Uncertainty and the Slowdown of Capital Accumulation in Europe *

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Abstract

We analyze the slowdown in the process of capital formation in continental Europe in the nineties. We use sector-level data from the OECD's International Sectoral Data Base (ISDB). Our econometric estimates of an investment function indicate structural instability in the early nineties and, specifically, a break in the coefficient linking the growth of capital stock to demand. This result neither seems to be related to non-linearities in the relationship between capital formation and expected demand, nor to the sectoral composition of european economies. We find evidence that the drop in the accelerator is at least partly attributable to greater demand uncertainty in the nineties as compared to the earlier period.

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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. The deceleration of capital formation in Europe in the nineties cannot be explained only by cyclical factors: indeed, the slowdown in investment growth recorded in the Euro area in the nineties was stronger than that of GDP (Table 1).

In this paper we study the process of capital formation for a set of large European economies. We first show some "stylized facts" on the accumulation process and then present an econometric analysis that will yield some clues to interpreting them. We use the OECD's International Sectoral Database (ISDB) (see Appendix A.2) to estimate a neoclassical investment equation at the sectoral level, pooling the data for the six large euro countries for which data were available (Germany, France, Italy, the Netherlands, Belgium and Finland).

Our results show that the slowdown in capital formation in continental Europe 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 in the nineties compared to the previous fifteen years. We also find that the drop of the "accelerator" can be attributed, at least in part, to greater demand uncertainty. Indeed, once we directly account for uncertainty, the instability of the investment function disappears.

Our contribution to the literature is twofold. First, we contribute to the growing empirical literature on investment under uncertainty. While previous studies are based on firm-level data in a given country (see, for instance, Guiso and Parigi (1999) and Bloom *et al.* (2000)), we show that a relationship between investment and uncertainty can be detected also at sectoral level, adding a new piece of evidence on the importance of uncertainty for investments. Second, we document and propose an explanation for the deceleration of investment in Europe in the nineties, that has been indicated as one of the causes of the euro area slow growth but has received surprisingly little attention in the academic debate.

The paper is organized as follows. Section 2 shows that in this decade the value of the (ex-post) ratio between the rate of growth of investment and that of GDP has decreased dramatically in the main euro-area countries; the econometric analysis indicates that the coefficient linking investment to demand has changed structurally in the nineties. Section 3 demonstrates that this change can be attributed neither to compositional effects (manufacturing vs. services) nor to non-linearities in the relationship between capital formation and demand. Section 4 analyzes the links between the break in the accelerator and demand uncertainty; we find evidence that the drop in the accelerator is at least partly attributable to greater demand uncertainty in the nineties as compared to the earlier period. The concluding section summarizes the main results.

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

2.1 Capital formation in the leading industrial economies in the postwar period

From appropriately updated aggregate data from the Penn World Tables (see Appendix A.1 for details), four distinct phases can be identified in the postwar period. In the fifties, the need to rebuild the capital stocks of the countries that suffered the most damage during the second world war explains the relatively higher ratio of investment to GDP in continental Europe with respect to the United States and the United Kingdom (Table 1). In the sixties and up until the onset of the first oil shock, the growth of investment remained strong in continental Europe. The subsequent period, to the end of the eighties, was marked by a generalized sharp deceleration in productive activity and investment; the ratio of investment to GDP declined slightly in all the leading industrial countries except Spain. Finally, in the nineties 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. Comparison with the performance of the euro-area countries is harsh. With the exception of Germany and especially the

Netherlands, in the nineties the rate of growth of investment in continental Europe was by far the lowest in the postwar period, averaging below 1 per cent. Moreover, we can detect for the euro area a possible "break" in the relationship between investment and growth: despite an average rate of GDP growth of nearly 2 per cent, investment increased by only 0.6 per cent: the "ex-post" elasticity is therefore just one third, the lowest in the postwar period.[1]

The "stylized fact" that forcefully emerges from this first analysis based on aggregate data is the following: in the nineties the process of capital formation sharply decelerated in all the leading euro-area countries, with the exception of 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. This suggests the possibility of a break in the relationship between investment and demand, an issue that we tackle in the next section.

