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Why has investment resumed in France despite low capacity utilization rates?

- French industry's capacity utilization rate has picked up progressively, after falling sharply during the crisis. Even so, in early 2011 it was still well below its long-term average. Yet despite this under-utilization of existing stock of capital, non-financial corporations resumed investing as early as the second quarter of 2010, and even as early as fourth-quarter 2009 for productive investment excluding construction.

- This apparent paradox-low capacity utilization and dynamic investment-is not specific to the present cycle of the crisis. This configuration has already occurred in the past, notably in the 1993 crisis, even if the 2008-2009 crisis saw a far larger fall in the capacity utilization rate.

- Both theoretical and practical arguments suggest the capacity utilization rate should be treated with caution as a predictor of investment. On the one hand, industry accounts for only utilizing 20-25% of productive investment in France and is therefore not entirely representative of capacity utilization across the economy as a whole. On the other, from a theoretical standpoint, an increase in investment in a context of low capacity utilization is possible when expected demand far exceeds current demand. In that case, it may be profitable for a firm to invest today in order to smooth its capital stock adjustment costs, even if that means under-utilizing its existing capacity.

- Other indicators are surely more relevant for short-term investment forecasting. To begin with production bottlenecks or opinions concerning industry's production capacity are presumably more representative than the capacity utilization rate of pressures on capacity, which is merely an average indicator. Secondly, some indicators have indeed heralded the investment upturn: Insee's quarterly indicator of industrial investment, the services sector survey with its specific questions on investment in the services sector, and to a lesser extent the survey of business owners' expectations of future activity in the wholesale sector. These three sources have proved more reliable than the capacity utilization rate in forecasting the short-term pace of investment in the recent period.

- The investment recovery registered since mid-2010 could thus spring from the expectation by many firms of strong expected stabilizing demand and from their desire to smooth their capital stock adjustment costs.

Capacity utilization rates in industry and investment excluding construction by non-financial corporations


Deviation from long-term mean, standard deviation percentage points

Quarterly change (in %)

Most recent data points: Q1 2011 (Capacity utilisation rate, April 2011 survey)
Q1 2011 (actual investment)

— Capacity utilisation rate in industry
— Investment, excluding construction, by non-financial corporations (righthand scale)

Sources: Insee, DG Trésor calculations.

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DES FINANCES ET DE L'INDUSTRIE
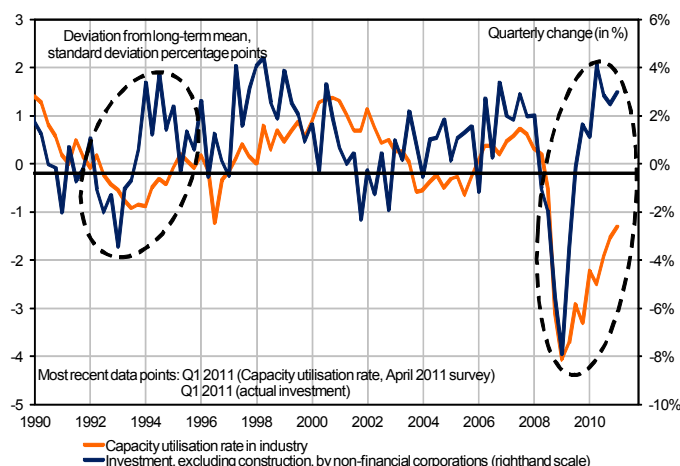
1. The investment recovery in 2010 may seem surprising given that capacity utilization in industry was still low

1.1 The Industry capacity utilization rate has picked up slightly since the beginning of 2009, but remained at historically low levels in 2010

The industry capacity utilization rate is the ratio between the production capacity (plant and equipment) actually utilised by a firm in its production process and all of the available capacity within the same firm at a given date. Capacity actually utilised depends on the level of output, whereas available capacity varies as a result of new investments and capital depreciation. The estimation of the capacity utilization rate, which is obtained via the results of the Insee and Banque de France surveys, is subject to some uncertainty, especially because these take capital goods retirement into account: at first sight, capital goods retirement ought to push up the capacity utilization rate, all other things being equal (on a constant output, technology and labour input basis). But this effect is not necessarily always fully captured in business owners' responses[1].

