Comment on Inflation Uncertainty, Relative Price Uncertainty, and Investment in U.S. Manufacturing
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Comment on Inflation Uncertainty, Relative Price Uncertainty, and Investment in U.S. Manufacturing, by Stephen G. Cecchetti

John Huizinga has written a very intriguing and thought-provoking paper in which he studies a particular cost of inflation uncertainty. The paper starts with the intuition gained from the current theory of investment in the presence of irreversibility to try to show how inflation uncertainty might reduce aggregate investment. Huizinga has clearly thought carefully about the issues he is examining, but in the end, I find his arguments unconvincing.

The argument of the paper proceeds in four steps. First, with irreversibility, increased uncertainty can cause firms to postpone investment decisions. This intuition comes from thinking about the decision to invest as the exercise of a call option. Increased volatility increases the value of the option. This is the essence of the example in section 1 of Huizinga's paper, and the entire discussion in Pindyck's (1991) survey. It suggests that higher uncertainty reduces investment. The second step in Huizinga's argument is the claim that there is time variation in the conditional time series variance of inflation. Next, he maintains that the conditional time series variance of inflation is positively related to the cross-sectional variance of real profits (or relative prices). Since an increase in the variance of real profits is an increase in the uncertainty about the value of installing a new machine, the first three steps imply that higher inflation uncertainty (in a time series sense) may cause lower investment.

I have a number of problems with this argument that I will detail in the three sections that follow. The first two sections discuss theoretical issues. First, I will discuss whether the uncertainty-investment relationship described by Huizinga holds in any generality in a partial equilibrium setting. Then I will examine the same question in general equilibrium. Finally, I will comment on the empirical evidence that is included in the paper.

The author thanks Giuseppe Bertola for his patience in teaching him the theory of investment.

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1. The Theory of Investment

Any complete model of investment must consider at least the following three components (even in partial equilibrium): (1) uncertainty in fundamentals, (2) irreversibility, and (3) changes in the required rate of return. In examining the impact of uncertainty on investment, one must look at its effect on each of these three things.

My quick survey of the literature on investment turned up the following results. First, in partial equilibrium it is well known that uncertainty increases investment when the marginal revenue product of capital is convex in the source of uncertainty. This result, due to Hartman (1972), suggests that obtaining the Huizinga result will be difficult.

When considering the impact of uncertainty in the presence of irreversibility, things get complicated and messy very fast. Even in partial equilibrium, this effect is ambiguous. Caballero (1991), for example, shows that the impact of an increase in uncertainty on the level of investment at the firm level can depend on industry structure. Bertola (1988) describes how the likely result is that irreversibility will actually lead to a higher capital stock in the stochastic steady state. Bertola’s result arises for the following reason. Investment generally occurs in good states, that is, when it is believed that the future marginal revenue product of capital will be high. But with irreversibility, the firm knows that it may wish to disinvest when a bad state is realized sometime in the future. With discounting, however, the firm will not care about the future when the capital it now installs is unwanted, and so it invests anyway. The implication is that the firm will have a higher steady-state level of capital since some of it was installed in good times, not caring that bad times will occur in the future.

Finally, we can consider the impact of increased uncertainty on the required rate of return. But this must depend on preferences, and so any attempt to study it requires that we move to general equilibrium and specify agents’ preferences. I will move on to this next. But first, it is important to notice that even in partial equilibrium, the effect of increased uncertainty on investment is far from unambiguous.

2. General Equilibrium Considerations

In the end, Huizinga’s real concern is with the impact of time series inflation uncertainty on aggregate investment. But any study of aggregate investment can be carried out only in general equilibrium. In looking at the literature, we can again ask what it has to say about the link between aggregate investment and uncertainty about something like real profits.

This is a very subtle question, and there are very few results available. I have found the following three: (1) Bertola and Caballero (1992) show that irreversibility seems to influence the dynamics of the investment path, but has little impact on the steady-state level of the capital stock. (2) Craine (1989), in a model without irreversibility, concentrates on the endogeneity of the rate of return, but his analysis is difficult to understand because he concentrates on an example with log utility. And (3), Caballero and Pindyck (1992) make some headway, but they consider aggrega-
tion from the firm to the industry level, and concentrate on issues more relevant to questions in industrial organization.

As always, sorting out anything in general equilibrium is difficult. In fact, reading Pindyck, we know that we are in trouble right away. He is explicit about the fact that the call option pricing formula he uses to study the investment decision depends on the fact that the stochastic changes in the value of a project once installed is spanned by existing assets—markets are sufficiently complete that the firm’s decisions do not affect the opportunity set available to investors! This suggests that changes in this type of uncertainty cannot have any impact at all on aggregate investment.

In general equilibrium the problem is to calculate the response of aggregate investment to changes in systematic risk. This is risk that is not priced, and so the intuition of the Pindyck partial-equilibrium example is not applicable. What we care about is the aggregate consumption-saving decision.

In thinking about general equilibrium, it is always useful to start with a simple representative agent example. This provides a good baseline case from which we can depart later.

