ISTITUTO DI STUDI E ANALISI ECONOMICA

Inventories and business cycle volatility: an analysis based on ISAE survey data

by

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ABSTRACT

The paper looks at an often debated issue - the decline observed in business cycle volatility - from a rather original point of view represented by careful consideration of qualitative data deriving from Business Tendency Surveys. It first concentrates on the manufacturing sector, providing evidence that volatility slowdown is attributable to a break in the Data Generating Process (Cecchetti, Flores Lagunes, Krause, 2006) rather than to a long trend decline (Blanchard and Simon, 2001). Moreover, it shows that lower variance of the ISAE Confidence Indicator is mostly explained by the behaviour of firms' assessments of demand and inventories. In particular, inventories volatility has decreased, while volatility of production has instead increased with respect to that of demand. Both of these results are consistent with the claim that better inventories management should have a specific role in shaping the production decisions of the firms (Wen, 2005).

Keywords: Inventories, business cycle, business cycle volatility

Classificazione JEL: E32, E22, D24

NON-TECHNICAL SUMMARY

The major novelty of this paper is that of examining an often debated issue - the decline observed in business cycle volatility - from a rather original point of view represented by careful consideration of qualitative data from Business Tendency Surveys. First of all, by looking both at the Industrial Production Index (IPI) and at the ISAE Confidence Indicator (CI), I find evidence of a break in business cycle volatility at the beginning of the eighties; moreover, CI is closely correlated with IPI and the decline in its volatility is mostly explained by the contribution of firms' assessments on demand and inventories. Three main alternative explanations may be advanced for these findings, respectively attributing the "Great Moderation" to sounder monetary policies, the IT revolution enabling better inventories management, and "good luck".

As for the first point, I show that a major decline in inflation rates and expectations has actually occurred, consistent in time with both major institutional innovations in monetary policy management and the volatility decline observed in industrial activity. However, the relationship between lower inflation and volatility decline is not straightforward, some authors recently arguing that lower inflation rates may also determine higher, not lower, output variance. As for the "good luck" hypothesis, I provide evidence that firms' expectations on the general economic situation have indeed reacted to recent shocks, but that these, for some reason, have failed to translate into major variability of the Confidence Indicator. These findings may be considered as supporting the hypothesis that technological innovation may indeed have played a significant role. As a confirmation, I also argue that inventories volatility has decreased, and that volatility of production has instead increased, with respect to that of demand, both these results being consistent with the claim that better inventories management has a specific role in shaping the production decisions of the firms.

SCORTE DI PRODOTTI FINITI E VOLATILITA' DEL CICLO ECONOMICO: UN'ANALISI BASATA SULL'INCHIESTA ISAE

SINTESI

Il lavoro guarda ad un tema molto spesso dibattuto in letteratura - quello del declino della volatilità del ciclo economico - da una prospettiva originale, derivata dai dati delle inchieste congiunturali ISAE sul settore manifatturiero. In primo luogo, l'analisi mostra che la minore volatilità del ciclo è attribuibile ad un preciso cambiamento strutturale nel Processo Generatore dei Dati (PGD, si veda a questo proposito Cecchetti, Flores Lagunes, Krause, 2006), e non ad un lungo declino protratto nel tempo come ipotizzato da Blanchard e Simon (2001). Inoltre, è possibile verificare che una più bassa varianza dell'indicatore di fiducia ISAE è essenzialmente dovuta ai giudizi delle imprese sull'andamento della domanda e delle scorte di prodotti finiti. In particolare, la volatilità delle scorte è effettivamente diminuita negli ultimi anni, mentre la varianza delle attese di produzione è aumentata rispetto a quella della domanda. Entrambi questi risultati sono coerenti con l'ipotesi che una gestione più accorta dei magazzini abbia avuto un ruolo importante nell'influenzare le decisioni di produzione delle imprese (Wen, 2005).

Parole chiave: Scorte, ciclo economico, volatilità del ciclo economico

Classificazione JEL: E32, E22, D24

CONTENTS

1 INTRODUCTION AND OVERVIEW

Business cycle volatility has declined markedly in the last twenty years in most of the industrialised world (see among others Blanchard and Simon, 2001, Stock and Watson, 2002). Various explanations have been advanced for this finding, variously linking the decline in output fluctuations to better inventory management (Kahn, McConnell and Perez Quiros, 2002; McConnell, Perez Quiros, 2000), more appropriate monetary policies (Clarida, Galì, Gertler, 2000), financial innovation (Dynan, Elmensdorf and Sichel, 2005), growing openness to trade (Barrell and Gottschalk, 2004) and "good luck" (Stock and Watson, 2002). A role may also have been played by the gradual rise in the share of services in total output, the service sector being generally considered less volatile then industrial activity. This paper concentrates on the manufacturing sector in Italy, with the aim of further investigating the McConnell, Perez Quiros (2000) hypothesis that less pronounced output fluctuations are primarily attributable to a change in inventory management due to the Information and Communication Technologies (ICT) revolution and the introduction of Just In Time (JIT) techniques[1]. Unlike previous studies, this one measures inventory accumulation on the basis of Business Tendency Surveys (BTS) data[2] , rather than using National Accounts, which are subject to ample revisions and also comprise measurement errors (Knetsch, 2004).

After showing that output volatility in Italy has indeed declined since the eighties (section 2), I shall use the Bai-Perron (1998; 2003) methodology to test for multiple breaks in the persistence and volatility of industrial activity and of the Confidence Indicator (CI) calculated by the Institute for Studies and Economic Analysis (ISAE in the Italian acronym). I then decompose the observed decline in CI variance into the components attributable to the three series used to calculate it (namely, firms' evaluations of demand, inventories and production) and those associated with their covariations (section 4). I finally provide some evidence on the main possible explanations for the "Great Moderation" (section 5). The paper concludes with some considerations on the use of survey data not only, as is customary, for short term analysis and forecasting, but also to address more structural and theoretical issues, along with some proposals for future research.

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1 This explanation has been confuted, for instance, by Stock and Watson (2002), who argue that it is indeed possible that JIT techniques smooth out production in the horizon of weeks or months, but that this effect disappears at the business cycle frequencies.