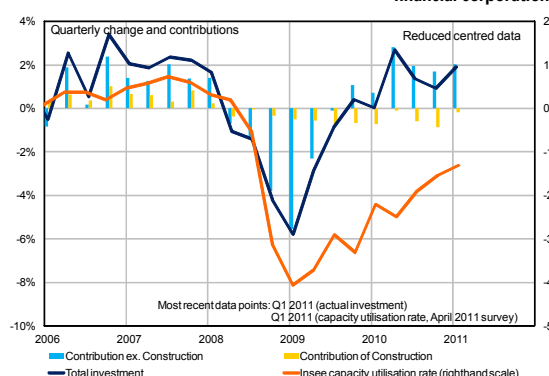Chart 1: Industry capacity utilization rates
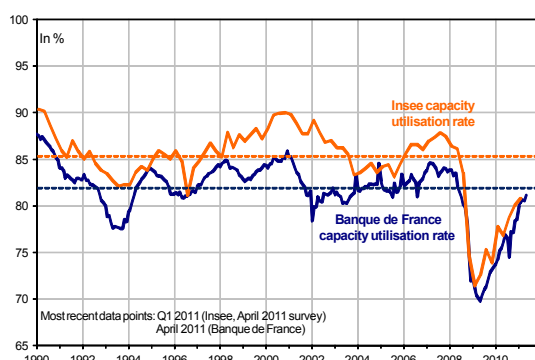
Sources: Insee, Banque de France.

The average industry capacity utilization rate over the period 1981-2010 works out to 85.3% according to Insee, and 81.9 % according to the Banque de France[2]. Compared to the average for the period 1981-2010, the capacity utilization rate measured by Insee (and respectively that measured by the Banque de France) fell by 3.2 percentage points (and by −4.4 respectively) during the 1993 crisis, versus a far more pronounced decline of 14.0 percentage points (respectively −12.1) during the recent crisis. The low point was reached at the beginning of 2009 and the capacity utilization rate has been recovering steadily ever since, but it remained at historically levels (below 80%) throughout 2010.

1.2 Surprisingly however, at first sight, investment has picked up since Q2 2010 (since Q4 2009 for its non-construction component) despite the low capacity utilization rate

Although the capacity utilization rate was well below its long-term average in the first half of 2010, business investment began to pick up in Q2 2010, and indeed in Q4 2009 for its non-construction component. If we look more specifically at investment in manufactured goods, which comes closer to investment in plant and producer goods, then the contraction lasted only five quarters, stabilizing as far back as Q3 2009.

Chart 2: Manufacturing capacity utilization rate and investment by non-financial corporations

Sources: Insee, DG Trésor calculations.

1.3 A configuration already seen in the past

A look at the 1993 crisis shows that business investment excluding construction can take place even if the industry capacity utilization rate is low:

- Although business investment (excluding construction) has fallen more steeply in the current crisis than in 1993, the length of the decline in investment has been equivalent (six quarters).

- In the 1993 crisis, the capacity utilization rate did not rise above its long-term average until Q2 1995, in other words, at that time the investment recovery preceded the return to normal of the capacity utilization rate by six quarters. Even this comparison with 1993 is purely illustrative, it does show that the situation is not a new one.

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(1) In practice, to overcome this difficulty, utilised capacity is approximated by actual output and available capacity by the company's maximum output in the Insee and Banque de France business cycle surveys.

(2) There may be a number of explanations for the differences between capacity utilization rates measured by the Insee and Banque de France surveys. These include differences regarding the scope of the survey, polling methods and company samples, etc. Also worth noting, the two surveys define "maximum output" differently: in the Insee questionnaire, maximum output means the maximum obtainable if all available capacity were utilised and allowing for the possibility of hiring additional labour, whereas for the Banque de France, maximum output means the maximum achievable in the very short term, i.e. without hiring additional labour (however these different definitions are the not main source of the discrepancies, since the Banque de France's capacity utilization rate ought to be consistently higher than for Insee, whereas the reverse is true, on average).

