would like a measure which captures forward looking expectations of investors; second, we need for a sector-specific as well as country specific measure. Because of problems of data availabily, we had to compromise and chose a forward looking indicator which is country specific but not sector specific. In particular, our measure of demand uncertainty is given by the standard deviation, computed within each year, of the expected short-term trend in industrial production derived from national surveys (see Appendix B). This choice can be partially razionalized by our previous findings (see Section 4) showing that sectoral characteristics do not seem to have played a crucial role in our story of a break in the accelerator in the nineties.

Accordingly (6) was modified as follows:

$$(7) \qquad i_{j,t} = \beta_0 + \beta_1\, i_{j,t-1} + \beta_2\, y_{j,t} + \beta_3\, r_{j,t} + \beta_4\, y_{j,t}\, D_{91} + \beta_5 \sigma_t y_{j,t} + \lambda_t + \mu_j + \nu_{j,t}$$

where σ_t represents our indicator of demand uncertainty. As mentioned before, σ_t has to interact with $y_{j,t}$.

Table 9 reports the estimates of (7) for the two groups of countries (column [2]). In column [1] we present also those obtained by dropping β_4 from (7). For the euro-area countries β_5 turns out to be negative, as expected, and highly significant in both cases; β_4 is still negative, but lower in absolute value (see Table 4), and hardly significant. Again, our results for the Anglo-Saxon countries are less satisfactory: β_5 has the wrong sign, but is not significant; β_4 is still positive, but much smaller than before and hardly significant. In Table 10 we also report the results obtained by including uncertainty as a separate variable (column [1]) and in the form of variance rather than standard deviation (column [2]) which confirm the previous findings.

Summing up, the results obtained for the euro-area countries are rather encouraging. We claim that (increased) uncertainty played a role in Europe in the observed sharp deceleration of capital accumulation, though this is probably only a part of the story. For the Anglo-Saxon countries there is a clear econometric evidence that there was an increase in the value of the accelerator, but we were able to find only partial support to the hypothesis that this phenomenon is due to decreased demand variability .

6. Concluding remarks

This paper shows that the relationship between capital formation and productive activity has profoundly changed since the beginning of this decade in both the euro area countries and the Anglo-Saxon countries. In the euro-area, though the economy grew at rates only slightly below those recorded in the period from the first oil shock to the end of the eighties, the growth in investment was very weak, at times even negative; in the Anglo-Saxon countries, especially in the United States, on the contrary, the growth in investment was very strong, and exceeded what could have been expected on the basis of the growth, though also quite high, of the economy.

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 a break in the coefficient that links capital accumulation to value added occurred. 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.

For the euro-area countries, the reduction of the accelerator can be seen as partly due to the increase in demand uncertainty in this decade compared with the previous period. For the

Anglo-Saxon countries our results point to a significant increase in the value of the accelerator in the nineties; however, we found only a weak and indirect evidence of the role played by decreased demand uncertainty.

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 DEVELOPMENTS 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 brackets 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 since 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
y_t	0.0107 (0.0029)	0.0064 (0.0006)
i_{t-1}	0.6757 (0.0881)	0.8723 (0.0127)
r_t	-0.0246 (0.0084)	-0.0336 (0.0139)
Constant	0.0127 (0.0048)	0.0027 (0.0030)
Sargan [p-value]	0.714	0.488
LM(1) [p-value]	0	0.003
LM(2) [p-value]	0.488	0.086
Observations	1,837	805

Notes: Asymptotically robust standard errors are reported in brackets below coefficients. Estimation by GMM-SYSTEM using DPD98 package one-step results; for the Anglo-Saxon countries only stacked instruments in the level equations. A full set of time dummies is included; "Sargan" is a Sargan-Hansen test of the overidentifying restrictions; "LM(k)" is the test for the presence of k-th order serial correlation in the first differenced residuals. In columns [1] only the lagged dependent (i_{t-1}) has been treated as endogenous; in columns [2] both i_{t-1} and the value added (y_t). For the euro, the instruments are i_{t-2} to i_{t-5} in the differenced equation and $\Delta\, i_{t-1}$ in the level equation. For the Anglo-Saxon countries, the instruments are i_{t-2} in the differenced equation and $\Delta\, i_{t-1}$ in the level equation.