2.2 A formal investigation using sectoral data

The analysis presented in this and in the following sections aims at verifying econometrically the "stylized fact" illustrated before. We use the OECD's ISDB, which includes data on capital stock, investment and value added comparable across a number of countries (for the Euro-area, Germany, France, Italy, the Netherlands, Belgium and Finland, which account for more than 80 per cent of the area GDP), and for the most important manufacturing and service sectors (essentially the 25 branches of the NACE classification). 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.[2] Our unit of observation is the sector-

[1] The periodization used can be criticized since in 1990 continental Europe was enjoying a "boom", driven by the favorable prospects of Germany's economic and political unification. 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. In this way, a recession - that of the early nineties - and an expansion 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. Previous findings are robust to such changes.

[2] 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

country; we use it to construct an unbalanced panel of approximately 2,000 observations (see Appendix A.2 for a detailed description of the data). The econometric analysis covers the period from the second half of the seventies (1975) to the date of the latest available observation.[3]

We use the standard neoclassical framework (Jorgenson, 1971) 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 (nonlinear) 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 $\{r^*, \left(\frac{Y}{K}\right)^*\}$ yields:

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

where the θ's are constants.

The standard neoclassical framework, as represented by (3), has been widely used in the empirical analysis, though it has been subject to a number of criticisms.[4] One of these, already recognized by Jorgenson (1971), refers to the lack of explicit account of intertemporal aspects. In fact, the main problem in the empirical implementation of (3) is

includes investment in residential construction and weighs heavily in all of the countries. We excluded these categories since they are characterized by extremely erratic behaviour of both investment and value added. For all of 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.

[3] 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.

[4] See Chirinko (1993) for a comprehensive survey.

that residuals turn out to be serially correlated. We follow the usual way to overcome it and enrich the dynamics of (3) by including the lagged dependent variable ($\frac{I_{t-1}}{K_{t-2}}$). A second problem is that (3), augmented with the lagged dependent variable, implies a proportional relationship between short and long run responses of investment to demand. For this reason we have further enriched the dynamics of (3) by adding also the lagged value of demand ($\frac{Y_{t-1}}{K_{t-2}}$). As emphasized by Bloom *et al.* (2000) when testing the relationship between investment and uncertainty, which will become the main focus of the analysis in the following sections, it is important to allow for unconstrained short and long run effects of demand on investment. Furthermore, to estimate this equation using country-sectoral data, we assumed that steady-state levels can be accounted for using additive year specific effects (λ_t) and country-sector specific effects (μ_j). Thus, we run the following equation:

$$i_{j,t} = \alpha_0 + \alpha_1 i_{j,t-1} + \alpha_2\, y_{j,t} + \alpha_3\, y_{j,t-1} + \alpha_4\, r_{j,t} + \lambda_t + \mu_j + \nu_{j,t} \tag{4}$$

where j is the coutry-sectoral index, $i_{j,t} = \frac{I_{j,t}}{K_{j,t}}$, $y_{j,t} = \frac{Y_{j,t}}{K_{j,t}}$ and $r_{j,t}$ is a measure of the user cost of capital. By introducing μ_j we control for country-sector differences in the intercept of our equation; with λ_t we account for shifts in the intercept over time, under the hypothesis that these shifts are common to all units; $\nu_{j,t}$ is an error term. Demand expected by investors is proxied by value added.[5] Due to data availability the user cost of capital has been approximated by a measure of the real interest rate.[6] 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. However, 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 (1995), Blundell and Bond (1998)

[5] This is an obvious shortcut. This choice 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.

[6] 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 is 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 aggregate value added deflator).

and Arellano and Bond (1999) that combines equations in first differences and 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 test of over-identifying restrictions.[7] 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.* 1999). Standard errors and test statistics are robust to heteroskedasticity.