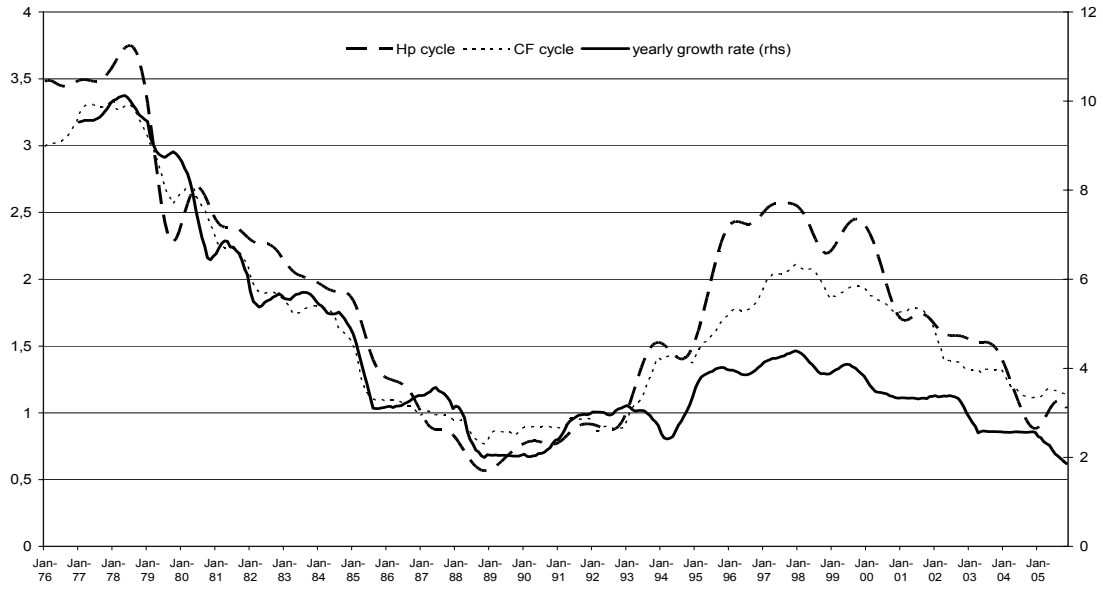
2 The ISAE survey on the manufacturing sector is part of the Harmonised program of the European Commission; see European Commission (2004).

2 THE DECLINE IN BUSINESS CYCLE VOLATILITY

2.1 Industrial production

Business cycle volatility is first analysed in terms of the behaviour of the monthly Industrial Production index (IPI), seasonally adjusting with Tramo-Seats the raw data originally provided by ISTAT for the period 1971-2005. The focus of the analysis is on economic fluctuations over the horizon relevant for medium-term macroeconomic policy and the business cycle. For this reason, following Stock and Watson (2002), I consider transformations of the original data that filter out higher frequency, alternatively using 12-month growth rates and two filters that eliminate long-run components of the series, namely the Hodrick-Prescott (HP) and the Christiano-Fitzgerald (CF) band pass filters. I then calculate the rolling standard deviation of the three series (figure 1)[3]:

Fig. 1: Volatility of Industrial production, 1975-2005



following Blanchard and Simon (2001), I use a window of 60 months (5 years) to calculate them, with the first available observation in 1971:1 and the first observation for the standard deviation of the cyclical component in 1976:1 (1977:1 for yearly growth rates). Volatility increases in the first part of the sample, reaching a peak in 1978; thereafter, it shows a cyclical pattern, with a

[3] I respectively use, for the Hodrick-Prescott filter, the value of 14.400 for the smoothing parameter λ, and for the Christiano-Fitzgerald filter, the full-sample, asymmetric version, assuming that IPI is integrated of order 1 and focussing on business cycle frequencies with periods of 18 to 96 months.

trough at the end of the eighties and a new one in the last part of the sample, when the volatility reaches its lowest levels of the last 30 years. The results are quite similar to those obtained by Blanchard and Simon (2001) for the US economy using GDP data, for which they also find a clear decline in volatility during the second part of the eighties.

2.2 ISAE Confidence Indicator

Interesting insights into the determinants of the "great moderation" may also be gained from qualitative data deriving from Business Tendency Surveys (BTS), which usually show a strong correlation with output. Survey data provide unique information on inventory behaviour, possibly more accurate than those derived from National Accounts. In Italy, ISAE began its survey on the manufacturing sector in 1962, within the framework of the harmonised project of the European Commission. The 4,000 firms answering the survey are asked each month to report - among other things - on the current state of their order books and inventories and on their 3-months-ahead expectations about production. The results are processed in the form of percentages of positive, neutral and negative replies; quantification is obtained as the balance of positive and negative replies. The ISAE Confidence Indicator is then calculated as the average of the balances of the three above-mentioned questions[4].

More specifically, the question on inventories asks whether they are currently "above" or "below" "normal" levels, or if there are "no inventories". A recent ad hoc question submitted to the ISAE sample for the first six months of 2006 has confirmed that a correct interpretation of the "normal" level is that inventories are adequate to the current needs of the firm[5]. The balance is then calculated as the difference between "above normal" and "below normal" replies, therefore considering the "no inventories" option equivalently to the "normal" reply[6]. From a theoretical point of view, the exact nature of the relationship between inventories accumulation and the business cycle is rather

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4 I am indebted to Paola Bellincampi and Massimo di Tommaso for their careful historical reconstruction of the ISAE series; for a description of the ISAE survey, see Malgarini, Margani, Martelli (2005). The published ISAE CI adds the value of 100 to the average of the three balances and indexes it to the year 2000.

5 On average, more than 95% of the firms replying "normal" to the inventories question have indicated that inventories are also "adequate" to their current needs.

6 The "no inventories" option is a special feature of the ISAE survey. Another ad hoc survey carried out in 2004 confirmed that a large majority of firms answering that they had no inventories considered it as their "normal" operational behaviour.

controversial: according to the currently standard literature, inventories are pro-cyclical, in the sense that they are positively correlated with sales, so that firms accumulate stocks when demand is buoyant and vice-versa[7]; this hypothesis is generally confirmed by the data in the case of the US. Pro-cyclicality of inventories also implies that the volatility of production should exceed that of demand plus the volatility of inventories, the relationship among production (Y), change in inventories (ΔS) and demand/sales (D) being formalised as:

$$Y = D + \Delta S \tag{1}$$

From (1) the decomposition of the variance of production may be easily derived:

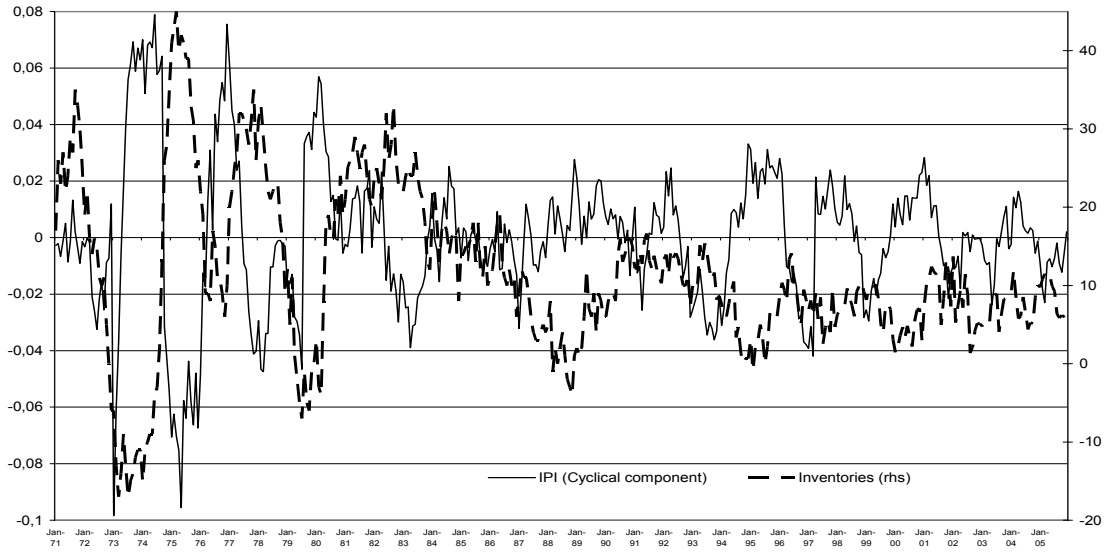
$$Var(Y) = Var(D) + Var(\Delta S) + 2cov(D,\Delta S) \tag{2}$$