Table 4

INSTABILITY OF THE INVESTMENT EQUATION

	Euro			Anglo-Saxon		
	[1]	[2]	[3]	[1]	[2]	[3]
y_t	0.0118	0.0117	0.0111	0.0055	0.0055	0.0061
	(0.0029)	(0.0029)	(0.0030)	(0.0007)	(0.0007)	(0.0006)
$D_{91}*y_t$	-0.0060	-0.0076		0.0116	0.0112	
	(0.0034)	(0.0029)		(0.0052)	(0.0053)	
i_{t-1}	0.6730	0.6705	0.6760	0.8759	0.8756	0.8731
	(0.0887)	(0.0885)	(0.0893)	(0.0125)	(0.0125)	(0.0127)
$D_{91}* i_{t-1}$	-0.0934		-0.1276	-0.2241	-0.2053	-0.1470
	(0.0903)		(0.0851)	(0.1351)	(0.1394)	(0.1312)
r_t	-0.0201	-0.0219	-0.0209	-0.0331	-0.032	-0.0327
	(0.0091)	(0.0091)	(0.0089)	(0.0161)	(0.0149)	(0.0161)
$D_{91}* r_t$	-0.0541	-0.0253	-0.0520	0.0098		-0.0048
	(0.0394)	(0.0271)	(0.0403)	(0.0325)		(0.0329)
Constant	0.0122	0.0124	0.0124	0.0034	0.0034	0.0031
	(0.0050)	(0.0049)	(0.0049)	(0.0030)	(0.0030)	(0.0030)
Sargan [p-value]	0.750	0.728	0.739	0.895	0.914	0.763
LM(1) [p-value]	0	0	0	0.003	0.004	0.003
LM(2) [p-value]	0.443	0.478	0.440	0.168	0.161	0.144
Observations	1,837	1,837	1,837	773	773	773

Notes: Asymptotically robust standard errors are reported in brackets below coefficients. Estimation by GMM-SYSTEM using DPD98 package one-step results; for the Anglo-Saxon only stacked instruments in the level equations. A full set of time dummies is included; "Sargan" is a Sargan-Hansen test of the overidentifying restrictions; "LM(k)" is the test for the presence of k-th order serial correlation in the first differenced residuals. For the euro countries, the instruments are i_{t-2} to i_{t-5} in the differenced equation and Δi_{t-1} in the level equation; for the Anglo-Saxon countries, the instruments are i_{t-2} in the differenced equation and Δi_{t-1} in the level equation.

Table 5

BREAK IN THE ACCELERATOR

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

	Euro	Anglo-Saxon
y_t	0.0115 (0.0028)	0.0060 (0.0007)
$D_{91}*y_t$	-0.0067 (0.0029)	0.0134 (0.0042)
i_{t-1}	0.6740 (0.0873)	0.8729 (0.0125)
r_t	-0.0248 (0.0084)	-0.0332 (0.0137)
Constant	0.0123 (0.0049)	0.0030 (0.0030)
Sargan [p-value]	0.714	0.687
LM(1) [p-value]	0	0.003
LM(2) [p-value]	0.467	0.090
Observations	1,837	805

Notes: Asymptotically robust standard errors are reported in brackets below coefficients. Estimation by GMM-SYSTEM using DPD98 package one-step results; for the Anglo-Saxon countries only stacked instruments in the level equations. A full set of time dummies is included; "Sargan" is a Sargan-Hansen test of the overidentifying restrictions; "LM(k)" is the test for the presence of k-th order serial correlation in the first differenced residuals. In columns [1] only the lagged dependent (i_{t-1}) has been treated as endogenous; in columns [2] both i_{t-1} and the value added (y_t). For the euro countries, the instruments are i_{t-2} to i_{t-5} in the differenced equation and Δi_{t-1} in the level equation. For the Anglo-Saxon countries, the instruments are i_{t-2} in the differenced equation and Δi_{t-1} in the level equation.

