

The Asymmetric Effects of Uncertainty

By Andrew Foerster

In the wake of the financial crisis and severe recession, the U.S. economy's recovery has been sluggish by historical standards. One oft-cited explanation for the tepid recovery is that elevated uncertainty about the future has been a drag on economic activity.

Several episodes of heightened uncertainty followed the financial crisis. In May 2010, the European sovereign debt crisis caused financial markets to question the survival of the euro area and how the crisis would be resolved. Similarly, in August 2011, the U.S. debt ceiling crisis cast doubts on the U.S. government's commitment to repay its debts, causing financial turmoil. In June 2013, uncertainty about the Federal Reserve's plans for slowing the pace of ongoing asset purchases after a speech by then-Chairman Ben Bernanke resulted in a brief period of heightened financial market volatility that is popularly called the "taper tantrum." A large increase in uncertainty during each of these episodes may have slowed the recovery. In each case, however, uncertainty declined after a short period.

Examining temporary spikes in uncertainty can help determine its effects on economic activity, specifically whether increases have the same effect as decreases. If uncertainty has symmetric effects—that is, if decreases in uncertainty offset increases—then short-lived spikes in uncertainty should not have long-lasting effects. On the other hand,

Andrew Foerster is a senior economist at the Federal Reserve Bank of Kansas City. This article is on the bank's website at www.KansasCityFed.org.

if uncertainty has asymmetric effects—if increases have more sizable effects than decreases—then short-lived spikes in uncertainty may persistently lower economic activity.

This article examines whether increases and decreases in uncertainty have asymmetric effects. It concludes that sizable increases in uncertainty have larger effects on economic activity than sizable decreases. As a result, the short-lived uncertainty episodes during the current recovery may have had long-lasting effects, leading to lower growth in output and employment. The first section of the article discusses how uncertainty might affect the economy, and documents the high uncertainty during the recovery. Section II shows that changes in uncertainty have asymmetric effects on the U.S. economy, with increases having larger effects than decreases. Section III uses the results on asymmetry to demonstrate how movements in uncertainty caused lower economic activity and employment growth during the recovery. The lower employment growth created substantial cumulative losses in aggregate employment, with the burden falling disproportionately across industries.

I. UNCERTAINTY AND THE ECONOMY

Economic theory suggests that rising uncertainty causes firms to wait before investing and hiring, and causes consumers to wait before purchasing certain consumption goods. These delays can slow the economy. Recovery from the financial crisis has been unusually slow, and measures of stock market volatility suggest uncertainty has been high. These observations are consistent with the view that uncertainty has slowed the recovery.

Why uncertainty might matter

Uncertainty about future economic outcomes can be viewed as a probability distribution. For example, a firm may be uncertain about whether future demand for its product will be higher, lower, or the same as current demand. If the firm's uncertainty increases, it may place greater weight on relatively extreme outcomes—for example, the likelihood that demand will be significantly higher or lower—and thus increase the possible range of outcomes. In many cases, such as the recent financial crisis, uncertainty rises because of negative news, which lowers

expectations of future economic activity but also increases the range of possible outcomes.

Economic theory, such as that developed by Bernanke, and Bloom and others, predicts that rising uncertainty may lower economic activity as firms postpone their investments and hiring, and consumers postpone their purchases.¹ Suppose a firm contemplates hiring new employees but is unsure about future demand. The firm will consider how additional employees will help production but will also factor in the costs of hiring employees, the wages that must be paid, and the costs of laying off workers if demand for the firm's product is low. If the firm is fairly certain that future demand will exceed current demand, it may hire new employees. If uncertainty about future demand increases, however, the firm may wait to hire to avoid incurring hiring and firing costs. While this example highlights why firms may postpone hiring, the same logic may also apply to consumers' timing of major purchases. Through this and similar channels, Basu and Bundick, Leduc and Liu, and Bloom and others (2012) argue that changes in uncertainty help explain economic fluctuations.

When uncertainty decreases, economic theory suggests that economic activity increases, especially if there is pent-up demand for investment or hiring after a period of high uncertainty. However, theory doesn't necessarily dictate the speed of the increase. Investing in large capital projects or hiring specialized workers requires a significant implementation period, meaning that if uncertainty decreases quickly, activity might increase more slowly. If a firm passes through a period of heightened uncertainty about future demand and then decides to hire more employees, it will have to post vacancies, screen applicants, and possibly provide training before workers become productive.