If inventories are pro-cyclical, then cov(D, ΔS)>0, from which it follows that Var(Y)>Var(D)+Var(ΔS) and Var(Y)>Var(D), Var(Y)>Var(ΔS), i.e. volatility of production is greater than that of both sales and inventories. However, inventories may also be thought to have a negative correlation with the business cycle: counter-cyclical inventories may be explained by considering the production smoothing model, according to which output should exhibit a less pronounced variability with respect to sales in order for firms to avoid costs associated with changing output levels[8]. Alternatively, counter-cyclical inventories may also be explained in terms of firms' ability to forecast sales: if positive (negative) demand changes come as a surprise, firms cannot adjust their production plans immediately by raising (lowering) their production levels, so that they have to draw down (accumulate) inventories. Inspection of the ISAE data shows that inventories have historically exhibited a negative correlation with output, confirming the countercyclical hypothesis (see Fig. 2); for this reason they enter the calculation of the CI with a negative sign. As a consequence, in this case production volatility is necessarily smaller than the sum of the volatilities of demand and sales, i.e. Var(Y)<Var(D)+Var(ΔS).

7 Blinder, 1986; Ramey and Vine, 2003.

8 See Blinder and Maccini (1991).

Fig. 2 Inventories and industrial production, 1971-2005



Given that, by definition, balances of opinion are bounded (assuming a value comprised between ±100), we expect them and the CI to be stationary variables. Table 1 confirms this hypothesis, providing the results for standard Dickey-Fuller and Phillips-Perron unit root tests: in fact, both imply a strong (1% confidence level) rejection of the null hypothesis of all the series having a unit root. Similar results - not set out in this paper but available upon request - were

Tab. 1 Unit root tests

Test	Confidence indicator	Order book assessment	Inventories assessment	Production expectations
	t-statistics	t-statistics	t-statistics	t-statistics
Augmented Dickey - Fuller	-6.03 (**)	-5.56 (**)	-5.32 (**)	-4.48 (**)
Dickey - Fuller GLS	-4.15 (**)	-3.65 (**)	-4.13 (**)	-2.76 (*)
Phillips - Perron	-4.31 (**)	-4.22 (**)	-4.67 (**)	-4.72 (**)

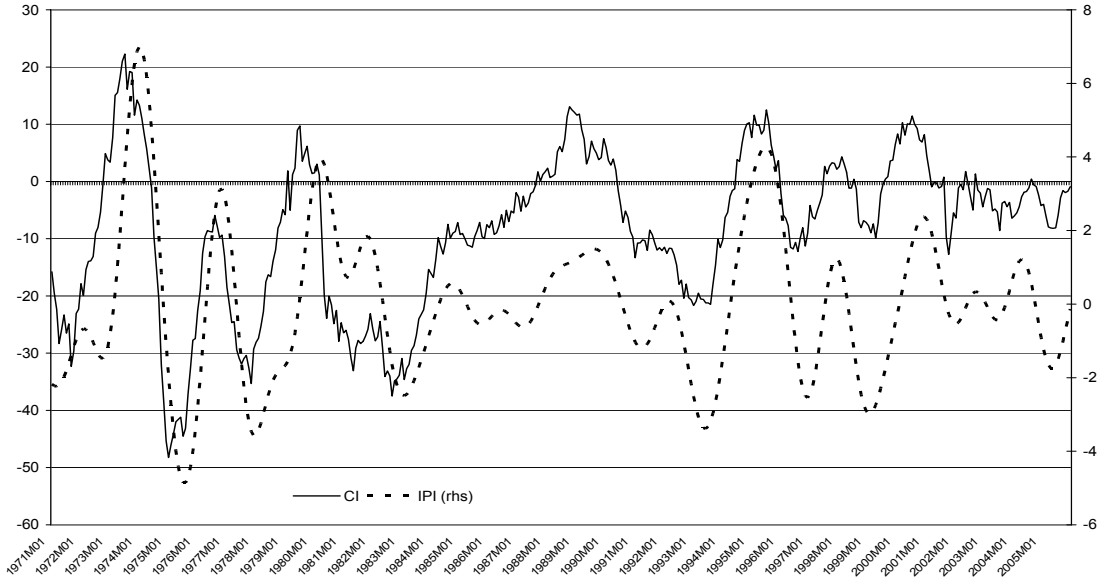
(*) Significant at 10% level.

(**) Significant at 1% level.

obtained by also looking at CI elaborated for the Main Industrial Groupings (MIG, i.e. investment, consumption and intermediate goods productions). I then extracted the cyclical component of the CI calculated for the whole manufacturing sector and the MIG, using - for the sake of simplicity - only the full-sample asymmetric CF filter, applied on the assumption that the series are

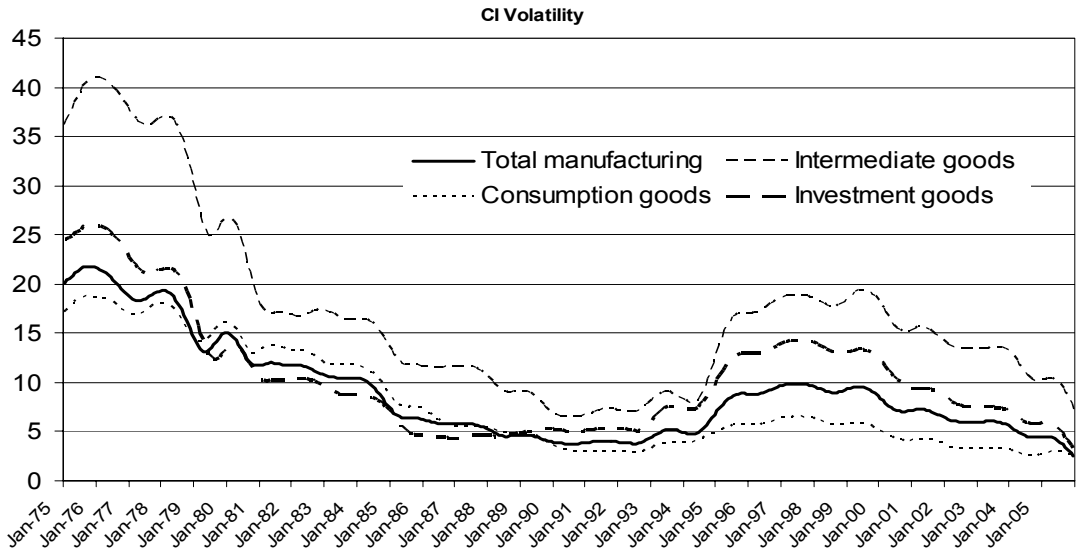
stationary. Figure 3 confirms the hypothesis that the CI is strongly correlated with IPI: the contemporaneous correlation between the two series is indeed quite high (ρ_0=0.7), with the CI showing clear leading properties with respect to Industrial production, as tested by their cross correlation function reaching a peak at lag 4 (ρ_4 = 0.84).