Table 2, column [1] reports the results of our basic specification, equation (4). We find no evidence of specification problems: the values of the Sargan test indicate that the instruments we used are valid. All the explanatory variables, including the real interest rate, have the expected sign and are significant. If we define α_2 as the short-run response of investment to demand and $\frac{\alpha_2+\alpha_3}{1-\alpha_1}$ as the long-run one, we find that the former is almost twice as large as the latter (0.0678 vs. 0.0352). The estimates of the year dummies (not reported) are all negative after 1991, with the exception of 1995. Only the estimate for 1993 is statistically different from zero; this is an expected result, since in 1993 continental Europe recorded a deep recession.

As 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. The investment 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. Note that the possibility of a permanent downward shift in the value of the constant had already been taken into account in (4) by the year dummies, λ_t. Formal tests of instability of the coefficients 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 be detected in the parameters of the other regressors.[8] Therefore

[7] 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.

[8] Formal tests of instability of all the coefficient are reported in a previous draft (Caselli, Pagano and Schivardi, 2000).

we rewrite (4) as:

$$i_{j,t} = \alpha_0 + \alpha_1\, i_{j,t-1} + \alpha_2\, y_{j,t} + \alpha_3\, y_{j,t-1} + \alpha_4 r_{j,t} + \alpha_5 D_{91} y_{j,t} + \lambda_t + \mu_j + \nu_{j,t} \qquad (5)$$

where D_{91} is a dummy variable that takes the value 1 after 1991 and 0 before.[9] The results, also reported in Table 2, column 2, show that α_5 is indeed negative and statistically significant.[10] 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]. The estimated value of α_5 implies that, in the log run, the link between investment and demand has halved after 1991 with respect to the previous period. These results therefore suggest that the accumulation process in continental Europe was characterized by a structural change in the response of capital accumulation to expected demand, leading to a pronounced deceleration of investment, for a given path of expected demand.

3 Sectoral composition and nonlinearities

The next step is to investigate the source of this break. Before doing that, we have checked whether it has been uniform across sectors. 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 split into manufacturing and services, the negative break would be sharper for the former, while the latter should not exhibit any break at all. Given the fact that euro-area countries have a relatively higher share of employment in manufacturing with respect to the US and the UK, one could argue that the weak accumulation was partially related to their specialization pattern.[11] This conjecture is not supported by the data. In Table 3, column [1], we run the regression allowing for different parameters

[9] This specification implicitly imposes that the break is proportional between the long and the short run. Given the short time period available to estimate the structural change and the obvious collinearity in $y_{j,t}$ and $y_{j,t-1}$, allowing for a different coefficient also for lagged value added after 1991 sensibly worsens the estimates, so we impose this restriction in what follows.

[10] We also checked the year in which the break in the accelerator occurred by estimating (4) recursively. The results show that 1991 is the first year in which the estimate of α_2 falls outside the confidence bands prevalent in the eighties, suggesting that the break occurred then.

[11] See Ferrando (1999) for a description of the sectoral productive structure in the leading EU countries.

of demand for manufacturing and services. As expected, manufacturing sectors are more sensitive to demand in the short run (0.0887 vs. 0.0416). However, even if the absolute value of the break is higher in the "manufacturing" than in the "other sectors" (-0.0087 vs. -0.0054), relatively to the size of the accelerator the two breaks are similar, both in the short and in the long run.[12] This indicates that the structural change that occurred after 1991 cannot be attributed to the sectoral compositions of European investment.

As already mentioned, beginning in the early nineties economic activity decelerated in the euro-area countries; thus, the break in the accelerator could, in principle, be also 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, 1999). First we have tested this hypothesis by introducing two quadratic terms, y_t^2 and y_{t-1}^2, in (5) but both of them turned out to be not significant. We then split the sectors into two groups of ten, according to their average growth rate of value added after 1991 compared with that recorded before. It turns 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.[13] We conjecture that the sectors that experienced a drastic deceleration in demand reacted by decelerating capital accumulation even more, while in the remaining sectors the response of investment did not change. This kind of nonlinear response may be rationalized 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; when demand decelerated, excess capacity had to be unloaded. The results obtained do not support this conjecture. Table 3, column [2], shows that the value of the accelerator is very similar for the two subgroups before 1991; in the nineties, however, both subgroups recorded a negative and statistically significant break, almost identical in absolute value.