Although economic theory suggests increases in uncertainty will lower economic activity and decreases in uncertainty will increase it, theory does not necessarily predict the magnitude of the effect. The level of uncertainty changes constantly, and firms and households may simply tune out small changes. Large increases or decreases may trigger changes in behavior, but small changes may simply be ignored.

The aggregate implications of changes in uncertainty, therefore, may depend on both the sign and the size of the changes. Large increases, such as those on which Bloom focused, cause firms to postpone

hiring and investing, consumers to postpone purchases, and the economy to slow. Large decreases in uncertainty tend to increase activity, but not necessarily all at once, as firms and consumers adjust slowly. Small changes in uncertainty may have little or no effect. Thus, periods of high uncertainty that dissipate quickly might have longer-lasting repercussions if the response to uncertainty is asymmetric.

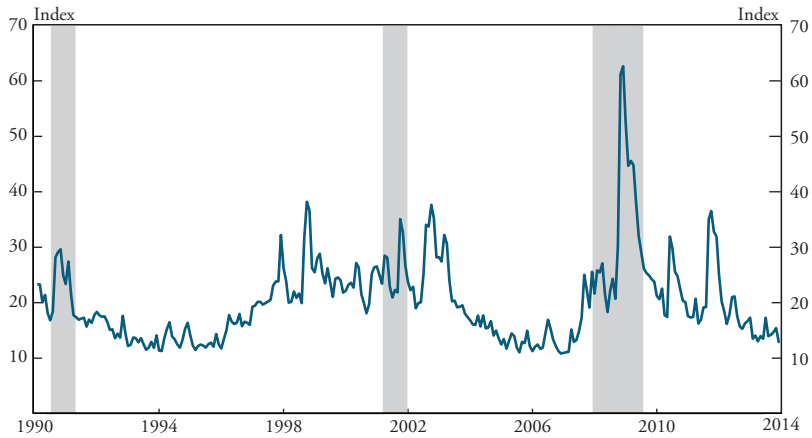
Measuring uncertainty

Uncertainty about future economic conditions can extend to aggregate, local, industry, or individual-specific conditions. Consequently, it is difficult to quantify the degree of uncertainty in the economy at any time. One way to measure economy-wide uncertainty without relying on surveys of households or businesses is to use expected measures of volatility that depend on stock prices.

One such measure of uncertainty is the Chicago Board Options Exchange Volatility Index, commonly referred to as the VIX. The VIX uses options prices for the Standard & Poor's 500 (S&P 500) up to 30 days in the future to determine the implied volatility of stock market prices. Higher values of the VIX indicate a wider range of possible outcomes for the S&P 500 in the coming month, implying participants are more uncertain about future market prices than usual. Since the stock market responds quickly to new information about the aggregate economy, the VIX is a useful indicator of the level of uncertainty in the economy. Chart 1 shows the VIX since 1990. The index typically rises during recessions and trends down during recoveries, but also experiences many short-lived fluctuations. During the financial crisis, the VIX reached a record high.

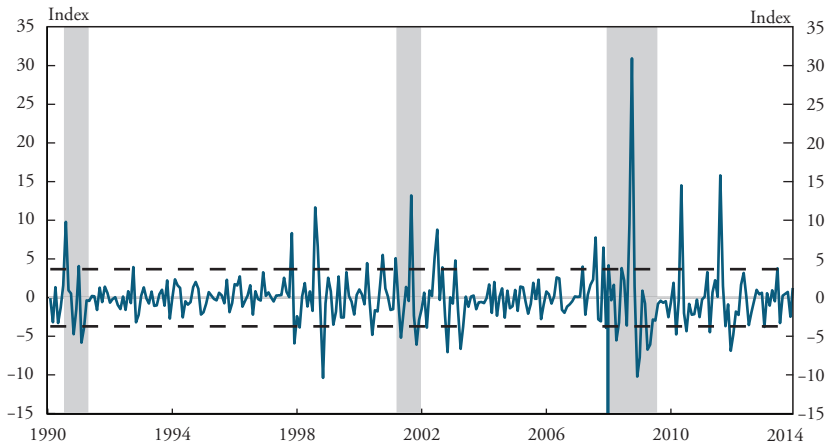
A number of spikes in the VIX have been notably large, and several of the largest occurred during the recovery from the financial crisis. Chart 2 shows the monthly change in the VIX since 1990, along with two dashed lines that indicate changes that exceed 1 standard deviation from the mean in either direction. The mean change of the VIX over the sample 1990-2014 was -0.03 and the standard deviation was 3.70, so the thresholds are given by -3.73 and 3.67. Since 1990, changes exceeded these thresholds in 49 months: the change increased more than 1 standard deviation from the mean in 24 months and decreased more than 1 standard deviation from the mean in 25. Three episodes of large