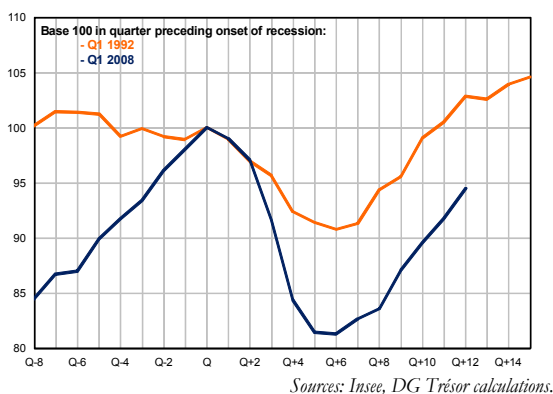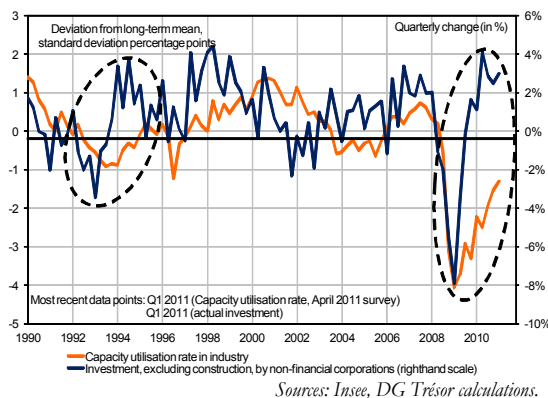**Chart 3: Investment cycle excluding construction by non-financial corporations, 1993 and 2008 recessions**

Sources: Insee, DG Trésor calculations.

Chart 4: Industry capacity utilization rate and investment excluding construction by non-financial corporations

Sources: Insee, DG Trésor calculations.

2. Both theoretical and practical arguments suggest caution is required in using the capacity utilization rate as a short-term predictor of investment

2.1 In theory, low capacity utilization need not necessarily dampen investment

A company's effective output capacity is equal to the sum of the stock of available capital and the capacity utilization rate. A company wishing to boost its effective capacity at a given moment in time, in order to cope with increased demand, for example, can either invest (by increasing available capital), or can extract greater output from its existing production capacity, if that is possible. In other words, to achieve its desired level of output, a firm must strike a trade-off between its capacity utilization rate and its level of capital, hence its investment. Yet each of these choices entails costs of their own, whether real or opportunity costs. Depending on its expectations, the company will opt for what it sees as the most profitable solution:

- Faced with what is seen as a temporary demand shock, a company may consider it more advantageous to adjust its output by varying its capacity utilization rate rather than the level of its stock capital. After all, there is a degree of irreversibility about new physical investment, along with high fixed costs, including installation, training, prospecting, etc., which can only be recouped by using the new equipment over a long period of time. Adjusting the capacity utilization rate, on the other hand, gives the company time to gather information in a climate of uncertainty and postpone its investment decision until it sees a greater certainty of earning a return on its investment.

- However, adjusting capacity utilization rates can only be a short-term solution. Prolonged under-utilization of capacity carries a hefty opportunity cost, as past investments have yet to earn a profit. Over-intensive utilization of capacity is costly for the firm too (due to accelerated capital retirement, additional labour costs, and opportunity costs since a near-100 %

capacity utilization rate means the company cannot fill new orders).

In theory, then, the optimal trade-off between the capacity utilization rate and investment depends on the initial capacity utilization rate, and on current and expected demand. A low capacity utilization rate with positive investment configuration may be optimal for the company when expected demand is highly favourable. It is this trade-off that is explained in Box 1, which presents a simple analysis of the investment choice programme. Here we eliminate questions of the relative cost of capital versus the other production factors and financial constraints, since these lie outside the scope of this study.

