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# Uncertainty shocks and the relative price of investment goods ☆

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ABSTRACT

This study empirically shows that higher uncertainty leads to not only a simultaneous drop in consumption and investment, but also a rise in the relative price of investment goods. This negative relationship between the relative price and quantity of investment suggests that heightened uncertainty depresses investment as an adverse supply shock to the investment sector. We demonstrate that a two-sector sticky price model with realistic asymmetric sectoral price rigidity can successfully account for our empirical findings. In particular, the underlying mechanism behind the negative relationship between the price and quantity of investment is limited intersectoral factor mobility. By contrast, the standard two-sector model featuring perfect factor mobility causes a negative co-movement between consumption and investment, contradicting the business cycle phenomenon.



## 1. Introduction

The recent Great Recession has sparked the idea that an increase in uncertainty can be an important driver of economic fluctuations.[1] According to Bloom (2014)'s calculation on the magnitude of the impact of uncertainty, for example, the size of the uncertainty shock experienced during the Great Recession might account for around one-third of the 9% drop in GDP versus trend during 2008–2009. Recent empirical results by Alexopoulos and Cohen (2009), Bachmann et al. (2013), Baker et al. (2016), Bloom (2009), Jurado et al. (2015), and Leduc and Liu (2016), suggest that uncertainty shocks can produce an adverse effect on aggregate economic activity.

How are uncertainty shocks propagated to the economy? In this study, we present a novel channel through which exogenous changes in uncertainty affect the economy. Using a structural vector autoregression (SVAR) framework, we document that unanticipated increases in uncertainty lead to a simultaneous decline in key macroeconomic variables, such as output,

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[1] Following the literature, we use the term "uncertainty" as shorthand for what would more precisely be referred to as "objective uncertainty" or "risk," in which the probabilities are well understood. There might be an alternative source of uncertainty, that is, ambiguity, in which the probabilities are not well understood.

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consumption, and investment, and yet an increase in the relative price of investment goods. Along with the co-movement among the key macroeconomic variables, we pay a particular attention to uncovering the underlying mechanism behind the estimated relationship between the relative price and production of investment goods.

Our focus on the observed negative relationship between the price and quantity of investment is motivated by the fact that it suggests a new mechanism through which higher uncertainty depresses investment other than a conventional real-options effect. Due to the non-convex nature of adjustment costs, the real-options effect emphasizes the value of waiting and staging flexibility when firms make decisions on investment (e.g., Bloom, 2009; Bloom et al., 2012). Higher uncertainty raises the value of waiting so that firms postpone purchases of new capital goods until the uncertainty is resolved. This wait-and-see effect of higher uncertainty on investment is more like a demand-side story, in which we would expect a simultaneous drop in price and quantity of investment goods. Hence, our estimated negative relationship between the relative price and production of investment goods seems at odds with the prediction of a real-options effect. The negative relationship instead hints some supply-side effect at work to depress investment in response to uncertainty shocks because it can be interpreted as an inward shift of the supply schedule of investment goods along with the investment demand curve. Our attempt to explore another channel for the propagation of uncertainty shocks other than the real option effect is also motivated by the finding of Bachmann and Bayer (2013), who show that risk shocks exert small aggregate effects through the wait-and-see effect in a heterogeneous-firm DSGE model.

We seek to account for our empirical findings in the context of a two-sector, representative-agent sticky price model that consists of a sticky-price consumption sector and a flexible-price investment sector. There are good reasons to believe that the pricing of the investment sector producing durable goods can be better characterized as flexible rather than as sticky. As Barsky et al. (2007) convincingly point out, we tend to bargain over big-ticket, long-lived items. Large durable goods often require considerable customization; this necessitates negotiations, and the discussions about the exact nature of the good are likely to be accompanied by negotiations about prices. This suggests that the transaction prices of many long-lived goods are effectively flexible. In addition to these conceptual reasons, several empirical findings support modeling the investment sector as flexibly priced.[2]

We show that the introduction of imperfect intersectoral factor mobility, in conjunction with the asymmetric price rigidity between the two sectors, is the key to constructing a satisfactory model that generates our empirical findings. In contrast, we demonstrate that the standard two-sector sticky price model in which factors freely move across sectors fails to generate the observed responses of the relative price and production of investment goods to uncertainty shocks. In such a model, higher uncertainty lowers the relative price and thereby causes a pronounced expansion in the production of flexibly priced investment goods. Surprisingly, the increase in production of the investment sector can be so large that GDP and aggregate hours rise in response to uncertainty shocks.

Our two-sector model that explains the increase in the relative price of investment goods enriches our understanding on how uncertainty shocks generate an adverse effect on economic activity in sticky price models. Much of our understanding about the propagation mechanism of uncertainty shocks in a representative-agent model comes from one-sector sticky price models (e.g., Basu and Bundick, 2017) which abstract from differences in price rigidity between sectors. However, Barsky et al. (2007) emphasize the importance of investigating such differences in two-sector sticky price models. As mentioned above, the presence of flexible-price investment goods can undo the implications of one-sector sticky price models in which uncertainty shocks cause a decline in economic activity. To restore the adverse effect of uncertainty shocks, it is crucial that the relative price of investment increases through the imperfect factor mobility effect.

In addition to its importance in the propagation mechanism of uncertainty shocks, matching the rise in the relative price provides an important implication for optimal monetary policy. Recent literature on inflation targeting and optimal monetary policy highlights that the central bank faces a different kind of policy tradeoff in multisectoral sticky price models than the one-sector model (e.g., Aoki, 2001; Carvalho, 2006; Barsky et al., 2016). Our two-sector model also poses a different challenge to the monetary authority that would not emerge in the one-sector model analyzed in Basu and Bundick (2017). The fact that the relative price of investment increases in response to the uncertainty shock implies that it has a differential impact on sectoral inflation rates. Hence, the central bank has a choice among several possible measures of inflation and should determine which measure of inflation should be stabilized. In the one-sector model, however, this issue would not arise because the relative price is unchanged. Hence, our two-sector model calls for a different monetary policy recipe in response to uncertainty shocks than the one-sector model does.

Finally, empirical evidence supporting the notion that labor and capital cannot be immediately reallocated between sectors has been well established. Imperfect intersectoral labor mobility is consistent with persistent sectoral wage differentials (e.g., Krueger and Summers, 1988; Neumuller, 2015). Horvath (2000) and Katayama and Kim (2018) report low estimates of intersectoral labor substitutability. Beaudry and Portier (2011) present empirical evidence that intersectoral labor mobility is not sufficient, so that the returns to labor between individuals initially attached to different sectors is not equated. Davis and Haltiwanger (2001) find that reallocation friction is an important channel through which oil shocks drive economic fluctuations. Ramey and Shapiro (2001) document high costs associated with reallocating capital across sectors.

[2] Bils et al. (2013) find that residential housing and structure are flexibly priced based on estimating the frequency of price adjustment using micro data. Furthermore, Bouakez et al. (2009) and Kim and Katayama (2013) find that the construction and durable goods sectors have flexible prices based on macroeconometric estimates of multi-sector DSGE models.