Chart 1
THE VIX



Note: Gray bars represent NBER-defined recessions.
Source: Chicago Board Options Exchange.

Chart 2
CHANGES IN THE VIX



Notes: Gray bars represent NBER-defined recessions. Dashed lines indicate 1 standard deviation from the mean in either direction.
Sources: Chicago Board Options Exchange and author's calculations.

movements have occurred since the financial crisis: May 2010, when the European debt crisis dominated headlines; August 2011, when the United States narrowly avoided a default due to the debt ceiling crisis; and June 2013, when the “taper tantrum” took place.²

Uncertainty episodes during the recovery, while not as large as those of the financial crisis, are represented by large increases in the VIX from lower levels. All of these increases were short-lived, with the VIX subsequently falling to previous levels. If changes in uncertainty have symmetric effects, these spikes will have had only temporary effects on economic activity. If, however, changes in uncertainty have asymmetric effects, with large increases having a more substantial impact than large decreases, then these spikes may have been a persistent drag on economic growth.³

II. ASYMMETRY IN THE RESPONSE TO UNCERTAINTY

The combination of sluggish growth and the three large increases in the VIX suggest that uncertainty may have slowed growth via its asymmetric effects on economic activity. This section introduces a statistical model that incorporates the potential for asymmetry in the response of economic activity to uncertainty. Regression results using an index of economic activity indicate that large increases in uncertainty lower economic activity, while large decreases and small changes in either direction have little or no effect. Transitory spikes in uncertainty can thus have persistent effects. The results also suggest that employment growth responds asymmetrically at the aggregate level and for many industries.

A statistical model of asymmetry in uncertainty

The statistical model relates the monthly changes in economic activity to previous changes in activity, previous changes in the stock market, and previous changes in the VIX. The model is at a monthly frequency from 1990 to 2013:

$$\Delta y_t = \alpha + \rho \Delta y_{t-1} + \beta \Delta SP500_{t-1} + \delta \Delta VIX_{t-1} + \gamma_+ \Delta VIX_{t-1}^{big+} + \gamma_- \Delta VIX_{t-1}^{big-} + e_t$$

The variable Δy_t represents the percentage change in economic activity. The coefficient ρ captures persistence in activity. The variable

$\Delta SP500_{t-1}$ represents the percentage change in the S&P 500 index, and the coefficient β captures the effect of stock prices on activity. The variable ΔVIX_{t-1} represents changes in the VIX. Two additional variables capture possible asymmetry in VIX changes: the variable ΔVIX_{t-1}^{big+} captures large increases, and the variable ΔVIX_{t-1}^{big-} captures large decreases. The cutoff value determining an increase or decrease as large, introduced in Chart 2, is 1 standard deviation (3.70) from the mean (-0.03). Consequently, the large increases are given by

$$\Delta VIX_{t-1}^{big+} = \begin{cases} \Delta VIX_{t-1}, & \text{if } \Delta VIX_{t-1} > 3.67 \\ 0, & \text{otherwise} \end{cases}$$

Similarly, the large decreases are given by

$$\Delta VIX_{t-1}^{big-} = \begin{cases} \Delta VIX_{t-1}, & \text{if } \Delta VIX_{t-1} < -3.73 \\ 0, & \text{otherwise} \end{cases}$$

The equation allows changes in the VIX to have different effects on the change in activity depending on their size. The effect of a small change in the VIX is $\delta \cdot \Delta VIX$; the effect of increases in the VIX by more than 1 standard deviation is $(\delta + \gamma_+) \cdot \Delta VIX$. The effect of decreases in the VIX by more than 1 standard deviation is $(\delta + \gamma_-) \cdot \Delta VIX$.

