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Risk aversion, intertemporal substitution, and the aggregate investment–uncertainty relationship ☆

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Abstract

We analyze the role of risk aversion and intertemporal substitution in a simple dynamic general equilibrium model of investment and savings. Our main finding is that risk aversion cannot by itself explain a negative relationship between aggregate investment and aggregate uncertainty, as the effect of increased uncertainty on investment also depends on the intertemporal elasticity of substitution. In particular, the relationship between aggregate investment and aggregate uncertainty is positive even if agents are very risk averse, as long as the elasticity of intertemporal substitution is low. A negative investment–uncertainty relationship requires that the relative risk aversion and the elasticity of

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intertemporal substitution are both relatively high or both relatively low. We also show that the implications of our model are consistent with the available empirical evidence.

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1. Introduction

Economic theory has been analyzing the effect of uncertainty on investment for more than 40 years. One seminal strand of the literature starts with Oi (1961), followed by Hartman (1972) and Abel (1983). They show that, in a perfectly competitive environment, an increase in output-price uncertainty raises the investment of a risk-neutral firm with a constant returns to scale technology. Intuitively, this is because constant returns to scale imply that the marginal revenue product of capital rises more than proportionally with the output price when firms can adjust employment after uncertainty is resolved. Hence, the marginal revenue product of capital is convex in the output price and, by Jensen's inequality, greater price variability translates into a higher expected return to capital and higher investment.

This theoretical conclusion has been contradicted by empirical research as no study has found a positive investment–uncertainty correlation; estimates range from negative to zero. Most of the empirical evidence is about the relationship between investment and uncertainty at the aggregate level. Many studies are based either on country data (see Ramey and Ramey, 1995; Aizenman and Marion, 1999; Pindyck and Solimano, 1993; Calcagnini and Saltari, 2000; Alesina and Perotti, 1996) or on highly aggregated data (see Huizinga, 1993; Ferderer, 1993a,b). Only Leahy and Whited (1996), Guiso and Parigi (1999) and Bloom et al. (2005) do empirical work at the micro level.

Investment irreversibility has been one of the first elements considered by economic theory to explain the negative effect of uncertainty on investment. Bernanke (1983), McDonald and Siegel (1986), Pindyck (1988) and Bertola (1988) show that, if the firm cannot resell its capital goods, then the optimal investment policy derived under reversibility, equalization of the marginal revenue product of capital and the Jorgensonian user cost of capital (Jorgenson, 1963), does not hold anymore. In particular, if investment is irreversible, the firm invests only when the marginal revenue product of capital is higher than a threshold that exceeds the Jorgensonian user cost of capital because the firm takes into account that the irreversibility constraint may be binding in the following periods. The difference between this threshold and the Jorgensonian user cost of capital represents the value of the option of investing in the future. A higher degree of uncertainty implies a higher threshold for investing since the value of the option is always increasing in the variance of the stochastic variable.

The higher threshold for investing under irreversibility does not necessarily translates into lower investment however. For this to happen, two additional conditions must be satisfied. The first condition, highlighted by Caballero (1991), Pindyck (1993) and Abel and Eberly (1997), is that the marginal revenue product of capital is a decreasing function