[12] We actually split all the sectors into manufacturing and "others"; 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 "others" and we obtained the same results.

[13] 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 panel.

Summing up, so far we have not found evidence that the break in accelerator occurred in Europe in the nineties is to be attributed to some particular sector or to non linearities in the relationship between investment and demand. In the next section we investigate an other candidate explanation

4 Demand uncertainty

A growing body of theoretical and, more recently, empirical literature has stressed the relevance of uncertainty in the process of capital formation.[14] Abel and Eberly (1996) offer a characterization of the investment decision process at the firm level under uncertainty and costly reversibility by extending the neoclassical framework of Jorgenson (1971). They show that, in this setting, the user cost of capital should be modified to take into account the investment and disinvestment thresholds: in terms of equation (1), the user cost r_t now also includes two terms, a positive real option term ϕ_U at the investment threshold and a negative one ϕ_L at the disinvestment threshold. The optimal policy then prescribes that as long as the marginal product of capital does not cross the boundaries the firm will not change its capital stock. In this framework, uncertainty reduces the responsiveness of investment to demand both by widening the inaction region and by decreasing the amount of investment, when it occurs: $\frac{\partial i}{\partial \sigma} < 0$ were σ is the measure of demand uncertainty.

Empirical studies of the effects of uncertainty on investments based on firm-level data give support to this prediction. Guiso and Parigi (1999) find a significant negative effect of uncertainty on capital formation with data derived from the sample of Italian firms of the Bank of Italy's investment survey. Bloom *et al.* (2000) 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. We use a similar approach and test the predictions of this theory with our sectoral data to determine if demand uncertainty may help explaining the slowdown of capital accumulation in continental Europe in the nineties.

We have first calculated several indicators of demand variability for the four leading

[14] For a comprehensive survey of the literature on investment and uncertainty see Guiso and Parigi (1999).

euro-area countries of our sample.[15] Table 4 indicates that demand variability increased in Germany, France and Italy, suggesting that this could be at least partially responsible for the sluggish process of accumulation. To test this hypothesis we chose the following two-step strategy. First, we introduce direct measures of uncertainty into equation (5). Second, we follow an "indirect" approach and divide the sectors into two groups: those for which the variability of demand increased from 1991 onwards and those for which it did not. By using different measures of uncertainty in the two exercises, we will be able to test the robustness of our findings.

Since our specification is closely akin to Guiso and Parigi (1999), we introduce in (5) uncertainty interacted with demand:

$$i_{j,t} = \alpha_0 + \alpha_1 i_{j,t-1} + \alpha_2 y_{j,t} + \alpha_3 y_{j,t-1} + \alpha_4 r_{j,t} + \alpha_5 D_{91} y_{j,t} + \alpha_6 \sigma_t y_{j,t} + \alpha_7 \sigma_{t-1} y_{j,t-1} + \lambda_t + \mu_j + \nu_{j,t} \quad (6)$$

The presumption is that if demand uncertainty affects investment negatively, and if the downward shift in the accelerator is due to the fact that we have omitted this variable so far, then introducing uncertainty should reduce the significance and the absolute value of the estimated break. As a proxy of demand uncertainty, we chose a forward-looking indicator that is country-specific but, unfortunately, not sector-specific, i.e. the standard deviation, within each year, of the expected short-term trend in industrial production, as derived from monthly national surveys on the industrial sector.[16]

Table 5 reports the estimates of equation (6). In column [1] − [2] we present the estimates obtained without a break in the accelerator; the coefficients of the current and lagged interaction of uncertainty with demand (α_6 and α_7) are negative, as expected, and highly significant. This means that uncertainty has a negative impact on capital accumulation, in accordance with previous studies. This result holds true also when we drop the lagged value

[15] Backward looking indicators 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 standard deviation of the expected short-term trend in industrial production is instead a forward looking indicator.