The regression equation's form embodies several plausible assumptions about the evolution of economic activity and the effects of the VIX. First, the VIX enters the equation with a one-period lag, which reflects the assumption that the stock market detects any changes in uncertainty before they affect the real economy. Second, the regression includes the S&P 500 index, which controls for movements in the level of stock prices. In most cases, increases in uncertainty are driven by bad news that also lowers expectations about future growth; including the stock market helps control for this effect. Third, the lagged dependent variable allows for the persistence of activity so that changes in uncertainty might have effects beyond one month. For instance, a change in uncertainty in January might influence activity in February; activity in February might then, in turn, influence activity in March. Fourth, the regression allows for, but does not require, asymmetry in the response to the VIX. If the estimation implies that γ_+ equals 0, then large increases in the VIX affect activity in the same manner as small ones, and similarly for large decreases if γ_- equals 0. If the estimation implies that γ_+ equals γ_- then large increases and large decreases have identical effects, and can offset one another. Fifth, the regression—by having one

equation with a single lag and a limited set of variables—only considers the direct effects of uncertainty. Indirect channels, such as longer lags and feedback, are ignored. For example, the VIX may influence economic activity, which in turn influences the stock market, leading to additional feedback effects. These indirect channels may increase or decrease the magnitude of the direct channel.

Uncertainty and national activity

The first set of regression results considers the effects of uncertainty on changes in economic activity. The Chicago Fed National Activity Index (CFNAI) is a measure of the change in economic activity that aggregates information from 85 monthly indicators. Values above zero indicate the economy is growing above trend, and values below zero indicate the economy is growing below trend. The regression uses the CFNAI as the measure of $\Delta\gamma_t$.

The estimation results presented in Table 1 show asymmetry in the CFNAI's response to changes in the VIX. The regression in the first column imposes symmetric responses by restricting γ_+ and γ_- equal 0. The estimated coefficients indicate that increases in the VIX tend to imply decreases in the CFNAI, although this estimate is not statistically different from zero. The regression reported in the second column also imposes symmetric effects, but allows for large changes to have disproportionate effects by restricting γ_+ to equal γ_- . The estimated coefficient on large changes is statistically insignificant—meaning the effect of large changes is no different than the effect of small ones.

In contrast, the asymmetric regression shows evidence of asymmetry in responses. In the third column of Table 1, the coefficient on ΔVIX_{t-1} indicates that small changes in uncertainty have no statistically significant effect; furthermore, the coefficient on ΔVIX_{t-1}^{big-} implies the effect of large decreases is no different than the effect of small changes. The coefficient on ΔVIX_{t-1}^{big+} , on the other hand, is statistically significant and negative, implying that large increases tend to decrease activity by a larger degree than small changes. The F-statistic, which tests whether large positive and large negative changes have equal influence, is significant, which means the data support the hypothesis of asymmetric responses.

Table 1

EFFECT OF UNCERTAINTY ON ECONOMIC ACTIVITY

| Dependent variable: Chicago Fed Nat. Activity Index | Symmetric ($\gamma_+ = \gamma_- = 0$) | Symmetric with big changes ($\gamma_+ = \gamma_-$) | Asymmetric |
|---|---|--|---------------------|
| Lagged activity | .6576*** (.0450) | 0.6568*** (.0450) | .6046*** (.0476) |
| S&P 500 growth | .0332** (.0148) | .0331** (.0148) | .0361** (.0147) |
| VIX changes | -.0046 (.0144) | .0161 (.0272) | .0246 (.0269) |
| VIX big changes | -- | -.0240 (.0272) | -- |
| VIX big increases | -- | -- | -.0522* (.0283) |
| VIX big decreases | -- | -- | .0294 (.0320) |
| Constant | -.0800** (.0379) | -.0748* (.0383) | -.0390 (.0396) |
| F-statistic for asymmetry | -- | -- | 9.26*** |
| Adjusted R-squared | .4864 | .4860 | .5007 |

Note: Standard errors are in parentheses.