2.2 In practice, the importance of the industry capacity utilization rate needs to be treated with caution, since this sector accounts for only a modest share of total investment and the pace of investment

The quarterly industry survey (which assesses the capacity utilization rate in industry) questions a sample of companies in the industrial sector. Yet even if this sector is an important driver of economic trends, it represented only 25% of total business investment in 2005, according to Insee[3].

An approach by "branch" of activity rather than by "sector"[4] allows us to use the most recent data, and over a longer period. Consequently the industry "branch"[5] (including food products and beverages and energy) accounted for only 20% of total business investment in 2009, which is distinctly less than the market services "branch" (over 60%).
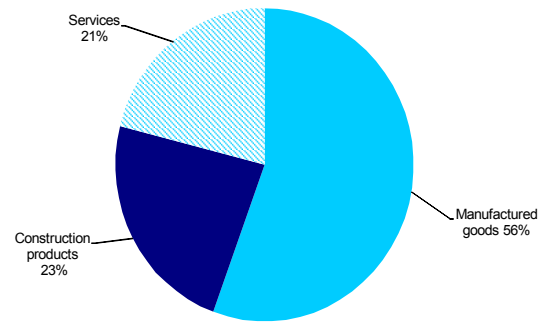
In addition, the capacity utilization rate reflects pressures on the production system (plant and equipment), so it is therefore linked to investment in manufactured goods; but this accounts for barely 60% investment by the industry "branch".

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(3) Cf. Bardaji J. and Lhommeau B. (2009), "L'enquête sur les investissements dans l'industrie: méthodologie" (Industrial investment survey: methodology), *Insee méthodes* no. 119, février.

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Breakdown by "branch" of activity
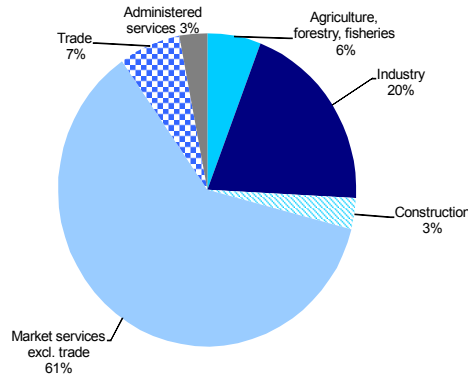
Chart 5: Breakdown of total investment by non-financial corporations
Breakdown by type of goods produced by the industry "branch"

Box 1: **A model of the trade-off between the capacity utilization rate and investment**

This model looks at deviations from the average level, allowing us to linearise the relationship between output (Y), the capital stock (K) and the industry capacity utilization rate (U).

$$Y_t = K_t \cdot U_t \quad \text{(Relationship between levels)}$$

$$\hat{y}_t = \hat{k}_t + \hat{u}_t \quad \text{(Relationship expressed as a deviation from the average situation)}$$

In this simplified approach, investment (I) is equal to the variation in the stock of capital (in other words ignoring capital depreciation). Moreover, we confine ourselves to a time frame of two periods (T = 0, 1, 2).

$$\hat{i}_t = \hat{k}_t - \hat{k}_{t-1}$$

Starting from an initial situation $\hat{y}_0, \hat{k}_0, \hat{u}_0$, from known level of demand for the first period $(\hat{y}_1)$ and expected demand for the second period $(E(\hat{y}_2))$, the company schedules its production (determining its capacity utilization rate and level of investment), while minimising its expectation of intertemporal costs, which is assumed to be expressed as follows, via the cost function ψ:

$$\psi = \frac{1}{2} \cdot \hat{u}_1^2 + \gamma \cdot \frac{1}{2} \cdot (\hat{k}_1 - \hat{k}_0)^2 + \beta \cdot E\left(\frac{1}{2} \cdot \hat{u}_2^2 + \gamma \cdot \frac{1}{2} \cdot (\hat{k}_2 - \hat{k}_1)^2\right)$$

where β is a discounting factor and γ a relative cost parameter.