Table 6

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	
	Manufacturing versus others	Low versus high growth sectors	Manufacturing versus others	High versus low growth sectors
$Y_{t,manuf}$	0.0150		0.0046	
	(0.0030)		(0.0012)	
$y_{t,high}$		0.0116		0.0069
		(0.0028)		(0.0009)
$Y_{t,others}$	0.0104		0.0066	
	(0.0028)		(0.0005)	
$y_{t,low}$		0.0113		-0.0019
		(0.0035)		(0.0009)
$D_{91}*y_{t,manuf}$	-0.0096		0.0073	
	(0.0031)		(0.0036)	
$D_{91}*y_{t,high}$		-0.0073		0.0014
		(0.0028)		(0.0045)
$D_{91}*y_{t,others}$	-0.0053		0.0089	
	(0.0032)		(0.0061)	
$D_{91}*y_{t,low}$		-0.0041		0.0075
		(0.0037)		(0.0042)
i_{t-1}	0.6561	0.6744	0.8659	0.8676
	(0.0876)	(0.0864)	(0.0128)	(0.0146)
r_t	-0.0306	-0.0243	-0.0341	-0.0312
	(0.0089)	(0.0085)	(0.0137)	(0.0139)
Constant	0.0127	0.0123	0.0038	0.0034
	(0.0049)	(0.0048)	(0.0031)	(0.0030)
Sargan [p-value]	0.731	0.727	1.000	0.713
LM(1) [p-value]	0	0	0.001	0.003
LM(2) [p-value]	0.452	0.458	0.118	0.083
Observations	1,837	1,837	805	805

Notes: Asymptotically robust standard errors are reported in brackets below coefficients. Estimation by GMM-SYSTEM using DPD98 package one-step results; for the Anglo-Saxon countries only stacked instruments in the level equations. A full set of time dummies is included; "Sargan" is a Sargan-Hansen test of the overidentifying restrictions; "LM(k)" is the test for the presence of k-th order serial correlation in the first differenced residuals. For the euro countries, the instruments are i_{t-2} to i_{t-5} in the differenced equation and Δi_{t-1} in the level equation; for the Anglo-Saxon countries, the instruments are i_{t-2} in the differenced equation and Δi_{t-1} in the level equation.

Table 7

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 up to last cyclical peak (see Table 2). - (4) From last cyclical peak to the latest available data (see Table 2). - (5) Up to 1991, western regions.