Fig. 3 Industrial production and the ISAE confidence indicator



Inspection of the rolling standard deviations of the CI also shows that the decline in IPI volatility is common to the various confidence indicators (Fig. 4): in

Fig. 4 Volatility of the ISAE Confidence Indica



all of the sectors, volatility has declined since the mid-seventies, quite similarly to what was observed for the IPI. However, industry-level differences eventually emerge: in particular, volatility of consumption goods production has been lower than that of investment and intermediate goods since the 1990s, but in the final part of the sample the rolling standard deviations are almost equal in the three sectors. In other words, intermediate and investment goods productions seem to have experienced a stronger reduction of volatility in the last five years than consumption goods. All in all, over the past twenty years, volatility reduction has been particularly strong for investment goods.

3 TESTING FOR STRUCTURAL BREAKS IN BUSINESS CYCLE VOLATILITY

The decline in business cycle volatility observed by looking both at Industrial Production and the CI may be alternatively described as a long trend decline (Blanchard and Simon, 2001) or as a break in the Data Generating Process (DGP, see again McConnell and Perez-Queiros, 2000 and Stock and Watson, 2002). To clarify this issue, I tested for possible structural breaks in the persistence and volatility of the DGP of the series involved in the analysis. In so doing, I adopted the testing strategy for multiple breaks suggested by Bai and Perron (1998; 2003), and recently used in a similar context by Cecchetti, Flores-Lagunes and Krause (2006). More specifically, bearing in mind that output is usually thought to be an integrated of order one - [I(1)] - variable, while CI is stationary according to the results provided in table 1, I first looked for possible breaks in persistence of output growth and of the CI, estimating two AR(1) processes of the form:

$$\Delta y_t = \mu_1 + \rho_1 \Delta y_{t-1} + u_{1t} \quad (3)$$

$$z_t = \mu_2 + \rho_2 z_{t-1} + u_{2t} \quad (4)$$

In (3) and (4) y_t and z_t are, respectively, the natural logarithm of output and the CI, both HP-filtered in order to correct for possible mean-heteroschedasticity of the data, and Δ is the difference operator used to remove the unit root in the industrial production series; μ_1 and μ_2 are two constant terms, ρ_1 and ρ_2 are respectively the parameters representing persistence of output growth and of

the CI cyclical behaviour and u_1, u_2 are the residuals of the regressions, supposed to be independent over time, but not necessarily identically distributed. If one or more structural breaks are found in ρ_1 and ρ_2, I could interpret the result as evidence of structural breaks in the persistence of output growth and of the CI cyclical behaviour.

As a second step, I tested for possible structural breaks in volatility, using the series of estimated residuals of (3) and (4), u_{1t}^* and u_{2t}^*, normalised as $\sqrt{\frac{\pi}{2}}\left|u_t^*\right|$, so as to be an unbiased estimator of the standard deviation of u_t (McConnell and Perez Quiros, 2000), and estimating the following equations:

$$\sqrt{\frac{\pi}{2}}\left|u_{it}^*\right| = \alpha_1 + \varepsilon_{1t} \tag{5}$$

$$\sqrt{\frac{\pi}{2}}\left|u_{it}^*\right| = \alpha_2 + \varepsilon_{2t} \tag{6}$$

If one or more structural breaks occurred in α_1 and α_2, i. e. in the mean of the (normalised) residuals of equations 3 and 4, I could interpret the result as evidence of a break in the volatility of output growth and the CI.

Tab. 2 Testing for breaks in persistence and volatility

Variable	Persistence			Volatility		
	Date of the break	ρ_1 (st. dev)	ρ_2 (st. dev)	Date of the break	α_1 (st. dev)	α_2 (st. dev)
IPI	None	-0.20 (0.004)	/	1982:11	0.026 (0.001)	0.01 (0.001)
CI-Total manufacturing	None	0.95 (0.014)	/	1980:12	3.35 (0.15)	2.06 (0.13)
CI-Investment goods	1975:8	0.97 (0.022)	0.832 (0.028)	None		
CI-Consumption goods	1980:3	0.94 (0.018)	0.72 (0.044)	1984:8	4.14 (0.167)	2.55 (0.171)
CI-Intermediate goods	None	0.81 (0.025)	/	1978:1	11.5 (0.49)	3.5 (0.24)

Table 2 reports the results for total manufacturing and the MIG. According to the estimates, there is no evidence of breaks in persistence either in Industrial Production or in the aggregate CI. On the other hand, a significant break occurred for the confidence of consumption and investment goods

producers, respectively at the beginning of the eighties and in the mid-seventies. I next looked at possible volatility breaks, conditional on estimated breaks in persistence: for all of the series considered, except that for the CI calculated for investment goods, it was indeed possible to identify a single break, located at the beginning of the eighties - more precisely in November 1982 for the IPI - with the CI for total manufacturing and intermediate goods leading the way (with a break, respectively, in December 1980 and January 1978) and investment goods lagging behind (with a break identified in August 1984).[9] Persistence noticeably declined after the break for investment and consumption goods producers; all the sectors also experienced a large decline in volatility, which almost halved in the case of the IPI and fell dramatically for the CI calculated for intermediate goods. Similarly to Stock and Watson (2002), my results confirm that the decline in business cycle volatility can be usefully described in terms of a break both in the conditional means (the autoregressive coefficient) *and* in the conditional variances (error variances) of the DGP, or, better, only in the variances of the error term. This evidence runs counter to the hypothesis that the reduction in volatility is simply a consequence of a long trend decline. Moreover, it also emerges from the above analysis that not only are CI and IPI closely correlated (as shown in section 2) but their DGP also show similar breaks in their conditional moments, with some sectors exhibiting leading characteristics with respect to manufacturing industry as a whole. In this sense, closer inspection of the determinants of the decline in CI volatility may significantly contribute to explanation of the determinants of the volatility decline observed in the manufacturing sector as a whole, and more generally over the business cycle.