[16] This measure was calculated as the standard deviation, within each year, of the share of positive and negative responses, expressed as percentages, to surveys on the industrial sector conducted monthly in each country by the respective national institutes. It is therefore equal for all of the sectors, although it varies over time and across countries.

of the uncertainty variable. To see if the instability of the investment equation previously detected was due to the omission of uncertainty, the last two columns also include the break in the accelerator. Results are supportive of this hypothesis: the estimate of α_5 are still negative, but smaller in absolute value (see Table 3) and not statistically significant, particularly in the basic specification of column [3].

Given the problems in measuring uncertainty, we further explore these results by resorting to different measures and techniques. In particular, we would like to split sectors according to their demand uncertainty before and after 1991. Since the forward looking indicator used before is not sector-specific it cannot be used to this purpose. We therefore compute the standard deviation of the rate of growth of sectoral value added in each country/sector and in each sub-period.[17] The standard deviation only increased in four sectors; it remained broadly unchanged in six and it decreased in the remaining ten.[18]

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 α_5 should be greater, in absolute value, for the former. To test this conjecture, we estimated two different equations (see Table 6). First, we divided our sample into two subgroups, according to whether or not variability increased in the nineties (column [1]); second, we split the sectors into three groups, according to whether the variability increased, did not change or declined (column [2]). The results confirm our presumption: in both equations, we found that the absolute value of the break is higher for the first group of sectors (that is, those that experienced an increase of demand variability); moreover the long run decrease of the accelerator after 1991 for this group is much stronger also in percentage terms, at least in the first column. We interpret these results as supportive of the hypothesis that increased uncertainty might have

[17] Since for several units the number of observations used to calculate these standard deviations are limited, we compute a weighted average of the national values for each sector and for each sub-period; the weights used are the number of available observations for each country.

[18] 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 4). 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 in the nineties.

played a role in changing the relationship between investment and demand in the nineties in the euro-area countries.

5 Concluding remarks

In the nineties the relationship between capital formation and activity profoundly changed in both the euro-area countries and the Anglo-Saxon countries, mainly in the United States. In this paper we have focussed on the euro-area countries, whose economies 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 capital accumulation was nearly stagnant, even negative in some countries.

By estimating a standard investment equation we show the presence of structural instability at the beginning of the nineties; in particular, we have detected a break in the coefficient linking capital accumulation to demand. This phenomenon neither seems to be related to the sectoral composition of European investment nor to a nonlinear relationship between investment and demand. We have found evidence that the reduction of the accelerator can be explained, at least in part, by the increase in demand variability that occurred in Europe in the nineties compared with the previous period.

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A Appendix

A.1 The aggregate data

The aggregate analysis in Section 2 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 (Summers and Heston, 1991).

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 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 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

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 A1 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.

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 sector.

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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

BASELINE CASE

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

	[1]	[2]
y_t	0.0678 (0.000)	0.0696 (0.000)
$D_{91}*y_t$		-0.0066 (0.033)
y_{t-1}	-0.0579 (0.000)	-0.0560 (0.000)
i_{t-1}	0.7188 (0.000)	0.7133 (0.000)
r_t	-0.0259 (0.000)	-0.0265 (0.000)
Sargan: p-value	0.781 [98]	0.770 [98]
LM(1): p-value	0.000 [102]	0.000 [102]
LM(2): p-value	0.418 [100]	0.404 [100]
Observations	1,837	1,837

Notes: p-values from 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. The instruments are i_{t-2} to i_{t-5} in the equations in first-differences and $\Delta\, i_{t-1}$ in the equations in levels.

