Investment is one of the most important and volatile components of macroeconomic activity. In the short-run, the relationship between uncertainty and investment is central to understanding the business cycle. In the long-run, the effect of uncertainty on capital accumulation has significant implications for economic growth and development.

The main goal of this thesis is to contribute to the empirical literature about how uncertainty affects firm-level investment behavior and capital accumulation.

Achieving such a goal requires three methodological ingredients: first, firm-level investment data; second, a microeconomic model of investment that is consistent with the data; and third, an econometric approach that allows these questions to be addressed. This thesis incorporates these ingredients in a unified structural framework.

Under the assumptions of risk-neutrality, perfect capital markets, and no adjustment costs, within the framework of static neoclassical producer theory, a firm's optimal investment policy would equalize the marginal revenue product of capital and the user cost of capital, as derived by Jorgenson (1963). Two practical features of investment change the static problem into a dynamic one: uncertainty about future profitability and costly adjustment of the capital stock. Optimal investment then needs to take into account the intertemporal linkage between current investment and future returns to capital.

Chapter 2 surveys consensus, controversies and open questions in the literature on investment and uncertainty in such a dynamic framework. It illustrates that there are two key channels through which uncertainty may affect investment dynamics and capital accumulation. One reflects non-linearity of the operating profits with respect to the variables that characterize uncertainty, summarized as the Hartman-Abel-Caballero (HAC) effect. Another reflects the frictions in capital adjustment, summarized by different forms of capital adjustment costs. This implies that reliable evidence about the effects of uncertainty requires the specification and estimation of an investment model, which incorporates these two potential channels. This is achieved in a sequential order in Chapters 3 to 5.

The theoretical analysis in Chapter 3 focuses exclusively on the second channel. It extends the investment model of Abel and Eberly (1999), by generalizing the adjustment cost function from complete irreversibility only, to one which includes partial irreversibility, a fixed cost of undertaking any investment, and quadratic adjustment costs. In order to abstract the HAC effect, some commonly-used functional forms are chosen so that by construction, in the absence of any adjustment costs, both investment dynamics and capital accumulation are invariant to the level of uncertainty. This provides a useful benchmark that allows me to investigate two questions: first, what are the effects of different forms of adjustment costs, compared with the frictionless benchmark; and second, what are the effects of uncertainty in the presence of each of these forms of adjustment costs?

Chapter 3 finds that even such a simple investment model generates rich implications for investment behavior, depending on the precise form of adjustment costs. The impact effects of positive shocks to profitability on capital adjustment differ dramatically, according to the form of adjustment costs. These effects may be dampened, amplified or even reversed when translated into the expected level of the capital stock. Other parameters in the model also affect the quantities of interest in a substantial fashion. These findings highlight the importance of the empirical work undertaken in Chapters 4 and 5.

Using firm-level investment data for a panel of Brazilian manufacturing firms, Chapter 4 estimates a fully parametric structural investment model similar to that studied in Chapter 3, using the Method of Simulated Moments. Within this model, investment and capital accumulation are determined by five factors: the Jorgensonian user cost of capital, the production technology, the demand schedule, the stochastic process characterizing uncertainty in the profitability, and different forms of adjustment costs. For a given Jorgensonian user cost of capital, structural parameters for the other four factors are estimated by matching simulated model moments to empirical moments.

Distinctive features of the model estimated here are that, I allow for unobserved heterogeneity across firms in long-run profitability growth rate, and for measure-

ment errors in the firm-level data. The empirical results suggest an important role for quadratic adjustment costs, although at least one type of non-convex adjustment costs is also needed to match features of this firm-level dataset.

The estimated model is used to investigate how these firms' investment dynamics and capital accumulation would differ if they faced different levels of adjustment costs at the estimated level of uncertainty. Counterfactual simulations indicate that investment would be much more responsive to new information about profitability if firms in Brazil faced a lower level of adjustment costs. In the long run, a lower level of adjustment costs would induce firms to operate with substantially higher capital stocks.

Both the theoretical analysis in Chapter 3 and the empirical findings in Chapter 4 therefore highlight the importance of the adjustment costs. Meanwhile they also raise the question studied in Chapter 5: given these capital adjustment costs, what would be the effects on investment dynamics and capital accumulation if firms faced a difference level of uncertainty? To address this, the model is extended to allow for the HAC effect. Identification requires variation across firms in the level of uncertainty, and a firm-level proxy for uncertainty to be available in the data. This chapter uses panel data for UK manufacturing firms, which is observed over a longer time period (1972-1991).

Chapter 5 captures the HAC effect by generalizing the investment model considered in Chapters 3 and 4. By modelling uncertainty in both productivity and demand, the investment model in this chapter has two important implications, based upon which I design a 'two-step' identification procedure.

First, in the absence of adjustment costs, the expected capital stock level could increase, decrease or be invariant to the level of uncertainty, depending on the relative weight of productivity and demand uncertainty in overall uncertainty. With this property, the identification of the HAC effect is transformed into identifying the relative weight of these different sources of uncertainty.

Second, by construction the linear homogeneity of the investment model implies the HAC effect affects the level of variables from this model, but not ratios or

growth rates. Therefore despite the presence of the HAC effect, the irrelevance of the HAC effect on variables in ratio or growth rate allows me to estimate the four factors mentioned above, i.e. the production technology, the demand schedule, the stochastic process, and different forms of adjustment costs, by using information for variables in ratio or growth rate only, as achieved in Chapter 4. This is implemented in step 1 of the 'two-step' procedure.

In step 2 of the 'two-step' procedure, holding the parameters estimated from step 1 fixed, the model estimates the parameter that characterizes the HAC effect by matching information for variables in level. In particular, this requires matching the correlation between a measure of capital stock and a proxy of uncertainty.

Finally, as a robustness check, I consider a more general specification, which further allows for a risk-premium component in the discount rate. The correlation between the capital-to-sales ratio and uncertainty provides the identification for the additional parameter describing this discount rate effect.

With this empirical strategy, estimating the effects through each channel is transformed into estimating a set of structural parameters of the model. Using a simulated minimum distance estimator, these parameters are then estimated by matching simulated model moments with empirical data moments from a panel of UK manufacturing firms. The empirical results imply that a mix of partial irreversibility and quadratic adjustment costs fits the features of investment behavior in this dataset best; while the estimates for the HAC effect depend on whether the model allows for risk premium component in the discount rate or not.

Counterfactual simulations find that, in the short-run, the estimated investment model predicts a small effect of uncertainty on investment dynamics. This is mainly due to the importance of quadratic adjustment costs in the estimated model. In the long-run, this chapter estimates a negative and potentially large effect of uncertainty on capital accumulation, which operates through the negative effect of quadratic adjustment costs in the baseline model without discount rate effect, or through a richer combination of factors in the extended model with a discount rate effect.

Chapter 6 summarizes the findings of the thesis, discusses potential limitations of this methodology, and outlines some important and interesting extensions for future research.