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Commentary

Since the mid-1980s, the variability of both inflation and output appears to have decreased substantially. The stability of inflation is similar to that experienced in the 1950s and 1960s, while output has been more stable than at any other time in the post-war period. How can we explain such behavior? Have the shocks to the economy dissipated? Has policy done a better job in stabilizing output? Have firms become better at anticipating and smoothing through shocks to demand? And if all of these factors have made at least some contribution, what is their relative importance in explaining the increased stability of the economy?

This interesting paper by James Kahn, Margaret McConnell, and Gabriel Perez-Quiros argues that although monetary policy has been an important factor in reducing inflation volatility, improved information technology that has helped firms to manage their inventory and production decisions better has been a more important factor in explaining the stability of output, and it may have indirectly contributed to the stability of inflation as well. In support, the authors turn both to a set of stylized facts and to simulations from a theoretical model that combines firms' production and information technology with the policy reactions of a monetary authority.

First, the authors note that smoother durable goods production can account for a substantial portion—simple autoregressive models suggest about two-thirds—of the reduction in total output volatility between the pre- and post-1985 periods. Next, they argue that changes in final demand are probably just a small piece of the story: Within the durables sector, the reduction in the variability of output substantially exceeds that of sales, growth accounting indicates that reduced sales volatility accounts for very little of the smoothing in output, and vector autoregressions find that lagged sales explain less of the variation in inventories over the past fifteen years than they did in the previous thirty. This leaves improved production techniques and inventory management as prime suspects. Not only is the anecdotal evidence extensive, but, as documented by the authors, after showing little trend for decades, over the past fifteen years the real inventory-sales ratio in the durable goods sector has trended to historical lows, and deviations between actual and target ratios likely have diminished substantially.

The arguments put forward by Kahn, McConnell, and Perez-Quiros on the importance of improved production and inventory management technology in explaining the smoother behavior of GDP make a good deal of sense. However, it is not so clear to what degree these developments are showing through in the data. For example, in contrast to the real ratio, the nominal inventory-sales ratio for durable goods trended up until the early 1980s, and although it has moved down since then, by longer run historical standards, its recent levels are not as dramatically low as those for the real ratio. The inverse of the nominal ratio is a rough measure of the profitability of sales per value of stocks. Consequently, while the real inventory-sales ratio suggests that the stocks needed to support a particular

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volume of sales are by far at all-time lows, the nominal ratio suggests that the durable goods sector as a whole has not necessarily achieved unprecedented success in minimizing inventory-related costs.[1] Of course, these differences could reflect problems with the data or aggregation issues. But they also highlight the fact that there likely are a number of factors going on in the background that make it very difficult to identify the contribution of improved production and inventory management technology in explaining the reduced volatility of GDP.

With regard to the theory in their paper, the stylized examples and more complex model simulations presented by Kahn, McConnell, and Perez-Quiros do a very good job of illustrating how increased information flows that improve sales forecasts can smooth output in the face of shocks to sales. The authors note that allowing the firm to know more about demand before making its production decision can be interpreted as an increase in its production flexibility. (In a standard inventory model, this increased information also leads to a lower equilibrium inventory-sales ratio.) However, the production-flexibility story is a complicated one. The authors' interpretation makes sense for a given marginal production cost schedule. But increased flexibility may manifest itself through a flattening in the firm's marginal-cost curve, which need not have the same effect on output variability as increased information does.

In this paper's stylized example, once recognized, the firms immediately adjust stocks to their new inventory targets. Such behavior is optimal if marginal production costs are constant. But if marginal costs slope up, the optimal adjustment to the new target will be gradual. The table shows production and inventory stocks for the two cases in the paper and for two in which the firm holds the same sales expectations but only gradually adjusts stocks to the new targets. The "rolling variance" rows give the variance of output calculated with data in hand through period *t*. Very roughly speaking, the rolling variances for small *t* might be the variability that one would attribute to high-frequency changes in production, while those for larger *t* would correspond to lower frequency movements in the data.[2]

Several qualitative points arise from these numbers. First, regardless of the information set, the variances are larger—particularly for small *t*—when marginal costs are constant and production adjustments are instantaneous. Second, even the low-information, constant-marginal-cost firm aligns inventories with the new target faster than the high-information, rising-marginal-cost firm. Finally, the rolling variances rise and then fall when marginal costs slope up, but decline uniformly when marginal costs are constant. One way of interpreting these observations is that in contrast to the effects of enhanced information, improvements in production technologies that flatten a firm's marginal-cost curve could actually increase output volatility at high frequencies as firms adjust production more promptly to align stocks with their targets. But output volatility could still be expected to fall at lower frequencies—notably, over the business cycle—because more prompt production adjustment prevents inventories from straying too long or too far from targets.