4 A VARIANCE DECOMPOSITION EXERCISE

In section 3, I have shown that the reduction in output and confidence volatility is rather attributable to a structural break than to a long trend decline. Further insights into the determinants of business cycle volatility reduction may be derived concentrating on the confidence indicator and trying to disentangle the contribution of the different variables used to calculate it to the reduction of

[9] These results are quite similar to those recently obtained by Cecchetti, Flores-Lagunes, Krause (2006), who were able to identify a break in the persistence of Italian quarterly GDP at the end of 1979 and one in volatility in 1983, third quarter.

its variability. From section 2, the CI is calculated as the simple average of the balances of replies to three questions, namely those on the current condition of demand and orders (Ord) and inventories (Stocks) and on productions expectations ($prod^e$):

$$CI_t = \frac{Ord_t - Stock_t + \Pr od^{e_t}}{3} \tag{7}$$

Arithmetically, CI variability may therefore be decomposed into that of the three components and of their covariations:

$$\begin{aligned} Var(CI) = & \frac{[Var(Ord) + Var(Stock) + Var(\Pr od^e)]}{9} + \\ & + \frac{2[Cov(Ord, \Pr od^e) - Cov(Stock, Ord) - Cov(\Pr od^e, Stock)}{9} \end{aligned} \tag{8}$$

From (8), the decomposition of the change in the CI variance may be easily derived as the sum of change in the variance of the three series, plus (twice) the change in their covariations, all normalised dividing by 9. The variance decomposition exercise provides a first assessment of the different contribution of changes in demand, inventories and production opinion of the firms on confidence volatility. Table 3 shows the variance decomposition: the higher the component variance contribution, the more the decline in total variance may be attributed to that component, with a high covariance contribution also suggesting a significant contribution of the two components in question to the total variance decline, with all the rows of the table summing to 1.

The variance of the CI for the entire manufacturing sector falls after the break to almost 1/3 of its figure before it. Volatility decline is found to be even stronger on looking at industry-disaggregated data, with the variance of consumption goods producers falling to almost 1/10 of its previous values after the break (which in this case occurred in August 1984). For total manufacturing, most of the variance decline is explained by the component attributable to assessments of total demand and by its covariation with the other two components. However, also the decline in variance of inventories assessments and in its covariations explains more than half of the total variance reduction, while the contribution of production expectations is negligible in itself and acquires some significance only when its covariations with the other two variables is considered. The results seem to indicate that the reduction in confidence volatility is mainly attributable to a decline of the variability of firms' opinion on the situation of their orders; also the decline in the variance of

inventories assessments plays however an important role. Moreover, inspection of the CI for each MIG shows that inventories contribution is particularly strong for intermediate goods, for which the volatility of production expectations actually marginally increases in the second part of the sample. In other words, intermediate goods producers seem to have reduced inventory variance comparatively more than final goods producers after the mid-eighties break.

Tab. 3 Accounting for changes in variance of the ISAE Confidence Indicators

Confidence Indicator	Variance of the CI			Change in variance			Change in covariance		
	Full sample	Before the break	After the break	Order books	Production Expectations	Inventories	Orders, Inventories	Orders, Production expectations	Inventories, Production expectations
Total	202.7	303.5	125.0	0.18	0.06	0.12	0.30	0.18	0.16
Investment goods	274.0	447.7	196.0	0.15	0.08	0.11	0.28	0.17	0.20
Consumption goods	200.4	312.6	35.0	0.18	0.09	0.10	0.26	0.16	0.22
Intermediate goods	211.8	352.3	121.3	0.25	-0.01	0.19	0.35	0.11	0.10

5 INTERPRETING THE RESULTS

Following Summers (2005), most of the literature links the “great moderation” alternatively to structural changes in inventory management, to better monetary policies, or to “good luck”. In the rest of the chapter, I review some of the international literature on each of these three possible explanations, seeking to provide further evidence relative to Italy: in particular, the novelty of my approach is that in doing so I mostly use qualitative data derived from the ISAE survey. Besides the information on inventories, demand assessment and production expectations already examined above, I add consideration of agents’ inflation and general economic situation expectations in order to shed some light on, respectively, the impact of the change in monetary policy stance and on the “good luck” hypothesis.

5.1 Inventories

Structural changes in inventory management may derive from technological change: more specifically, the so-called ICT revolution may have implied more rapid and effective access to, and processing of, information; in turns, it may have helped firms to better change their levels of production in response to shocks on final demand. More specifically, the ICT-hypothesis claims that new technologies have made demand more forecastable, helping firms to attain greater flexibility in production, for example via shorter lead times in ordering and/or hiring decisions. A number of important, and testable, consequences may ensue in this case:

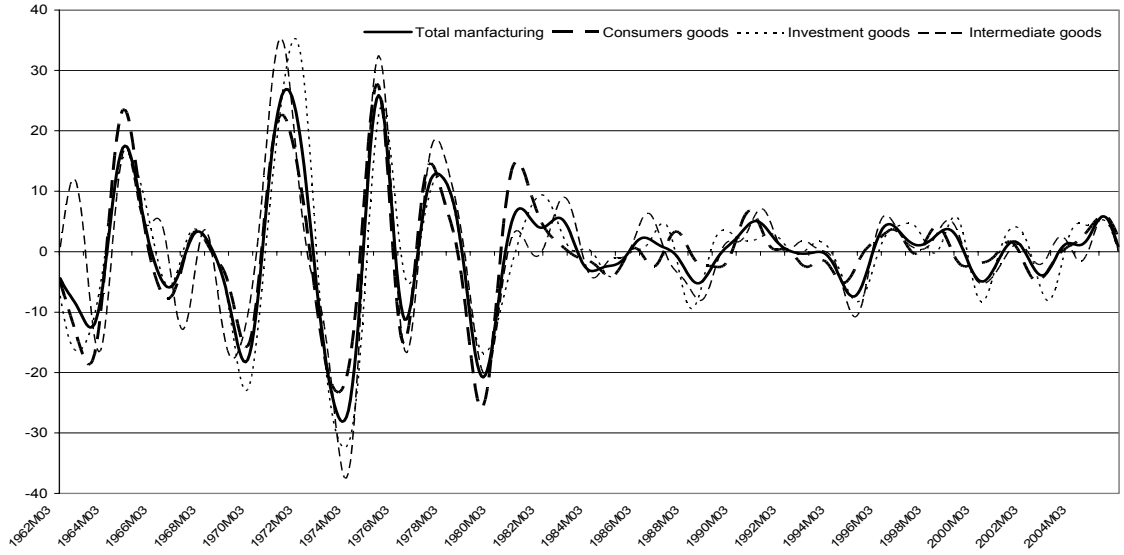
1. More forecastable demand calls for a less probable accumulation/decumulation of undesired stocks of finished products and therefore for a less volatile inventory behaviour; not only should inventories be less volatile in absolute terms, but their volatility should also decline relatively to that of demand.
2. More forecastable demand/sales patterns may also imply a lower average level of inventories, with a reduction of unnecessary stock investments; an increase in the number of firms with no inventories at all is also plausible.
3. Finally, volatility of output relative to that of demand may actually increase, owing to the adoption of technologies enabling firms to react more promptly to eventual shocks (Wen, 2005).

Inventories variance indeed declined steadily over the sample, as can be easily seen from Fig. 5, which reports the cyclical component (extracted as usual with the Christiano-Fitzgerald full sample-asymmetric band pass filter) of the inventory balance for the whole manufacturing sector and the MIG. Considering the break dates estimated above (see again table 2), in the manufacturing sector as a whole inventories variance fell after the break to slightly more than 1/3 of its value before the break; inventories variance halved in investment goods, falling respectively to less then 1/5 and 1/4 of its previous values in consumption and intermediate goods (table 4).