Table 3

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)

	[1] Manufacturing versus others	[2] High versus low-growth sectors
$y_{t,A}$	0.0887	0.0699
	(0.000)	(0.000)
$D_{91}*y_{t,A}$	-0.0087	-0.0081
	(0.002)	(0.004)
$y_{t-1,A}$	-0.0778	-0.0610
	(0.000)	(0.000)
$y_{t,B}$	0.0416	0.0771
	(0.020)	(0.000)
$D_{91}*y_{t,B}$	-0.0054	-0.0074
	(0.054)	(0.034)
$y_{t-1,B}$	-0.0337	-0.0671
	(0.046)	(0.001)
i_{t-1}	0.7934	0.7980
	(0.000)	(0.000)
r_t	-0.0270	-0.0227
	(0.000)	(0.000)
Sargan: p-value	0.785	0.808
	[100]	[100]
LM(1): p-value	0.000	0.000
	[102]	[102]
LM(2): p-value	0.370	0.367
	[100]	[100]
Observations	1,837	1,837

Notes: p-values from 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” .The instruments are i_{t-2} to i_{t-4} in the equations in first-differences and $\Delta\ i_{t-1}$ to $\Delta\ i_{t-2}$ in the equations in levels

Table 4

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)
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.

CAPITAL FORMATION AND UNCERTAINTY: DIRECT MEASURES OF DEMAND VARIABILITY

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

	[1]	[2]	[3]	[4]
y_t	0.0676 (0.000)	0.0723 (0.000)	0.0657 (0.000)	0.0699 (0.000)
$D_{91}*y_t$			-0.0046 (0.151)	-0.0053 (0.098)
y_{t-1}	-0.0512 (0.000)	-0.0577 (0.000)	-0.0495 (0.000)	-0.0553 (0.000)
σ_t*y_t	-0.0632 (0.034)	-0.0872 (0.002)	-0.0527 (0.078)	-0.0748 (0.008)
$\sigma_{t-1}*y_{t-1}$	-0.0505 (0.000)		-0.0489 (0.000)	
i_{t-1}	0.7193 (0.000)	0.7347 (0.000)	0.7221 (0.000)	0.7371 (0.000)
r_t	-0.0309 (0.000)	-0.0310 (0.000)	-0.0308 (0.000)	-0.0304 (0.000)
Sargan: p-value	0.724 [102]	0.671 [102]	0.743 [102]	0.653 [102]
LM(1): p-value	0.000 [102]	0.000 [102]	0.000 [102]	0.000 [102]
LM(2): p-value	0.390 [100]	0.316 [100]	0.394 [100]	0.318 [100]
Observations	1,803	1,803	1,803	1,803

Notes: p-values from 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. The instruments are i_{t-2} to i_{t-3} 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 6

**CAPITAL FORMATION AND UNCERTAINTY:
INDIRECT APPROACH**

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

	[1]	[2]
$y_{t,high}$	0.0585	0.0607
	(0.001)	(0.001)
$y_{t,med}$		0.1023
		(0.000)
$y_{t,low}$	0.0741	0.0581
	(0.000)	(0.000)
$D_{91}*y_{t,high}$	-0.0090	-0.0097
	(0.001)	(0.001)
$D_{91}*y_{t,med}$		-0.0010
		(0.762)
$D_{91}*y_{t,low}$	-0.0021	-0.0053
	(0.570)	(0.228)
$y_{t-1,high}$	-0.0477	-0.0499
	(0.007)	(0.005)
$y_{t-1,med}$		-0.0917
		(0.000)
$y_{t-1,low}$	-0.0629	-0.0463
	(0.000)	(0.002)
i_{t-1}	0.7144	0.7253
	(0.000)	(0.000)
r_t	-0.0265	-0.0255
	(0.000)	(0.000)
Sargan: p-value	0.785	0.831
	[98]	[98]
LM(1): p-value	0.000	0.000
	[102]	[102]
LM(2): p-value	0.401	0.414
	[100]	[100]
Observations	1,837	1,837

Notes: p-values from 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. The instruments are i_{t-2} to i_{t-5} in the equations in first-differences and $\Delta\ i_{t-1}$ in the equations in levels.

