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Volatility and welfare

Robert Lester [a], Michael Pries [a], Eric Sims [a,b,c,*]

[a] University of Notre Dame, 710 Flanner Hall, Notre Dame, IN 46556, United States
[b] NBER, United States
[c] ifo, Germany

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ABSTRACT

This paper explores the relationship between volatility and welfare. Even though households prefer smooth streams of consumption and leisure, welfare can be increasing in the volatility of an exogenous driving force if factor supply is sufficiently elastic. We provide some analytical results for a model without capital, and do some quantitative exercises in a model with capital and a variety of shocks. Welfare is greater in high shock volatility regimes under plausible parameter values. Augmenting the model with features that increase the elasticity of factor supply extends the range of parameters over which higher volatility results in greater welfare.

1. Introduction

There has been considerable recent interest in understanding the role of changes in volatility in macroeconomic models. This interest stems, in part, from a desire to better understand the causes and consequences of the "Great Moderation."[1] However, much less attention has been paid to the question of whether periods of lower volatility are actually preferable from a welfare perspective. Given risk-averse consumers, there is a natural inclination to assume that volatility is always welfare-reducing. However, if factors of production are in sufficiently elastic supply, they can be intertemporally allocated so as to take advantage of "good times" in a way that can boost well-being. In other words, elastic factor supply gives production the features of an option, and options are of course more valuable when volatility is higher. If this option effect dominates households' aversion to non-smooth streams of consumption and leisure, then more volatility in exogenous driving forces can actually be associated with higher levels of welfare. While this outcome may be conceptually possible, it is natural to ask whether it is a mere theoretical curiosity. Are there realistic parameter configurations, for a standard business cycle model, for which volatility is actually welfare-enhancing? And if so, how quantitatively significant are the effects?

When Lucas (1987) (see also Lucas, 2003) explored the welfare costs of business cycles, he did so by calculating the magnitude of the welfare gains that could be attained by completely eliminating consumption volatility. He famously concluded that those gains are very small. Thus, whether one interpreted economic fluctuations as the result of market imperfections that magnify the economy's response to shocks, or as an efficient response to those shocks, the potential

* Corresponding author at: University of Notre Dame, 710 Flanner Hall, Notre Dame, IN 46556, United States. Tel.: +1 5746316309.
E-mail address: esims1@nd.edu (E. Sims).

[1] Kim and Nelson (1999) and Perez-Quiros and McConnell (2000) were the first to document the decline in volatility since dubbed the "Great Moderation." Subsequent contributions include Stock and Watson (2003), Sims and Zha (2006), Davis and Kahn(2008), Fernández-Villaverde et al. (2010), and many others.

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benefit of dampened fluctuations, either from smaller shocks or from correcting the market imperfections that magnify shocks, was insignificant.

However, by focusing only on consumption volatility, and not specifying the equilibrium model in which that consumption volatility arises, Lucas's calculations by construction reflected an incomplete assessment of the relationship between volatility and welfare. In an equilibrium model, fluctuations in key aggregates are also affected by production decisions, and unlike households, to whom volatility by itself is unambiguously undesirable, firms may view volatility as a source of opportunity. Since at least Hartman (1972) (see also the subsequent elaboration by Abel, 1983), we have understood that when firms face greater volatility—either in the prices of their products, factor prices, or in productivity—they respond to that greater volatility with a higher average level of investment (and, similarly, output). A key ingredient of that result is that firms have the flexibility to adjust inputs—increasing them when conditions are favorable and reducing them when conditions deteriorate. Thus, the potential benefits of greater volatility are closely linked to the degree of elasticity in factor supplies. A comprehensive assessment of the relationship between volatility and welfare must weigh those benefits against the undesirable aspects of consumption volatility emphasized by Lucas. Cho et al. (2012) analyze the welfare consequences of greater TFP volatility in an RBC context, which takes account of these benefits and costs. While our model shares many similarities with Cho et al. (2012), we extend the framework along many important directions that Cho et al. (2012) do not consider. These additional directions are elaborated on below.