However, the decrease in inventory volatility may simply stem from more stable demand (possibly associated with sounder monetary policies). In this case, we expect to observe that the reduction in the variance of inventories is equally or less pronounced than that of demand; on the other hand, if some specific factors (i.e., technological innovations) have influenced stock accumulation, specifically reducing its variability, we expect to find an increase

in the ratio between demand and inventories volatilities. Indeed, this ratio (with demand being measured by firms' assessments of the status of current orders) has increased steadily after the break, being equal for total manufacturing to 2.38 in the period 1962-1980 (i.e., volatility of demand was more than twice as large as that of inventories) and growing to 6 afterwards (1980-2006). Interestingly, the rise is particularly strong for intermediate and investment goods, whilst the increase is less pronounced for consumption goods.

Fig. 5 Inventories (cyclical components, full-sample asymmetric CF filter)



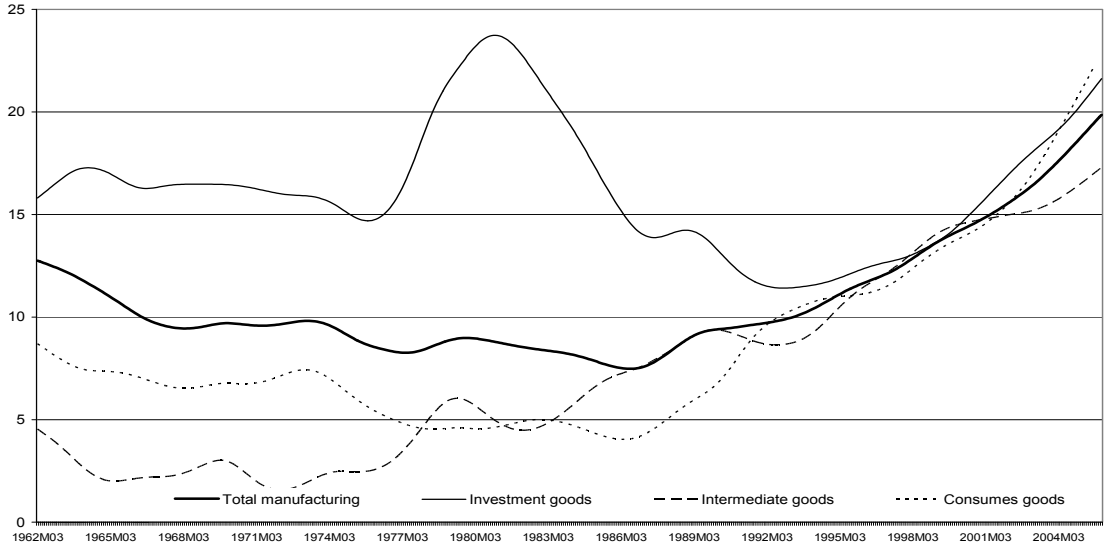
Tab. 4 Production, inventories and demand assessments volatility

Assessments on:	Total manufacturing			Investment goods			Consumption goods			Intermediate goods		
	Variance (s.a. series)			Variance (s.a. series)			Variance (s.a. series)			Variance (s.a. series)		
	Full sample	Before the break	After the break	Full sample	Before the break	After the break	Full sample	Before the break	After the break	Full sample	Before the break	After the break
Inventories	126.4	234.3	45.55	171.0	343.1	84.9	160.0	263.5	26.1	198.7	455.7	53.1
Production	192.3	212.0	152.9	327.9	418.4	285.0	190.4	261.9	74.6	203.8	164.7	195.1
Demand/orders	552.7	818.3	339.3	554.9	787.7	449.4	337.5	541.1	92.8	552.7	869.1	343.7
Demand/inventories variance ratio	3.13	2.38	6.05	3.25	2.30	5.30	2.10	2.05	3.56	2.78	1.91	6.48
Production/demand Variance ratio	0.35	0.26	0.45	0.59	0.53	0.63	0.56	0.48	0.80	0.37	0.19	0.57

From table 2, break dates are: for the whole manufacturing sector, 1980:1; for investment goods, 1975:8; for consumption goods, 1984:8; for intermediate goods, 1978:1.

The ISAE survey also allows one to check whether a reduction in the actual level of inventories occurred in the period considered in the analysis. In this case, I was not strictly interested in the business cycle frequencies, but rather in the long-run movement (extracted with the Hodrick-Prescott filter) of the number of firms replying that they had no inventories (Fig. 6). The proportion of firms with no inventories clearly increased during the sample, rising in the manufacturing sector as a whole from an average of 10% in the sixties to 16% in the first five years of this century; interestingly, an increase in the slope of the trend seems to occur in the mid-eighties, around the date identified in the international literature as a possible break in firms' behaviour with respect to inventory accumulation. Moreover, some striking differences at

Fig. 6 Firms declaring that they have no inventories (HP-filtered trend)



industry level emerge: an increase in the number of firms reporting that they had no inventories is particularly high for intermediate goods producers, only 2% of which declared that they had no stocks in the sixties, the percentage jumping to 15% in the last five years. Similarly, the number of consumption goods producers declaring that they had no inventories increased from 7 to 17% between the sixties and the 2000-2005 period, while investment goods producers exhibited a different pattern, with a remarkable increase already in the seventies, followed by a decline and a new increase at the beginning of the nineties. To sum up on this point, in this case the data seem to provide evidence of a gradual modification of firms' behaviour with respect to stock investment, with the number of firms choosing to make no investment at all growing since the mid-eighties, especially in intermediate and consumption goods.

Finally, if the ICT-hypothesis holds true, firms should be able to forecast future demand better, so that production should become more volatile with respect to sales, also considering the counter-cyclical behaviour of inventory accumulation. Using in this case survey data on firms' assessments of current production levels, I calculated the production/demand volatility ratio before and after the estimated break dates, finding that the ratio has indeed increased (see again table 4), rising from nearly 0,25 to 0,45 after the estimated break date at the beginning of the eighties; the increase is stronger for consumption and intermediate goods than for investment goods.

BTS data provide some evidence of a major role by innovation in the inventory accumulation process in reducing output volatility since the second part of the eighties. In what follows I also check for two possible alternative explanations, respectively linked to the role of monetary policy and to "good luck" in the form of a less frequent occurrence of shocks.