This strategy dictates that we examine the likely responses of the representative agent to increases in uncertainty. The answer depends on the source of the uncertainty. If labor income uncertainty increases, then precautionary saving might cause an increase in saving.

On the other hand, if the increase in uncertainty raises the uncertainty about the return to saving, then we need to compute the elasticity of saving with respect to an increase in this uncertainty. In this case, the impact on saving and investment will depend on the elasticity of intertemporal substitution if consumption is greater than or less than one. If the agent likes smooth consumption paths (intertemporal elasticity of substitution less than one), then it would seem likely that the increased uncertainty would generate higher saving as insurance against future bad states that would reduce consumption. In the log utility case, we know that consumption is proportional to wealth, and since we are discussing changes in second moments, these should not have any impact.

This intuition implies that in order to answer the question of interest, it is important to specify the fundamental source of uncertainty. There are three natural cases. First, there could be uncertainty in tastes of some sort. These could change the intertemporal marginal rate of substitution, causing consumption and investment to change. But I don’t think that this is what Huizinga is talking about. A second alternative would be to examine an increase in the variance of total factor productivity. This has some hope of delivering the result, but it is not likely to be terribly robust. Finally, we could assume that there is a stochastic process driving the division of income among the factors. The impact of this type of uncertainty might change the desired level of the capital stock, and hence investment. This could happen only if the risk was associated with labor enhancing productivity changes alone, and so long as the factor share risk is uninsurable. The data Huizinga examines actually suggest that he is looking at this source of uncertainty. But in a representative agent
context, it seems hard to argue that this will matter, since the agent only cares about total output, and the only uninsurable risk is uncertainty in total factor productivity. From this I conclude that it is very unlikely that we can get any convincing unambiguous theoretical result for the impact of uncertainty on investment in the aggregate. What this really means is that the question Huizinga addresses is a fundamentally empirical one, perfect for this type of study.

3. Empirical Results

Having made the case that the proper focus of the paper is on the empirical question, I now turn my comments to this area. Does the paper provide convincing evidence on the series of links in Huizinga’s argument?

First, we can ask if there is convincing evidence for the time series variation in the conditional variance of aggregate inflation. The answer to this is surely yes. Although a comparison of Evans and Wachtel’s Figure S with Huizinga’s Figure 1 leaves me wondering what the time path really looks like, it is clear that both find substantial time variation.

Next, we can examine the evidence for time variation in the conditional variance of real wages, relative prices, and the profit rate. Again, I am convinced by the results reported in Huizinga’s figures showing that these variances are not constant over time.

Finally, we have to ask if there is persuasive evidence that these two quantities are related. At horizons of one quarter, the frequency of data used in this paper, the answer is probably yes. But we know that the cross-sectional variance of inflation is positively related to the mean of inflation (the correlation over this period is about 0.4) and that the time series variance seems to be positively related to the mean. It immediately follows that relative price variability and aggregate price uncertainty will be related over short horizons. (I should note that even without the first-second moment relationship, one could argue that asynchronous price adjustment will cause the two variances to be positively correlated as different prices are set based on difference information, and if the variance of the aggregate price level is higher, then this source of noise in relative prices will be higher.)

But when looking at high frequency data, it is hard to escape the logic that the relationship between aggregate nominal price variation and relative price uncertainty could be a failure of individuals to completely adjust to shocks over the horizon of observation. This leads me to ask whether the quarterly data studied by Huizinga is appropriate for the question at hand.

In our 1990 paper, Ball and I argued that the relevant horizon for studying inflation uncertainty is three to five years, not one quarter. Our result, that high inflation raises long-run uncertainty, implies that inflation has substantial costs. But does this carry over to the case studied in the current paper? In any study of investment, the question of horizon is very important. Most investments have payoff streams that extend far into the future. Unless the discount rate is high, the uncertainty associated with these medium- and long-run payoffs will be very important for decisions that
are made today. Since Huizinga provides no evidence on the cross-section/time series relationship at these horizons, I do not believe that he has succeeded in answering the really interesting empirical question in this area.

While I find the specifics of Huizinga's argument unconvincing, I fully support his attempt to address the very important question that is the focus of this paper. In the end, I find that this is an extremely useful first step in examining the impact of inflation uncertainty on the level and composition of investment.

LITERATURE CITED


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**Comment on Inflation Uncertainty, Relative Price Uncertainty, and Investment in U.S. Manufacturing, by Jack Selody**

Anecdotal evidence suggests that bad investment decisions are sometimes linked to inflation uncertainty. In the latter part of the 1970s, firms made what turned out to be bad investments in energy mega-projects in large part because they anticipated con-

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tinuing inflation-driven increases in the relative price of energy, and did not foresee that real energy prices would decline as excess demand in the world economy dissipated. And, in the latter part of the 1980s, firms made bad investments in commercial real estate projects because they anticipated continuing inflation-driven increases in real estate prices. Yet, despite the anecdotal evidence, there is a dearth of quality empirical research into the extent to which inflation uncertainty distorts investment decisions. It is this gap that John Huizinga seeks to fill with his very thorough analysis of the effect of inflation uncertainty on U.S. manufacturing investment.