We examine this question quantitatively within the benchmark laboratory used by macroeconomists to study fluctuations, i.e. a standard real business cycle model. We take this approach, as opposed to one in which we incorporate a variety of extensions common in the literature—such as sticky prices or labor market frictions—because the competing effects of volatility are easier to identify and assess in the simpler benchmark model. Moreover, the basic insights obtained from this benchmark model would naturally carry over to the more elaborate models that build upon it. For much of the paper we focus on the welfare implications of volatility in an exogenous productivity process, though we extend our analysis to volatility in demand-side disturbances later in the paper. To gain analytical insights, in Section 2 we begin with a simpler version of that model in which there is no capital. As a benchmark we make the common assumption that preferences are iso-elastic and additively separable in consumption and leisure. We are able to show analytically that welfare is increasing in the volatility of shocks to productivity if the coefficient of relative risk aversion is sufficiently low and the Frisch elasticity of labor supply is sufficiently high. However, in this simplified model, even if the Frisch elasticity is infinite, for volatility to be welfare-enhancing the coefficient of relative risk aversion must be much lower (less than 1/2) than what is typically considered plausible.

One would expect that introducing capital into the model, and thus introducing a means by which consumers can substitute intertemporally as well as a second input that firms can adjust to changing conditions, might expand the range of parameters over which greater volatility is welfare-enhancing. To explore whether that is the case, in Section 3 we solve a fully dynamic model with capital. We solve the model using a perturbation method; given the focus on the effects of volatility, we must use a second-order approximation.[2] We solve the model for two values—high and low—of the standard deviation of productivity shocks. To measure the welfare differences between the different shock volatilities, we calculate the compensating variation—the percentage by which consumption in the high-volatility environment would have to be changed in order to achieve the same welfare as the low-volatility environment.

These compensating variation calculations are complicated by the fact that the equilibria of the high- and low-volatility environments have different mean capital stocks. In particular, the high-volatility environment has a higher mean capital stock, since the opportunity to take advantage of larger positive shocks makes capital more productive on an average. That will naturally make the high-volatility environment relatively more attractive if the transition costs of having acquired that additional capital (i.e. the foregone consumption) are not taken into account. To address this issue, we calculate a *conditional* compensating variation that measures welfare in the two environments as the value function at a common value of capital (we condition on the value of capital in the non-stochastic steady state), so that the two environments are compared on an equal footing. We then also calculate the *unconditional* compensating variation, which measures welfare as the unconditional expectation of the value function and thus gives a sense of the welfare difference in the long-run, once the costs of acquiring any additional capital have already been absorbed.

We find that the range of parameter values over which the high-volatility regime is preferred to the low-volatility regime does indeed expand relative to the simple model without capital. Moreover, the range now includes plausible parameter configurations that have been used in the literature—for example, with the preferences utilized in Hansen (1985)—with log utility over consumption and an infinite Frisch labor supply elasticity—both the conditional and unconditional compensating variations are negative, meaning that agents prefer the environment with more volatility in the exogenous productivity process. Nevertheless, the potential welfare impact from changes in shock volatility is small; over a range of parameters, the compensating variation associated with cutting the shock volatility in half never exceeds 0.5% of consumption.

We next explore some extensions of the baseline model. To better understand the role that different preference specifications play, we consider two specifications commonly used in the business cycles literature that depart from the conventional separability between consumption and leisure. First, we consider the King et al. (1988) specification that allows for balanced growth even when the coefficient of relative risk-aversion differs from 1. Second, we consider the preferences introduced in Greenwood et al. (1988), which eliminate the wealth effect of shocks on labor supply, and thus

[2] We use the method of Schmitt-Grohe and Uribe (2004). See also Aruoba et al. (2006) for a comparison of the speed and accuracy of this solution method relative to alternative methods.