Without loss of generality and to simplify, we assume that the stock of capital is determined in Q1 for both periods, in other words $k_2 = k_1$ (this does not alter the conclusions, but it does simplify the analytic expression of the solutions). Consequently, we can rewrite the cost function as follows:

$$\psi = \frac{1}{2} \cdot \hat{u}_1^2 + \gamma \cdot \frac{1}{2} \cdot (\hat{y}_1 - \hat{y}_0 + \hat{u}_0 - \hat{u}_1)^2 + \beta \cdot E\left(\frac{1}{2} \cdot (\hat{y}_2 - \hat{y}_1 - \hat{u}_1)^2\right)$$

The first order conditions of this optimisation programme are simplified and serve to explain the capacity utilization rate and investment in the first period analytically based on the initial assumptions:

$$\hat{u}_1 = \frac{\gamma}{1+\beta+\gamma} \cdot \hat{u}_0 + \frac{\gamma}{1+\beta+\gamma} \cdot (\hat{y}_1 - \hat{y}_0) - \frac{\beta}{1+\beta+\gamma} \cdot (E(\hat{y}_2) - \hat{y}_1)$$

$$\hat{k}_1 - \hat{k}_0 = \frac{1+\beta}{1+\beta+\gamma} \cdot \hat{u}_0 + \frac{1+\beta}{1+\beta+\gamma} \cdot (\hat{y}_1 - \hat{y}_0) + \frac{\beta}{1+\beta+\gamma} \cdot (E(\hat{y}_2) - \hat{y}_1)$$

In this model, the investment choice depends, all other things being equal, on the initial capacity utilization rate $(\hat{y}_1 - \hat{y}_0)$ and in expected demand $(E(\hat{y}_2) - \hat{y}_1)$.

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(4) A branch of activity encompasses homogeneous production units, i.e. units manufacturing the same product as defined in the nomenclature of activities; a sector encompasses corporations classified according to their main activity (i.e. a corporation with heterogeneous production units will be classified in the sector corresponding to the branch to which its most important unit belongs). Concerning investment in the recent past, assessments at this level of detail are available for branches only. There appear to be significant differences appear: based on 2005 data, the industry sector's share of total investment (25%) is 5% greater than the branch's share (20%). Part of the difference can be explained by investments made by sales department units of corporations in the industry sector (and hence outside the industry branch). It is worth noting that the companies questioned in the quarterly industry survey may be either the lead companies of a group or the industrial units of groups, thereby implying a hybrid approach between branch and sector. Consequently, the true representativeness of the field covered by the capacity utilization rate is probably midway between the two estimations (sector and branch).

(5) At this level of detail, France's national accounts are still published according to NAF 2003 (NAF revision 1) whereas the quarterly industry survey is published according to NAF 2008 (NAF revision 2). The aggregated fields for total industry and market services are roughly similar overall in the two nomenclatures, making the comparison acceptable at this level of aggregation. Wider differences are found at a slightly more disaggregated level (for example manufacturing industry according to NAF revision 2 now includes refining and food products and beverages, which was not the case according to NAF revision 1).

Even if we consider the impact of industry on investment volatility, it looks as if this "branch" accounts for only 40% of fluctuations in the annual growth in investment by non-financial corporations. In other words, even where fluctuation is concerned, it worth observing the "branches" other than industry.

Graphique 6 : Variation in investment in the industry "branch"
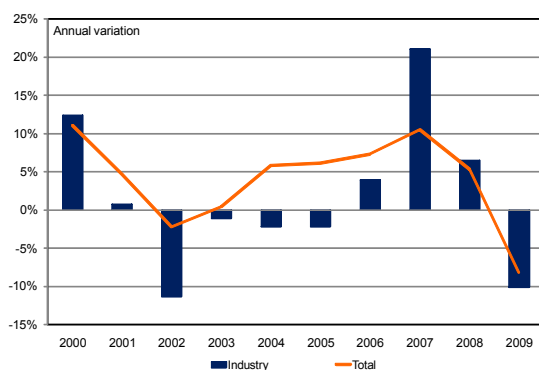
Sources: Insee, 2009 Accounts, DG Trésor calculations.