* Significant at 10 percent level

** Significant at 5 percent level

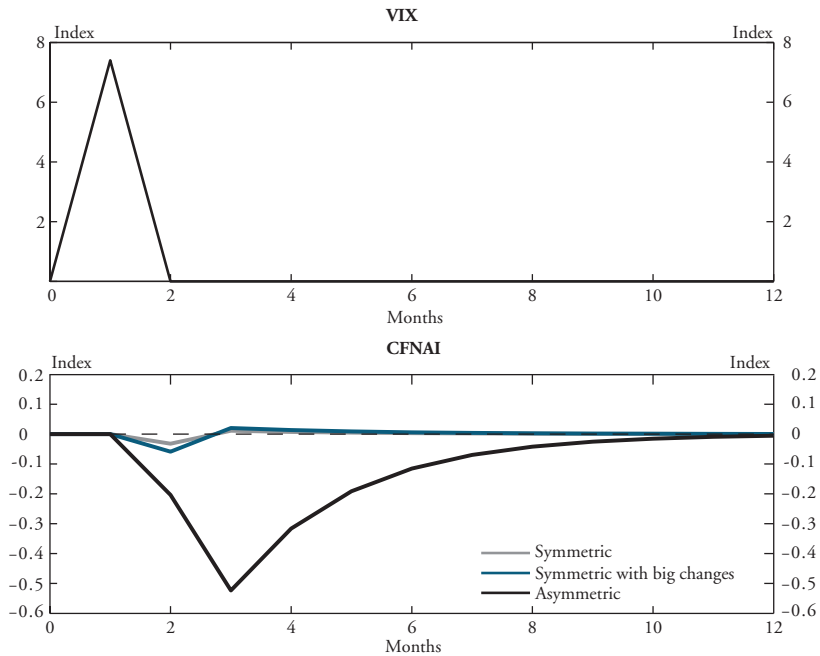
*** Significant at 1 percent level

Sources: Federal Reserve Bank of Chicago, Standard & Poor's 500, Chicago Board Options Exchange, and author's calculations.

The asymmetric and symmetric regressions have drastically different implications for the response of the CFNAI to a one-period spike in the VIX. Chart 3 shows how the CFNAI responds if the VIX increases by 2 standard deviations—about 7.4 points—and is then immediately offset by an equal decline in the subsequent period. The symmetric regression implies a slight drop in the CFNAI followed by an immediate bounce back, as the decrease in the VIX essentially negates the increase in the previous period. The symmetric regression with large changes produces an almost identical result. The asymmetric regression, by contrast, shows a much more persistent decline in the CFNAI. When the VIX increases, the asymmetric regression produces a steeper decline in the CFNAI, and when the VIX decreases the following period, the CFNAI falls further. The decline in the VIX does not produce a rebound in the CFNAI, and the CFNAI only gradually returns to its original level. This asymmetric response suggests that spikes in the VIX have long-lasting economic effects.

Chart 3

RESPONSE IN THE CFNAI TO A ONE-PERIOD VIX SPIKE



Source: Author's calculations.

Uncertainty and employment

The second set of regression results considers the effects of uncertainty on employment growth using Bureau of Labor Statistics data on private nonfarm employment at both the aggregate level and by industry. The aggregate regression thus uses the percentage change in private nonfarm employment as a measure of Δy_t , and the regressions by industry use the percentage change in employment in each industry as a measure of $\Delta y_{i,t}$.

The estimation results in Table 2 show evidence of asymmetry in the response of aggregate employment growth to changes in the VIX. The two symmetric regressions show that large and small changes in the VIX have no statistically significant effect on employment growth. The asymmetric regression, on the other hand, suggests that although small changes and big decreases in the VIX have no effect, large

Table 2

EFFECT OF UNCERTAINTY ON EMPLOYMENT GROWTH

| Dependent variable: percent employment growth | Symmetric ($\gamma_+ = \gamma_- = 0$) | Symmetric with big changes ($\gamma_+ = \gamma_-$) | Asymmetric |
|--|--|---|---------------------|
| Lagged activity | .8005*** (.0350) | .7974*** (.0350) | .7672*** (.0368) |
| S&P 500 growth | .0057** (.0027) | .0058** (.0027) | .0061** (.0027) |
| VIX changes | .0008 (.0027) | .0067 (.0051) | .0080 (.0051) |
| VIX big changes | -- | -.0069 (.0051) | -- |
| VIX big increases | -- | -- | -.0114** (.0054) |
| VIX big decreases | -- | -- | .0011 (.0060) |
| Constant | .01233* (.0073) | .0141* (.0074) | .0235*** (.0082) |
| F-statistic for asymmetry | -- | -- | 6.20** |
| Adjusted R-squared | .6807 | .6816 | .6874 |

Note: Standard errors are in parentheses.