CAPITAL FORMATION AND UNCERTAINTY: INDIRECT APPROACH

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

	Euro			Anglo-Saxon		
	[1]	[2]	[3]	[1]	[2]	[3]
$y_{t,high}$	0.0113	0.0112	0.0114	0.0041	0.0064	0.0041
	(0.0029)	(0.0028)	(0.0030)	(0.0014)	(0.0005)	(0.0016)
$y_{t,med}$			0.0116			0.0061
			(0.0031)			(0.006)
$y_{t,low}$	0.0118	0.0124	0.0123	0.0061	0.0054	0.0059
	(0.0032)	(0.0036)	(0.0044)	(0.0007)	(0.0009)	(0.0013)
$D_{91}*y_{t,high}$	-0.0095	-0.0070	-0.0098	0.0068	0.0022	0.0052
	(0.0026)	(0.0028)	(0.0026)	(0.0039)	(0.0045)	(0.0042)
$D_{91}*y_{t,med}$			-0.0026			0.0074
			(0.0034)			(0.0058)
$D_{91}*y_{t,low}$	-0.0032	-0.0051	-0.0049	0.0076	0.0090	0.0077
	(0.0035)	(0.0038)	(0.0043)	(0.0045)	(0.0045)	(0.0038)
i_{t-1}	0.6740	0.6707	0.6741	0.8710	0.8723	0.8712
	(0.0874)	(0.0876)	(0.0875)	(0.0130)	(0.0127)	(0.0129)
r_t	-0.0247	-0.0246	-0.0248	-0.0333	-0-0331	-0.0339
	(0.0083)	(0.0084)	(0.0082)	(0.0138)	(0.0137)	(0.0138)
Constant	0.0122	0.0123	0.0121	0.0032	0.0032	0.0032
	(0.0049)	(0.0049)	(0.0049)	(0.0030)	(0.0030)	(0.0031)
Sargan [p-value]	0.700	0.708	0.713	0.825	0.690	0.860
LM(1) [p-value]	0	0	0	0.003	0.003	0.003
LM(2) [p-value]	0.472	0.465	0.471	0.090	0.087	0.091
Observations	1,837	1,837	1,837	805	805	805

Notes: Asymptotically robust standard errors are reported in brackets below coefficients. Estimation by GMM-SYSTEM using DPD98 package one-step results; for the Anglo-Saxon only stacked instruments in the level equations. A full set of time dummies is included; "Sargan" is a Sargan-Hansen test of the overidentifying restrictions; "LM(k)" is the test for the presence of k-th order serial correlation in the first differenced residuals. For the euro countries, the instruments are i_{t-2} to i_{t-5} in the differenced equation and Δi_{t-1} in the level equation; for the Anglo-Saxon, the instruments are i_{t-2} in the differenced equation and Δi_{t-1} in the level equation.

Table 9

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	
	[1]	[2]	[1]	[2]
y_t	0.0163 (0.0031)	0.0161 (0.0030)	0.0062 (0.0041)	0.0060 (0.0041)
$D_{91}*y_t$		-0.0042 (0.0029)		0.0047 (0.0050)
σ_t*y_t	-0.0011 (0.0003)	-0.0009 (0.0002)	0.0003 (0.0004)	0.0003 (0.0004)
i_{t-1}	0.6942 (0.0652)	0.6982 (0.0657)	0.8433 (0.0234)	0.8447 (0.0235)
r_t	-0.0253 (0.0074)	-0.0251 (0.0073)	-0.0321 (0.0148)	-0.0317 (0.0146)
Constant	0.0124 (0.0034)	0.0117 (0.0035)	0.0051 (0.0022)	0.0052 (0.0022)
Sargan [p-value]	0.687	0.819	0.908	0.955
LM(1) [p-value]	0	0	0.007	0.007
LM(2) [p-value]	0.356	0.443	0.189	0.185
Observations	1,803	1,803	735	735

Notes: Asymptotically robust standard errors are reported in brackets below coefficients. Estimation by GMM-SYSTEM using DPD98 package one-step results; for the Anglo-Saxon only stacked instruments in the level equations. A full set of time dummies is included; "Sargan" is a Sargan-Hansen test of the overidentifying restrictions; "LM(k)" is the test for the presence of k-th order serial correlation in the first differenced residuals. For the euro countries, the instruments are i_{t-2} to i_{t-3} and σ_{t-2} in the differenced equation and Δi_{t-1} and $\Delta\sigma_{t-1}$ in the level equation; for the Anglo-Saxon countries, the instruments are i_{t-2} and σ_{t-2} in the differenced equation and Δi_{t-1} to Δi_{t-2} and $\Delta\sigma_{t-1}$ to $\Delta\sigma_{t-2}$ in the level equation.