5.2 Monetary policy

Alternatively, the reduced output volatility may be considered as resulting from the increased effectiveness of monetary policy in controlling inflation. In its turn, lower inflation determines a more stable economic environment because of reduced nominal distortions, less uncertainty and more stable inflation expectations.[10] In the literature on the US, the increased efficiency of monetary authorities in controlling inflation is generally associated with a change in the policy stance at the beginning of the eighties, with the move from the "accommodative" position of the pre-Volcker/Greenspan era (1960-mid 1979) to tighter FED policies. Clarida, Galì and Gertler (2000) show that this is accounted for by a change in the monetary reaction function with respect to increases in the inflation rate; this in turn results in a different Taylor rule, in which an inflation surge is met by more aggressive interest rate moves. Looking at the data for the US, they find that inflation rates indeed fell sharply in the mid-eighties, a timing fully consistent with the break found by many authors in output volatility. In the case of Italy, one possibility is to look at breaks in inflation associated with the so-called "divorce" between the Treasury and the Bank of Italy, which resulted in a significant increase in the Bank's independence and transparency; a more recent break is also possibly associated with the various steps leading up to Italy's participation in the Monetary Union. Also in this case,

[10] Lower inflation may also be associated with more forecastable demand patterns, which again determine lower output variability.

the paper proposes a rather original point of view, making use of survey data to check whether there is evidence of a break not only in actual inflation rates, but also in the inflation expectations of consumers and firms, which may be considered as a key target for policymakers aiming to reduce inflationary pressures.[11]

The data set out in figure 7 confirm that Italian inflation has fallen rapidly since the mid-eighties, the timing of the reduction being consistent with the institutional change in monetary policy: indeed, inflation averaged more than 20% in 1980, falling to slightly more than 5% on average in the period 1986-1995. Inflation expectations fell accordingly, with those of the manufacturing firms showing signs of anticipating the actual decline in inflation rates. In the mid-nineties, the decision to be among the first group of countries entering the Monetary Union[12] is associated with a further reduction in the inflation rate, which in the past decade has stabilized slightly above the 2% mark explicitly targeted as "price stability" by the European Central Bank. Interestingly, also in this case the curbing of actual rates is matched by a gradual stabilisation of the inflation expectations of both consumers and firms, with the former only showing a transitory revamp associated with the Euro changeover which gradually fade out a year after the event.

The results support the view that better management of monetary policy may have helped reduce output volatility since the mid-eighties, and more strongly with the introduction of the European common currency. However, there is still much uncertainty about the extent to which reduced output volatility may indeed be determined by change in the policy stance (Stock and Watson, 2002). In this respect, Cecchetti, Flores-Lagunes and Krause (2006) have recently examined policy effectiveness in stabilising output, estimating a macro econometric model of inflation and output for 24 countries - including Italy - and using interest rates as a measure of the central bank's policy instrument. They find that policy was a stabilising force in only 10 of the 24 countries considered: in Italy, the estimation suggests a role of monetary policy in increasing, and not stabilising, output volatility. Their interpretation is that, while focussing on inflation stability, policymakers moved along an output-inflation volatility frontier, choosing to make output more volatile, not less.

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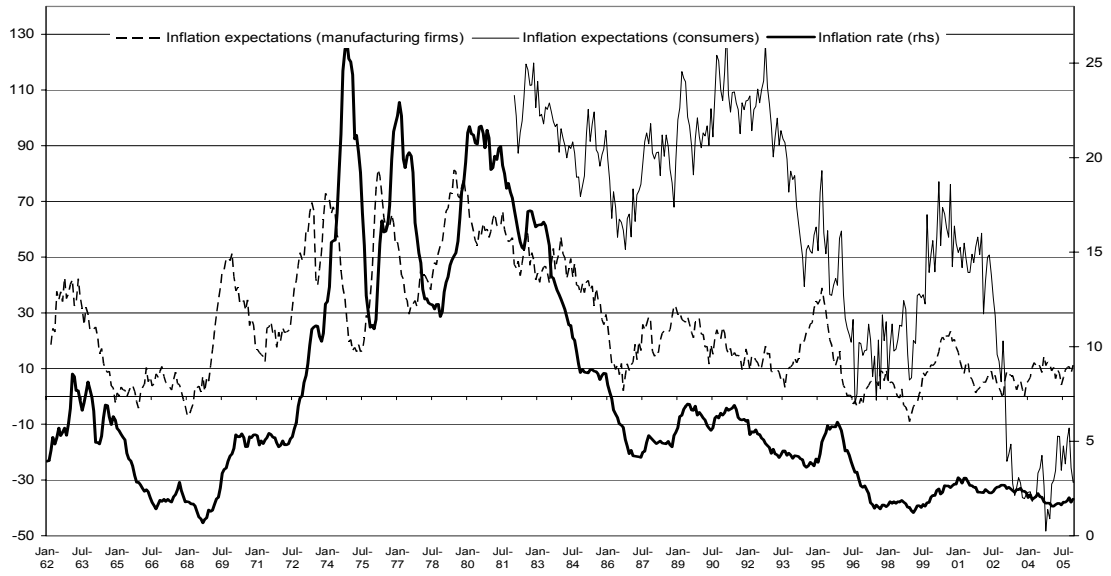
[11] Data on Italian inflation are provided by ISTAT, those on inflation expectations of consumers and firms by ISAE. All the series are seasonally adjusted with Tramo-Seats.

[12] Italian lira re-entered the Exchange Rate Mechanism in November, 1996; the final decision on the inclusion of the lira among the currencies participating to the Monetary Union from its beginning is made May 3rd, 1998, with the euro being introduced as the common currency of EU 11 member states January 1st, 1999.

To sum up on this point, the timing of inflation reduction is consistent with the hypothesis of a progressive change in the Italian monetary stance, associated with major institutional innovation. However, the link between the stability of inflation and that of output is still not clear: it is also possible that more stable inflation leads to higher - not lower - output volatility, leaving the field open for further research on this point in the future.

Fig. 7 **Inflation and inflation expectations**



5.3 Good luck

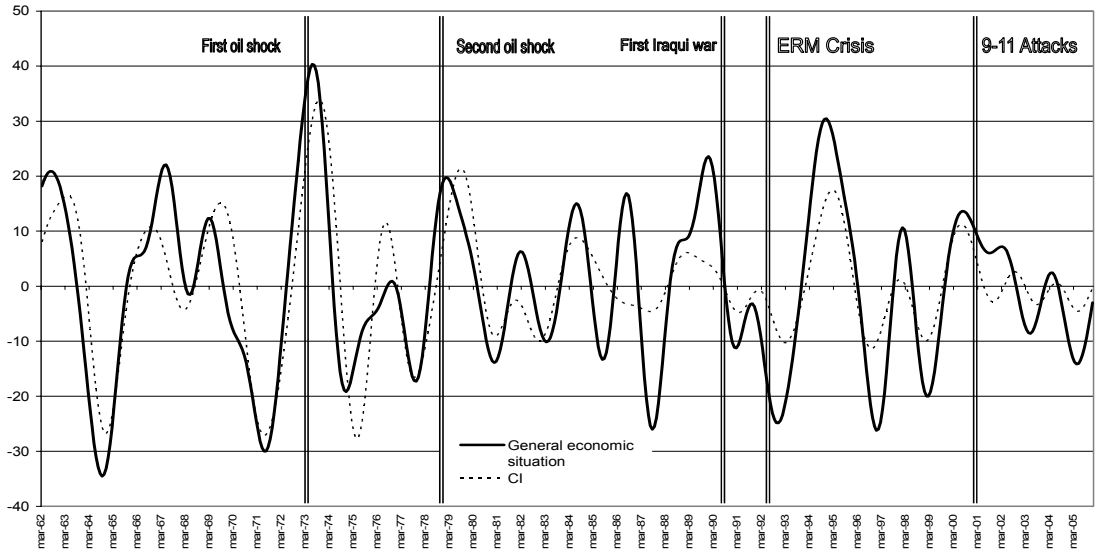
It is finally possible that reduced output volatility has simply stemmed from a less frequent occurrence of “adverse (or even favourable) events”, i.e. shocks, hitting one or several countries simultaneously and causing large output fluctuations. Examples of these are the two oil shocks of the seventies, respectively associated with the OPEC embargo of 1973-74 and the Iranian revolution of 1979. However, major events again hit the world economy in the nineties, for instance the first Iraq war and more recently the 9/11 attacks on the US and the following Afghan and second Iraq war. These shocks seem not to have had an impact on output volatility comparable to those of the seventies, either in the US or in the rest of the industrialised world.