The perspective I bring to the discussion is that of a central banker. I am mostly interested in what the paper has to say about the quantitative effects of inflation uncertainty on investment behavior and whether eliminating inflation is likely to significantly reduce these distortions. On this score I think the paper has a lot to offer.

_The Theory_

The basic idea in the paper is that inflation generates uncertainty about the future value of relative prices—particularly, the future value of the real wage, the real price of the firm’s output, and its real profit rate. Inflation is thought to change the real value of these variables in unpredictable ways because their money values are subject to various degrees of stickiness.

Uncertainty about relative prices generates uncertainty about the revenue stream from an investment project. This uncertainty creates an incentive to delay marginal investment projects in the hope that the uncertainty will be resolved. Thus, in aggregate, inflation is likely to reduce investment spending.

Huizinga’s test of this idea is straightforward. He first shows that inflation uncertainty varies through time since, if it did not, it would be indistinguishable from a constant in equations that used data from a single country. 1

Next, Huizinga shows that inflation uncertainty is linked to uncertainty about relative prices. The presumption here is that firms base their decisions on the expected future real values of variables, not the money values. In other words, he argues that if inflation uncertainty does not affect real values it is unlikely to be the cause of observed changes in investment behavior. 2

Finally, Huizinga looks at the correlation between uncertainty in relative prices and investment. He shows that uncertainty about real wages and real materials prices is negatively correlated with investment. This negative relationship is robust in that it is evident in both time series and cross-section data. And, although there are a couple of puzzles in the results, they are relatively minor compared to the strong evidence linking uncertainty about real wages and real materials prices to investment.

1. Inflation uncertainty is measured as the variance of inflation conditional on knowing the past history of inflation.
2. There are, of course, other ways that inflation uncertainty can affect investment behavior—by distorting the cost of capital, for example.
These Results Should Be Taken Seriously

The results presented by Huizinga lend support to the view that inflation is costly. Granted, the evidence is not definitive, but policymakers do not have the luxury of waiting for conclusive results before concerning themselves with inflation. A “do nothing” monetary policy is not an option—there is no automatic pilot.

What this means for interpreting economic research is that some evidence is better than none, and that the evidence that does exist has to be taken seriously even if all loose ends are not nailed down. On this score, the results presented by Huizinga decidedly support the view that inflation uncertainty is bad. But, exactly how does one go about eliminating inflation uncertainty, acknowledging that it is bad for the economy? In particular, could it be argued that a policy of reducing inflation adds just as much uncertainty to relative prices in the transition to lower inflation as a policy of maintaining inflation at a constant but higher rate? The point here is not that high, steady rates of inflation are feasible or desirable. Rather, it is that one needs to know about the nature of relative price uncertainty in order to design policies that can reduce that uncertainty. This issue is beyond the scope of Huizinga’s research but reinforces the conclusion that more work is needed on the causes of relative price uncertainty and its effect on economic behavior.

Inflation or Price Level Uncertainty?

From the perspective of monetary policy, the paper would be more interesting if Huizinga had explored the distinction between uncertainty about inflation and uncertainty about the price level. The theory in the paper suggests that it is the predictability of the future price level that affects investment behavior. Specifically, firms delay investment projects when they are uncertain about the future level of revenue from a project. In the empirical work, on the other hand, Huizinga measures uncertainty as the conditional variance of the inflation rate. These are not the same thing. One can easily imagine a case where the monetary authorities target a low or zero inflation rate but allow random base drift in the price level. In this case, the inflation rate could become quite predictable whereas the price level could remain unpredictable in the sense that its conditional variance could rise without bound with forecast horizon. On the other hand, it may be that innovations in the price level are small and inconsequential at low rates of inflation, such that random base drift is unimportant for economic behavior. As it now stands, the paper is silent on the question of whether the monetary authorities should be content with targeting a low or zero rate of inflation or whether they should commit to a policy of reversing unanticipated movements in the price level (that is, prevent longer-term base drift) to render the conditional variance of the price level stationary.3

From a policy perspective it is important to know what type of monetary uncer-

3. Although the distinction between price level and inflation uncertainty is no doubt relevant to forecasts of the future value of nominal assets, it may be less critical to forecasts of the future revenues from an investment project. In Huizinga’s model, the evaluation of investment projects depends only on relative prices, and the conditional variance of relative prices may be stationary even when the conditional variance of the aggregate price level is not.
tainty most affects economic behavior. Do the price level and/or relative prices become more predictable at low or zero rates of inflation? Under what circumstances should the central bank be concerned about “price-level” drift and therefore commit to a policy of keeping the price level on some predetermined path? Is a credible commitment to low or zero inflation sufficient to reduce price level and relative price uncertainty to negligible proportions? These questions are worthy of further research.