* Significant at 10 percent level

** Significant at 5 percent level

*** Significant at 1 percent level

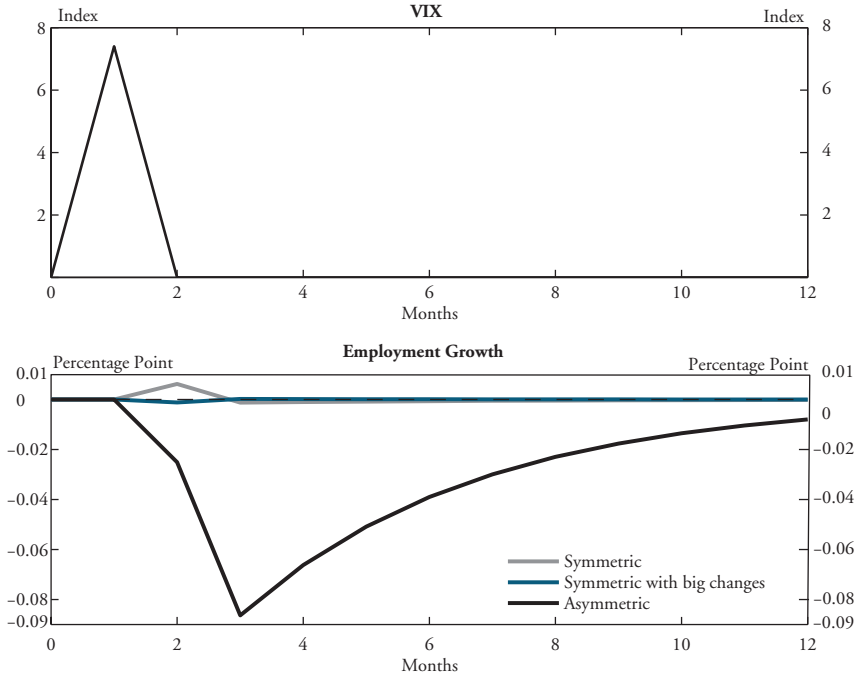
Sources: Bureau of Labor Statistics, Standard & Poor's 500, Chicago Board Options Exchange, and author's calculations.

increases produce statistically significant declines in employment growth. As both the coefficient on ΔVIX_{t-1}^{big+} and the F-statistic comparing the coefficients of ΔVIX_{t-1}^{big+} and ΔVIX_{t-1}^{big-} are statistically significant, the data thus support the notion that large increases produce different responses than small changes or big decreases.

As in the case with the CFNAI, the asymmetric and symmetric regressions have markedly different implications for the response of employment growth to a one-period spike in the VIX. Chart 4 shows how employment growth responds if the VIX increases by 2 standard deviations and decreases by the same amount the following period. The symmetric regressions with and without large changes imply little change in employment growth. The asymmetric regression, by contrast, shows a larger, more persistent decline. When the VIX increases, the asymmetric regression produces a marked decline in employment growth. But when the VIX decreases the following period, employment growth does not rebound. Instead, employment growth only gradually returns to its original level, suggesting that spikes in the VIX have long-lasting effects.

Chart 4

RESPONSE IN AGGREGATE EMPLOYMENT GROWTH TO A ONE-PERIOD VIX SPIKE



Source: Author's calculations.