Table 10

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	
	[1]	[2]	[1]	[2]
y_t	0.0098	0.0130	0.0089	0.0073
	(0.0024)	(0.0025)	(0.0017)	(0.0024)
$D_{91}*y_t$	-0.0070	-0.0045	0.0047	0.0046
	(0.0030)	(0.0029)	(0.0050)	(0.0050)
$\sigma^e_t*y_t$		-0.00006		0.00001
		(0.00001)		(0.00001)
σ_t	-0.0005		0.0002	
	(0.0001)		(0.0001)	
i_{t-1}	0.6956	0.7069	0.8456	0.8447
	(0.0654)	(0.0648)	(0.0182)	(0.0217)
r_t	-0.0242	-0.0239	-0.0323	-0.0317
	(0.0076)	(0.0073)	(0.0146)	(0.0145)
Constant	0.0156	0.0110	0.0034	0.0054
	(0.0038)	(0.0035)	(0.0025)	(0.0022)
Sargan [p-value]	0.740	0.714	0.965	0.948
LM(1) [p-value]	0	0	0.006	0.007
LM(2) [p-value]	0.308	0.425	0.080	0.199
Observations	1,803	1,803	735	735

Notes: Asymptotically robust standard errors are reported in brackets below coefficients. Estimation by GMM-SYSTEM using DPD98 package one-step results; for the Anglo-Saxon only stacked instruments in the level equations. A full set of time dummies included; "Sargan" is a Sargan-Hansen test of the overidentifying restrictions; "LM(k)" is the test for the presence of k-th order serial correlation in the first differenced residuals. For the euro countries, the instruments are i_{t-2} to i_{t-3} and σ_{t-2} in the differenced equation and Δi_{t-1} and $\Delta\sigma_{t-1}$ in the level equation; for the Anglo-Saxon countries, the instruments are i_{t-2} and σ_{t-2} in the differenced equation and Δi_{t-1} to Δi_{t-2} and $\Delta\sigma_{t-1}$ to $\Delta\sigma_{t-2}$ in the level equation.