These examples demonstrate that it is quite a complicated task to determine the implications for production variability of the wide range of factors that may have simultaneously altered the cost and information structures faced by firms during the 1980s. In the context of this paper, such an investigation is complicated further by the need to account for the possible effects of changes in the policy environment.

Production and Inventory Stocks

	Period						
Category	1	2	3	4	5	6	7
Sales	50	75	75	75	75	75	75
Target inventories	100	150	150	150	150	150	150
Constant marginal costs, low information							
Production	50	50	150	75	75	75	75
Rolling variance		0	3,333	2,240	1,688	1,354	1,131
Inventories	100	75	150	150	150	150	150
Constant marginal costs, high information							
Production	50	125	75	75	75	75	75
Rolling variance		2,813	1,458	990	750	604	506
Inventories	100	150	150	150	150	150	150
Rising marginal costs, low information							
Production	50	50	75	100	100	100	75
Rolling variance		0	208	573	625	604	506
Inventories	100	75	75	100	125	150	150
Rising marginal costs, high information							
Production	50	75	100	100	75	75	75
Rolling variance		313	625	573	438	354	298
Inventories	100	100	125	150	150	150	150

Kahn, McConnell, and Perez-Quiros address this problem by simulating a theoretical model, an approach that is quite reasonable when one considers the lack of success we have had in estimating structural econometric models of inventory behavior. Given the numerous factors in play, one might need to perform a wide range of simulations on a fairly complicated model to get a handle on how various cross-currents might be affecting the economy. The production side of their model is well suited for such exercises. At first glance, the model appears to be quite different from the standard production-inventory framework: Instead of a firm balancing the trade-off between the benefits of smoothing marginal production costs with the costs of deviating from target inventories, a social planner considers a trade-off between consumption and inventories in the face of taste and technology shocks. But the model has a rich structure, and, with some simple reinterpretation of shocks and parameters, its first-order conditions look like those of the standard model. Accordingly, alternative simulations can be constructed to examine the effects of changes in the information structure faced by the firm, the slope of the marginal-cost curve, and the sizes of inventory holding and shortage costs—all of the factors that affect the trade-offs described by standard models. The inflation model, however, is more limited. In particular, the policy reaction function responds only to lagged inflation; because the monetary authority does not take into account some expectation (possibly from a limited information set) of current or prospective marginal production costs when setting interest rates, the model probably stacks the deck against the ability of monetary policy to stabilize output.

The authors present some simulations that concentrate on the roles of expanding firms' information sets and of strengthening the reaction of monetary policy to past inflation in reducing the volatility of output, sales, and inflation. They find that enhancing the information structure does a better job of matching the changes in the variances of output and sales observed in the data than does increasing the reaction of policy to past inflation. For example, in the model with supply shocks, increasing information reduces the relative variance of output to sales by 7 percent, compared with a 2 percent reduction in the monetary policy simulation. However, as pointed out by the authors, the differences are small, and the reductions in volatility in the simulations do not come close to matching the reductions in the data.[3] Indeed, both simulations reduce output variability by a similar amount—less than 8 percent—and the "advantage" of the information simulations in terms of relative volatility largely reflects the fact that the variance of sales hardly changes in the enhanced information simulation.

The failure of these simulations to match the data more closely should not be viewed as a particularly negative result. In light of the wide range of changes in technology and policy that might have influenced the variability of output and sales, it would be surprising if only one or two factors could account for much of the reduced volatility seen in the 1980s. Accordingly, it would be interesting to see the effects of other changes in the cost and information structures on the variability of output, sales, and inflation. Given its rich parameterization, the production side of the theoretical model presented by Kahn, McConnell, and Perez-Quiros provides a very useful tool for undertaking such an exercise.

Endnotes

1. To complicate the inventory-sales ratio picture even more, the differences between the trends in the ratios when measured in real, nominal (current replacement costs), or book-value terms are not consistent across various sectoral aggregations in the economy.

2. The authors document the reduced variability of quarterly percentage changes in output. The statement in the text is a conjecture about the decomposition of that quarterly variability in the frequency domain.

3. In the data, the variance of durable goods output in the 1984-2000 period is about half that over the 1953-83 period; the variance of sales is roughly 25 percent smaller, so that the relative variance of output to sales is also reduced by about 25 percent over the last fifteen years. The variance of inflation is one-third as large in the latter part of the sample.