Graphique 7 : Breakdown by "branch" of variance of growth in total investment by non-financial corporations
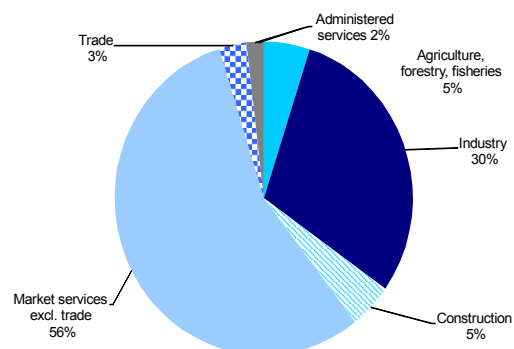
Sources: Insee, 2009 Accounts, DG Trésor calculations.

Box 2: **Calculating industry's contribution to investment volatility**

Industry's contribution to fluctuations in investment can be analysed using Grégoir and Laroque'sa method of calculating contributions to variance[a].

If a variable X is broken down as follows: $X = Y + Z$

Using the following notation:

σ_X^2, σ_Y^2 and σ_Z^2 the respective variances of X, Y and Z

ρ_{XY}, ρ_{XZ} the correlation between X and Y on the one hand and that between X and Z on the other

Then, $\sigma_X^2 = \rho_{XY} \cdot \sigma_Y \cdot \sigma_X + \rho_{XZ} \cdot \sigma_Z \cdot \sigma$

Remplacing X by the annual growth in investment $\left(\dfrac{\Delta I_t^{tot}}{I_{t-1}^{tot}}\right)$ and Y by the contribution of industry to this growth $\left(\dfrac{\Delta I_t^{Ind}}{I_{t-1}^{tot}}\right)$, then $\dfrac{\rho_{XY} \cdot \sigma_Y}{\sigma_X}$ represents the percentage share of the variance in the growth in investment by non-financial corporations explained by the industry "branch".

a. Grégoir S. and Laroque G. (1992), "La place des stocks dans les fluctuations conjoncturelles" (The role of stocks in cyclical fluctuations), *Annales d'économie et de statistique* no. 28.

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3. Other indicators than capacity utilization rate are doubtless more relevant when predicting the level of investment

3.1 More representative indicators of pressure on industrial production capacity

The Industry capacity utilization rate is an average indicator for industry as a whole, which cannot on its own reflect the very heterogeneous situation of different companies. Thus the very marginal rise in the average capacity utilization rate for industry conceals the fact a steep increase in the number of corporations experiencing production bottlenecks (i.e. a near-100% capacity utilization rate) in the first half of 2010. Similarly, business owners' opinions regarding their production capacity had reverted to its long-term average. These two indicators also overcome difficulties connected with measuring the capacity utilization rate and capital goods retirement, since they directly signal pressure on capacity.

Production bottlenecks connected with shortages of plant or equipment in the Insee quarterly survey of industry provide an initial indication of possible "structure effects" (i.e. deformation of the capacity utilization rate distribution with no change in the average). This is because this indicator signals the fraction of business owners unable to increase their output despite new orders (i.e. whose capacity utilization rate is close to 100%). These compounding effects appear to have been fully operative in 2010. Although the capacity utilization rate in 2010-2011 is still well below its long-term average, a by no means negligible number of companies presumably resumed their investment programmes as early as 2010, having reached the limits of their production capacity.

**Chart 8: Production bottlenecks and investment**

Source: Insee.
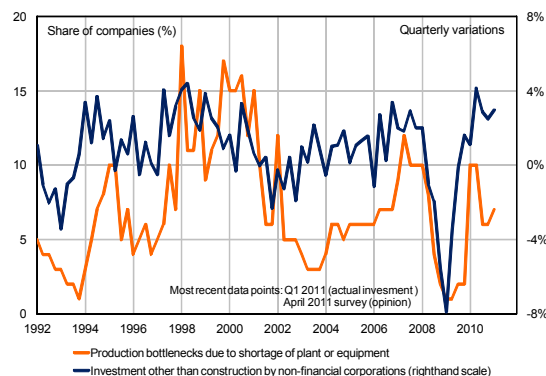
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Another indicator serves to observe the distribution of pressure within the industry "branch", namely **business owners' sentiment regarding their production capacity**. In 2009, a broad majority of business owners considered their production capacity more than sufficient, whereas in the first half of 2010 this opinion had reverted to its long-term average. This means that, despite the low capacity utilization rate, a "normal" share of the production system was feeling pressure on its capacity, which is a good sign for investment. A single company may experience a situation where production capacity is thought insufficient despite low capacity utilization because, if it has several production lines for different products, it takes pressure on just one line for the business owner to report a capacity shortage.

