Short-Term Shocks & Long-Term Investment

Proposal for NBER Workshop: Big Data & High-Performance Computing for Financial Economics

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1 Research Abstract

Our proposal centers around a benchmark dynamic structural firm investment model of the type commonly used for quantitative analyses in corporate finance and macroeconomics. A prototypical paper studying firm investment with this class of models begins with a theory about the nature of frictions at firms, e.g., financial constraints (Hennessy and Whited, 2007), imprecise information (David et al., 2016), agency conflicts (Nikolov and Whited, 2014), or adjustment costs (Hayashi, 1982), reasoning from these frictions to conclusions about firm value, the business cycle, and capital misallocation. By contrast, our work begins with a focus on the shock process at firms, a starting point which has proven deeply profitable for the analysis of household-level consumption (Blundell et al., 2008) but received less attention in the context of firms.

Our project, which has a set of preliminary results in hand, makes four points. First, we demonstrate that a little under half of the variance of productivity shocks hitting firms appears to come from short-term, transitory sources, a wide departure from the commonly used - purely persistent - AR(1) shock process at firms. Second, we show that firm investment in tangible and intangible assets systematically appears to exhibit sensitivity to these short-term shocks. Third, we argue that ignoring transitory shocks likely leads to systematic biases in estimating crucial parameters - such as adjustment costs or shock persistence - in investment models, but taking the existence of short-term shocks and investment sensitivities into account offers crucial quantitative discipline for a range of firm investment frictions such as financial constraints. Fourth, we estimate a model of firm investment subject to reduced-form wedges or distortions causing sensitivity of investment to short-term shocks, demonstrating that quantitatively meaningful misallocation of capital results from observed investment sensitivities. A preliminary draft is available here.

2 Research Strategy

Our ongoing work on this project has two components: empirical and theoretical. The empirical part involves the calculation of various statistics of the firm investment and productivity distribution from a panel of data on US public firms drawn from standard sources, e.g., Compustat. With this data in hand we estimate various stochastic processes from the firm-level data using standard generalized method of moments (GMM) techniques. This portion of our work can be done with local desktop computing resources and standard statistical languages such as R or STATA.

By contrast, the second part - our quantitative, theoretical work - requires more computational resources. In particular, we implement the numerical solution and structural estimation of the parameters of a dynamic structural firm investment model. The main portion of the analysis is based on an indirect inference procedure, estimating the underlying size of firm-level investment frictions to match the observed productivity process as well as investment sensitivities to short-term shocks. The procedure requires the repeated numerical solution of a firm's dynamic investment problem, based on canonical dynamic

programming techniques such as policy iteration, followed by simulation of the model for a large number of parameter values. We use Fortran to implement the solution and simulation of the model, relying upon heavy parallelization via OpenMP, and we implement the minimization of the statistical objective for structural estimation using a range of global, stochastic optimization routines, e.g., genetic algorithms, simulated annealing, or particle swarm optimization.

3 Data Description

As noted briefly above, our empirical analysis is straightforward. So the bulk of our work and need for resources centers on the numerical solution and estimation of a structural model of firm investment. However, we briefly summarize our data here. Our main dataset is drawn from the Compustat Fundamentals Annual file, with firm-fiscal year level financial statements including firm sales, capital expenditures, R&D investment, and employment. We combine these measures with data from the NBER-CES manufacturing database to generate a panel of cost share-based two-factor revenue TFP. The resulting panel, with straightforward transformations and moment calculations, is the crucial input into our empirical analysis.

4 Why XSEDE?

Our ongoing project would benefit from the use of XSEDE resources to complete the repeated numerical solution and simulation of our dynamic firm investment model. The state space of the model is large, so the dynamic programming or optimization step is naturally parellelizable. Our use of Fortran and OpenMP to solve the model implies that we can quickly and efficiently exploit the resources provided by a high-performance computing cluster. We are also interested in extending our code to MPI to implement the statistical optimization, running multiple solution + simulation jobs simultaneously as an input into the same structural estimation exercise. Each of these tasks is more burdensome and slow using only local computing resources, so we look forward to learning about the most efficient way in which we could make use of XSEDE resources.

References

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