Some interesting insights into the impact of these shocks, first on the agents’ general economic climate and then more specifically on output volatility, can again be gained by looking more closely at data from the ISAE Business Tendency survey on the manufacturing sector. In fact, firms are asked (this being specific to the ISAE questionnaire) for their opinions about the general

economic situation of the country. More specifically, respondents are asked to report if the general economic situation is expected to be “more favourable”, “less favourable” or “the same” in the next three months, regardless of the specific situation of the firm or the sector. My hypothesis is that external shocks pertaining to the general socio-economic and political situation first of all hit firms’ assessments of the general economic situation, and only in a second moment their assessments of orders, inventories and production.

The “good luck” hypothesis claims that no major shocks have hit the main industrial economies since the early eighties. A possible alternative is that such shocks may have occurred, but have had a less marked impact than before on the volatility of production and on the business cycle in general. In order to distinguish between the two explanations, I first looked at firms’ expectations on the general economic situation of the country. I then evaluated the correlation between general economic expectations and the Confidence Indicator in order to see whether there is some change in the way firms react to the shocks, or if there are simply no shocks hitting firms’ opinions in the second part of the sample. Figure 8 presents the balance of the answers to the aforementioned

Fig. 8 General economic expectations and the CI (Cyclical components)



question[13] together with the usual ISAE Confidence Indicator, considering in both cases the cyclical components of the series computed with the Christiano-Fitzgerald full sample-asymmetric band pass filter. I have also indicated on the

[13] As to be expected, given the fact that the question explicitly asks for the respondent’s opinion regardless of the specific situation of the firm or the sector, there is no major difference in the pattern of industry-specific replies; for this reason I report only the aggregate results, those disaggregated for the MIGs being available upon request.

graph some of the major shocks that one might think have hit the Italian economy in the period analysed, considering together international shocks such as the two oil shocks, the Iraq war and the 9/11 attacks, and a country-specific shock associated with the exit of the lira from the European exchange rate mechanism in the second half of 1992.

Even simple inspection of the graph yields interesting results: the volatility of firms' expectations on the general economic situation does not appear to have significantly diminished in the second part of the sample, with strong negative effects associated with the first Iraq war and the ERM crisis. On the other hand, the volatility of the CI has indeed decreased, as already shown in previous sections. Table 5 finally shows the correlation between the two series, together with their variances, calculated before and after the break in volatility of the CI, identified in 1980:12 according to the Bai-Perron methodology. I used in this case the seasonally adjusted series together with their cyclical components to take account also of possible co-movements of their not strictly cyclical components.

Tab. 5 General economic situation and Confidence Indicator

Indicator	Variance (s.a. series)			Correlation (s.a. series)		
	Full sample	Before the break	After the break	Full sample	Before the break	After the break
Confidence indicator)	202.7	303.5	125.0	0.75	0.70	0.83
General economic situation expectations	632.0	725.6	516.8	Correlation (cyclical components)		
				Full sample	Before the break	After the break
Variance ratio (general economic situation/CI)	3,07	2,39	4,13	0,79	0,84	0,79

The results do not support the "good luck" hypothesis: in fact, the volatility reduction after the break is much stronger for the CI than for expectations about the general economic situation, with the ratio between the variances of the two series almost doubling after the break. Correlation between the seasonally adjusted series actually increases, whilst that between the cyclical components is lower after the break.

A possible interpretation is that shocks have indeed continued to play a significant, albeit less strong, role in shaping firms' expectations about the country's situation. However, firms seem to have been able somehow to smooth out their reaction in terms of assessment of demand, inventories and production when confronted with external shocks hitting their perceptions on the general economic situation: in other words, these shocks have indeed affected firms'

general perceptions on the economic condition of the country, but not their confidence climate. In other words, it is possible that in recent years firms have been able to exert better control over their reactions in terms of production and inventory accumulation decisions when faced with external shocks, possibly by virtue of technology adjustments involving the role of inventories throughout the business cycle.

6 CONCLUSIONS AND FURTHER RESEARCH

The major novelty of this paper has been that it examines an often debated issue - the decline observed in business cycle volatility - from a rather original point of view represented by careful consideration of qualitative data from Business Tendency Surveys. In particular, concentrating on the manufacturing sector in Italy, it has found evidence (using the Bai-Perron, 1998, testing strategy) for a break in business cycle volatility at the beginning of the eighties by looking both at the Industrial Production Index (IPI) and at the ISAE Confidence Indicator (CI, calculated as the simple average of firms' evaluations of demand, inventories and production). In this sense, the results seem to show that the volatility reduction is not the consequence of a long trend decline as in Blanchard and Simon (2001). The paper has also shown that the CI is closely correlated with IPI, and that the decline in its volatility is mostly explained by the contribution of firms' assessments of demand and inventories. Three main alternative explanations may be advanced for these findings, respectively attributing the "Great Moderation" to sounder monetary policies, the IT revolution enabling better inventories management, and "good luck".

As for the first point, the paper has shown that a major decline in inflation rates and expectations has actually occurred, consistent in time with both major institutional innovations in monetary policy management and the volatility decline observed in industrial activity. However, the relationship between lower inflation and volatility decline is not straightforward: some authors (see Cecchetti, Flores-Lagune and Krause, 2006) have recently argued that lower inflation rates may also determine higher, not lower, output variance. As for the "good luck" hypothesis (Stock and Watson, 2002), the paper has provided evidence that firms' expectations on the general economic situation, a special feature of the ISAE survey, have indeed reacted to recent shocks, but that these, for some reason, have failed to translate into major variability of the

Confidence Indicator. These findings may be considered as supporting the hypothesis that technological innovation may indeed have played a significant role. As a confirmation, the paper has also argued that inventories volatility has decreased, and that volatility of production has instead increased, with respect to that of demand, both these results being consistent with the claim that better inventories management has a specific role in shaping the production decisions of the firms (Wen, 2005).

However, this paper is only a first attempt at analysing business cycle moderation using mostly survey data. It provides some preliminary evidence on the role of inventories in reducing output variability, possibly associated with major technological innovation connected with the ICT revolution. More studies in this field are required, especially ones which adopt a more structural approach to the modelling of firms' stock accumulation decisions and to the characterisation of the transmission mechanisms from different inventories management and sounder monetary policies to reduced output variability. The preliminary descriptive results provided here are indeed promising and should accordingly encourage further research which uses Business Tendency Surveys data not only - as is usual in this kind of literature - for short term analysis and forecasting, but also to investigate more structural problems related to business cycle theories and behaviour.

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