These variables can be integrated into accelerator-type investment equations for the purpose of measuring the utility of these three indicators of pressure on the production system (capacity utilization rate, production bottlenecks, and sentiment regarding production capacity) in tracking investment (see Box 3).

What emerges from these models is that production bottlenecks are the best predictors of investment other than construction by non-financial corporations. This may be accounted for in particular by the fact that they capture the fraction of companies with the most pressing investment needs.

Chart 9: Sentiment regarding production capacity and investment

Deviation form long-terme average, in standard deviation percentage points

Quarterly variations

Most recent data points: Q1 2011 (actual investment)
April 2011 survey (opinion)

— Sentiment regarding production capacity (inverse scale)
— Investment other than construction by non-financial corporations (righthand scale)
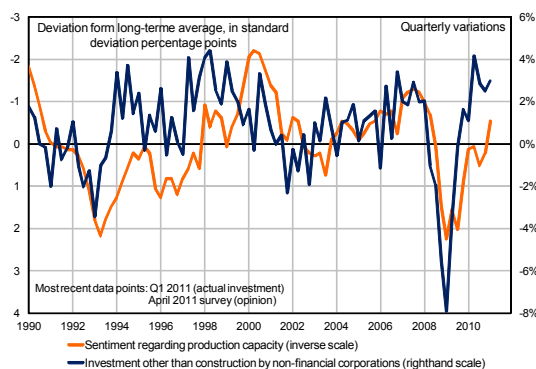
Sources: Insee, DG Trésor calculations.

Box 3: Investment equations and indicators of pressure on the production system

The investment equations presented in this box have deliberately been kept simple, since more complex models would fail to make the variables indicating pressure on the production system meaningful.

These are accelerator-type equations, and in addition to each of the pressure variables, they use the estimated value added based on instrumental values (i.e. household consumption and exports)[a] and the SP500 VIX volatility variable to reflect pressure on the financial markets. The econometric analysis here shows that an investment equation containing the "bottleneck" variable performs better and is more robust than a formalisation of investment based on the capacity utilization rate.

| Coefficients (t-student)	Model including capacity utilization rate	Model including JCP	Model including bottlenecks
Constant	−0.13540	0.01372	−0.00091
	(−2.9)**	(1.96)*	(−0.2)
Value added	2.31967	2.36520	2.08188
	(4.6)**	(4.7)**	(4.0)**
VIX	−0.00039	−0.00051	−0.00061
	(−1.8)*	(−2.3)**	(−2.7)**
Capacity utilization rate	0.00166		
	(3.0)**		
Opinion of production capacity		−0.00041	
		(−2.7)**	
Bottlenecks			0.00172
			(−3.5)**
R^2 ajusted	0.46	0.45	0.48
DW	1.61	1.63	1.74
Estimation period	Q1 1991-Q4 2009		

**: Significant to 5%, * Significant to 10%.

Source: DG Trésor calculations.

a. Given that investment excluding construction is one of the components of value added, this may give rise to a problem of endogeneity. The use of instrumental variables serves to correct this bias.

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3.2 More comprehensive qualitative indicators also predicted the investment recovery

The indicator of reevaluation used in the quarterly survey of investment in industry appears to identify investment turnarounds correctly with a one-quarter delay: investment did indeed grow sharply in Q1 2010 and remained buoyant throughout 2010. It also correctly identified the turning point in the previous recession of 1993.