Table B1

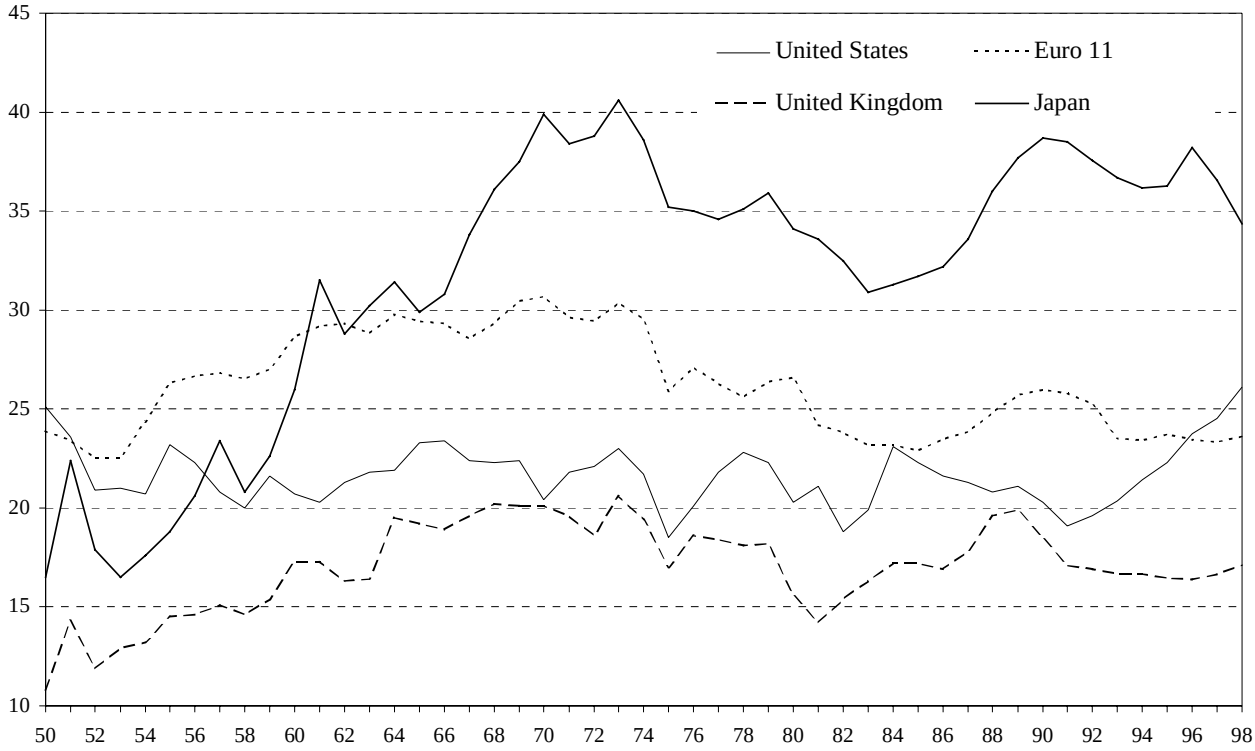
DATA USED IN THE ECONOMETRIC ANALYSIS

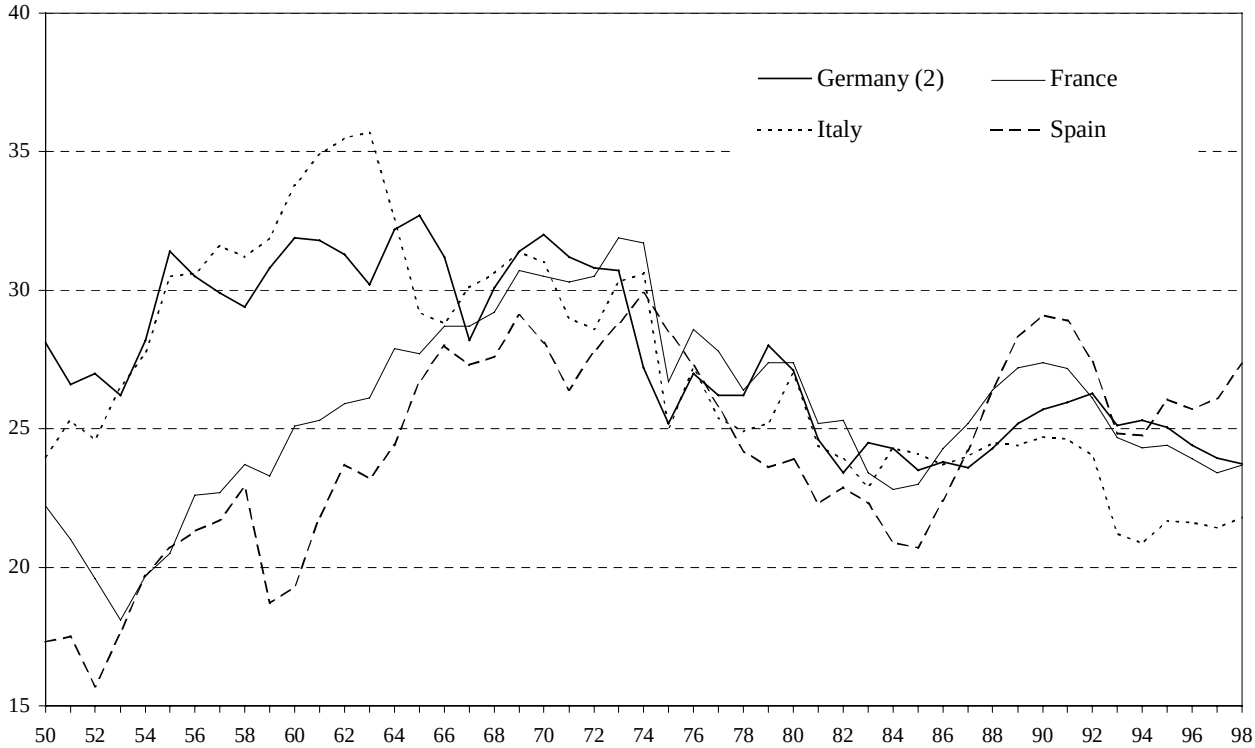
Sectors	BEL	CAN	FIN	FRA	UK	ITA	NLD	USA	WGR
BMA	—	—	1987-1996	1976-1995	—	1977-1994	—	—	1976-1993
BMI	1977-1996	1976-1993	1976-1996	1976-1997	1976-1991	1976-1994	1988-1994	1976-1996	1976-1993
CHE	1977-1996	1976-1993	1976-1996	1977-1997	1979-1995	1976-1994	1988-1994	1976-1996	1976-1993
EGW	1977-1996	1976-1993	1976-1996	1976-1997	1976-1996	1976-1994	1976-1994	1976-1996	1976-1993
FNS	1977-1996	1976-1993	1976-1994	1976-1997	—	1976-1994	—	1976-1996	1976-1993
FOD	1977-1996	1976-1993	1976-1996	1976-1997	1976-1995	1976-1994	1988-1994	1976-1996	1976-1993
HOT	1977-1996	1976-1993	1976-1996	1977-1997	—	1977-1994	—	—	1976-1993
MAI	—	—	1987-1996	1976-1995	1976-1995	1977-1994	1988-1991	—	1976-1993
MEL	—	—	—	1976-1995	1976-1995	1977-1994	1988-1992	—	1976-1993