Examining estimation results for employment growth by industry highlights that different industries have different asymmetric responses to uncertainty. Table 3 shows regression results for employment growth by industry for the symmetric regression. Assuming symmetry, only employment growth in Information Services and Other responds to changes in the VIX; responses in other industries are not statistically significant. Table 4 shows regression results using the asymmetric regressions. These estimates imply asymmetry in the response of employment growth for several industries, including Construction; Manufacturing; Trade, Transportation, and Utilities; Finance; Professional and Business Services; Education; Leisure and Hospitality; and Other. Asymmetry is supported by the F-statistic comparing the coefficients on ΔVIX_{t-1}^{big+} and ΔVIX_{t-1}^{big-} , which are significant in all but one of these regressions. In these industries, large increases in uncertainty tend to have greater

Table 3
EFFECT OF UNCERTAINTY ON EMPLOYMENT GROWTH: SYMMETRIC REGRESSIONS ($\gamma_+ = \gamma_- = 0$)

| Dependent variable: Employment growth | Mining | Construction | Manufacturing | Trade, transportation and utilities | Information services | Finance | Professional and business services | Education | Leisure and hospitality | Other |
|--|---------------------|---------------------|----------------------|---|-------------------------|---------------------|--|---------------------|----------------------------|---------------------|
| Lagged activity | .6438*** (.0458) | .5740*** (.0497) | .7582*** (.0375) | .6136*** (.0461) | .2809*** (.0566) | .7462*** (.0381) | .6606*** (.0437) | .2354*** (.0581) | .2354*** (.0581) | .5147*** (.0518) |
| S&P 500 growth | .0116 (.0122) | .0095 (.0126) | .0159*** (.0052) | .0112*** (.0039) | .0301*** (.0099) | .0091*** (.0030) | .0175*** (.0059) | -.0036 (.0028) | .0115*** (.0057) | -.0022 (.0038) |
| VIX growth | -.0013 (.0121) | -.0022 (.0123) | .0047 (.0052) | .0030 (.0038) | -.0301*** (.0097) | -.0048 (.0029) | .0070 (.0056) | -.0013 (.0028) | .0060 (.0056) | -.0061* (.0037) |
| Constant | -.0118 (.0319) | .0065 (.0320) | -.0447*** (.0144) | .0128 (.0101) | -.0186 (.0255) | -.0099 (.0079) | .0533*** (.0162) | .1827*** (.0157) | .1107*** (.0169) | .0444*** (.0104) |
| Adjusted R-squared | .4079 | .52496 | .6275 | .4300 | .1206 | .5982 | .5125 | .0527 | .0709 | .2622 |

Note: Standard errors are in parentheses.

* Significant at 10 percent level

** Significant at 5 percent level

*** Significant at 1 percent level

Sources: Standard & Poor's 500, Bureau of Labor Statistics, Chicago Board Options Exchange, and author's calculations.

Table 4
EFFECT OF UNCERTAINTY ON EMPLOYMENT GROWTH: ASYMMETRIC REGRESSIONS

| Dependent variable: employment growth | Mining | Construction | Manufacturing | Trade, transportation and utilities | Information services | Finance | Professional and business services | Education | Leisure and hospitality | Other |
|--|---------------------|---------------------|---------------------|---|-------------------------|---------------------|--|---------------------|----------------------------|----------------------|
| Lagged activity | .6420*** (.0460) | .5414*** (.0505) | .7304*** (.0400) | .5645*** (.0473) | .2618*** (.0589) | .7319*** (.0390) | .6071*** (.0451) | .2351*** (.0583) | -.2127*** (.0586) | .5097*** (.0506) |
| S&P 500 growth | .0110 (.0123) | .0095 (.0125) | .0163*** (.0052) | .0114*** (.0039) | .0299*** (.0100) | .0090*** (.0030) | .0186*** (.0058) | -.0037 (.0028) | .0111* (.0057) | -.0030 (.0037) |
| VIX growth | .0219 (.0234) | .0412* (.0236) | .0069 (.0098) | .0138* (.0073) | .0383** (.0191) | .0041 (.0056) | .0206* (.0106) | .0007 (.00537) | .0146 (.0107) | .0048 (.0069) |
| VIX big increases | -.0310 (.0249) | -.0598** (.0249) | -.0069 (.0103) | -.0183** (.0077) | -.0156 (.0206) | -.0019 (.0060) | -.0249** (.0112) | -.0027 (.0057) | -.0167 (.0114) | -.0199*** (.0073) |
| VIX big decreases | -.0187 (.0279) | -.0071 (.0277) | .012 (.0116) | .0049 (.0086) | .0055 (.0223) | .0079 (.0067) | .0121 (.0125) | -.0014 (.0064) | .0067 (.0128) | .0041 (.0082) |
| Constant | .0251 (.0349) | .0468 (.0346) | -.0379** (.0149) | .0306*** (.0110) | -.0050 (.0280) | .0161* (.0088) | .0867*** (.0182) | .1840*** (.0161) | .1296*** (.0185) | .0614*** (.0110) |
| F-statistic for asymmetry | .31 | 5.50** | 3.79* | 11.07*** | 1.29 | 3.26* | 12.72*** | .06 | 5.17** | 13.57*** |
| Adjusted R-squared | .4071 | .3493 | .6298 | .4515 | .1189 | .6001 | .5322 | .0467 | .0833 | .2983 |

Note: Standard errors are in parentheses.