Chart 10: The Industrial investment survey: indicator of reevaluation and investment by non-financial corporations
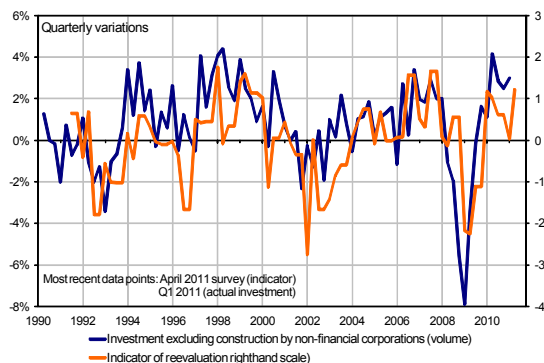
Source: Insee, DG Trésor calculations.

Moreover, Insee's quarterly survey of services supplies qualitative information on investment in the services sector, which accounts for a distinctly larger share of total investment than industry (60% v. 20%, see above). This survey fairly accurately identified the investment recovery, albeit with a slight delay. The business climate in the services sector had thus risen back about its long-term average in mid-2010, at a moment when this was surging distinctly.

Unfortunately, given that the two questions concerning past and expected future investment have been asked since July 2005 only, the period studied is too brief to yield reliable econometric correlations.

Chart 11: Insee monthly survey of services: sentiment on past and future investment
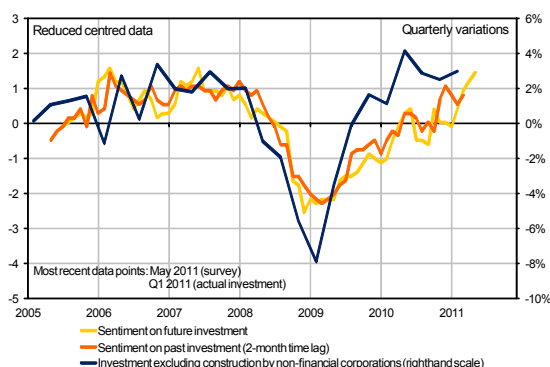
Sources: Insee, DG Trésor calculations.

Even if it is less relevant when analysing the recent crisis, the balance of sentiment on the general outlook in wholesale business can serve as an additional indicator. In the 1993 crisis, investment excluding construction started picking up in the fourth quarter of 1993, whereas the general outlook for activity reverted to its long-term average in March 1994.

Chart 12: Insee bi-monthly wholesale business survey
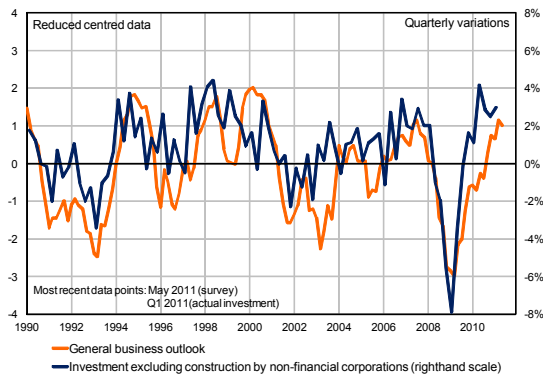
Sources: Insee, DG Trésor calculations.

The utilization of capacity utilization rate as a leading indicator of business investment is therefore clearly insufficient. It would probably be more appropriate to complete the diagnosis first by looking at the distribution of the capacity utilization rate around its mean (via production bottlenecks and sentiment regarding production capacity) and, second, by completing the analysis with additional indicators drawn from the business conditions surveys (indicator of reevaluation in the Insee quarterly industrial investment survey, questions on investment in the Insee survey of business conditions in the services sector, or the leading indicators in the Insee bi-monthly wholesale business survey.

Analysis of these different indicators confirms the vigour of the upturn in investment excluding construction in the first half of 2011. After pausing somewhat in the second half of 2010, the production system appears to have come under pressure again in early-2011, with bottlenecks building up, and a majority of companies considering they have a shortage of production capacity. Moreover, the investment outlook is favourable: forward-looking balances in the wholesale business survey are at a high since the start of the crisis. The same holds for future investment intentions in the Insee services sector survey. Further, additional information on lending to businesses lending also points in the right direction and appears to confirm the investment recovery.

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