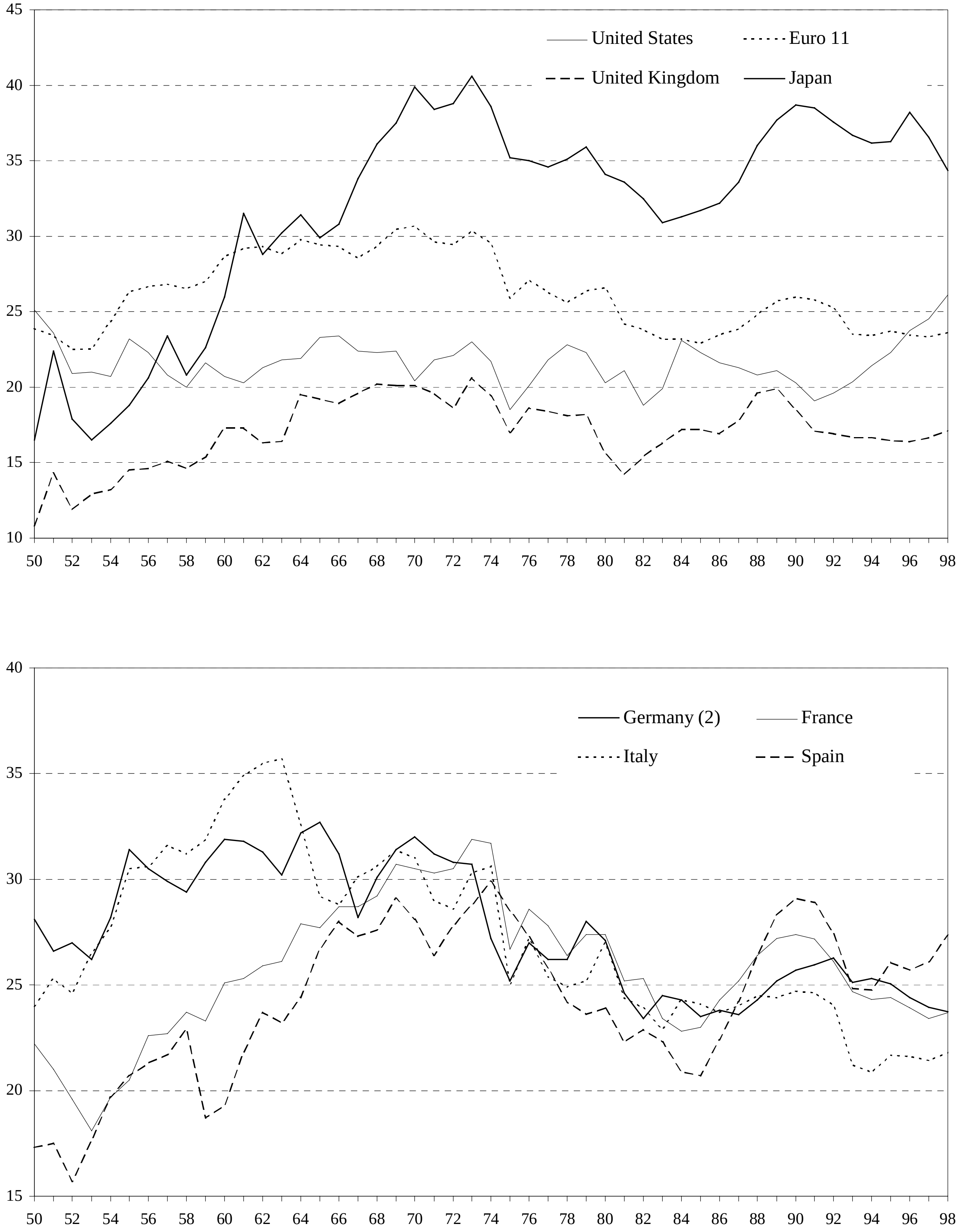
DATA USED IN THE ECONOMETRIC ANALYSIS

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.