MID	—	1976-1993	1976-1996	1976-1997	1976-1996	—	1976-1995	1976-1996	1976-1993
MIO	—	—	—	1976-1995	—	1977-1994	—	—	1976-1993
MNM	1977-1996	1976-1993	1976-1996	1977-1997	1976-1991	1976-1994	1988-1994	1976-1996	1976-1993
MOT	1977-1996	1976-1993	1976-1996	—	1979-1995	1977-1994	—	1976-1996	1976-1993
MTR	—	—	1987-1996	1976-1995	1976-1995	1976-1994	1988-1992	—	1976-1993
PAP	1977-1996	1976-1993	1976-1996	1976-1997	1976-1995	—	1988-1994	1976-1996	1976-1993
RWH	1977-1996	1976-1993	1976-1996	1976-1997	—	1977-1994	—	1976-1996	1976-1994
SOC	1977-1996	1976-1993	1976-1996	1977-1997	1977-1995	1976-1994	—	1976-1996	1976-1993
TEX	1977-1996	1976-1993	1976-1996	1976-1997	1976-1995	1976-1994	1988-1994	1976-1996	1976-1993
TRS	1977-1996	1976-1993	1976-1996	1977-1997	1977-1996	1977-1994	1984-1995	1976-1996	1976-1993
WOD	—	1976-1993	1976-1996	1977-1997	—	—	—	1976-1996	1976-1993

Legenda: 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)



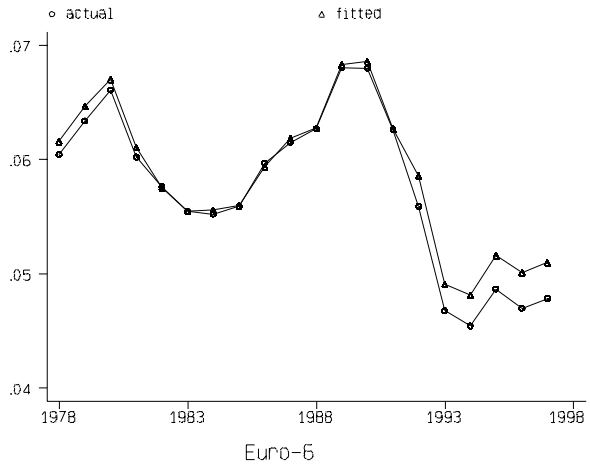


Source: based on Penn World Table (1994) and EU Commission (1998a and 1998b) data. See Appendix A.

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

Figure 2

AVERAGE INVESTMENT RATE: ACTUAL AND FITTED VALUES



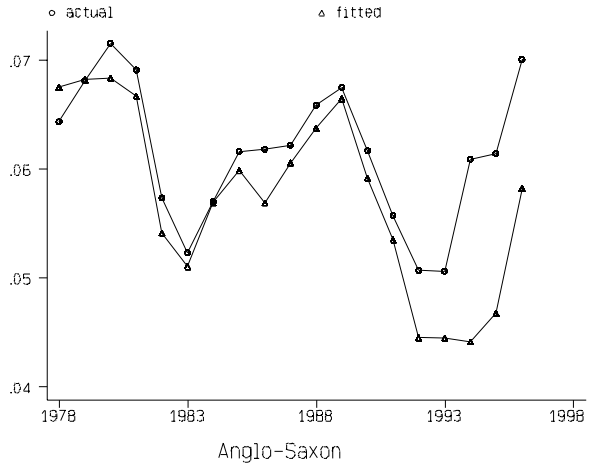
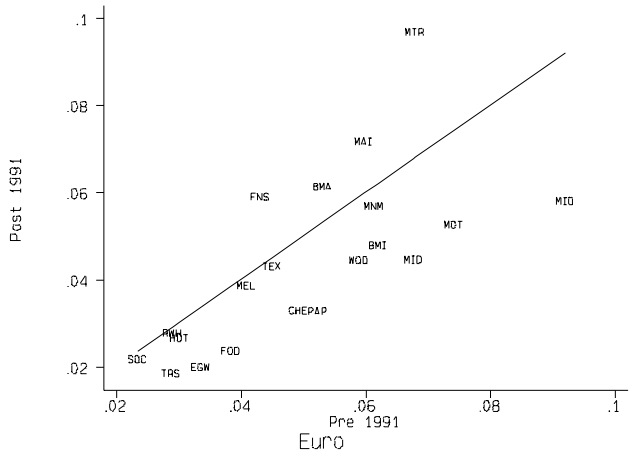
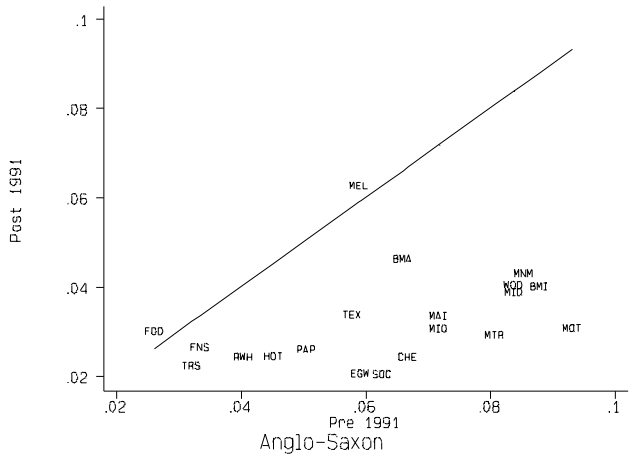


Figure 3

EVOLUTION OF SECTORAL STANDARD DEVIATION





Appendix I: 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 (1998a and 1998b) for the individual variables (population, GDP, investment, etc.).

As regards the data on Germany, the series of the Penn World Table were used up to 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 dynamic of 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.

Appendix II: 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 (1999). 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 these 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, to construct the 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, since the data for the gross capital stock are avalilable only up to 1993, they have been up-dated by using the rate of changes of the net capital stock, which is available up 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 costruction- 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 measure of demand uncertainty based on expected short-term trend in industrial production was calculated as the standard deviation, within each year, of the balances, expresed as percentages, of positive and negative answers to the surveys on the industrial sector run, in each country by the respective national institutes for conjunctural analysis (for Italy, ISAE). This measure is thus equal for all sectors, although it varies over time and across countries.

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