* Significant at 10 percent level

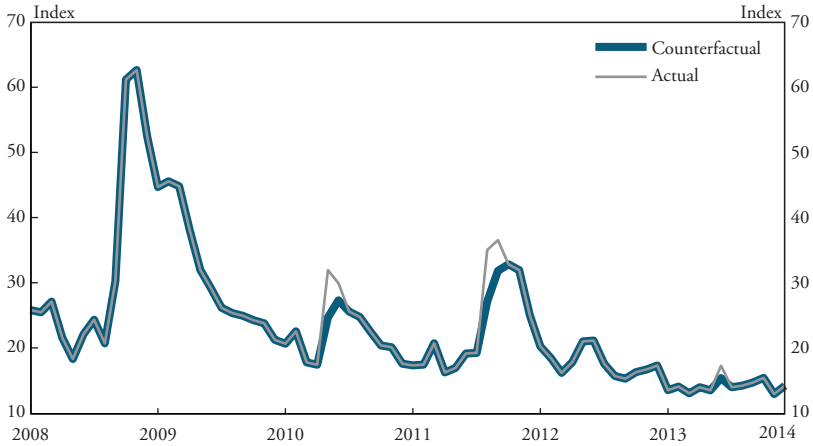
** Significant at 5 percent level

*** Significant at 1 percent level

Sources: Standard & Poor's 500, Bureau of Labor Statistics, Chicago Board Options Exchange, and author's calculations.

Chart 5

A COUNTERFACTUAL VIX



Sources: Chicago Board Options Exchange and author's calculations.

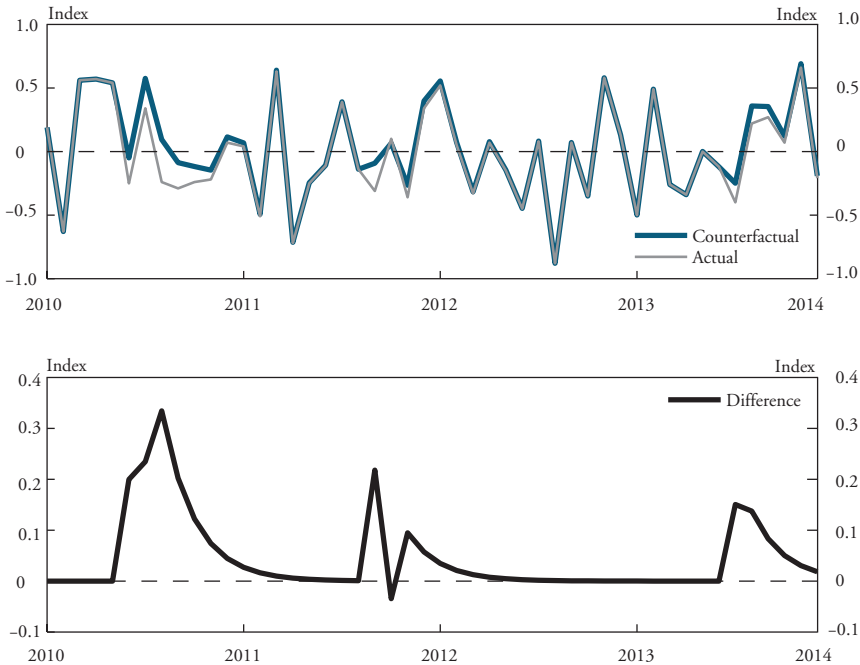
effects on employment growth than large decreases; therefore, large increases that are reversed, such as those in the three post-2010 episodes, may persistently dampen the employment recovery in those industries.

III. IMPLICATIONS FOR THE RECOVERY

The asymmetric regression results—which suggest the macroeconomic effects of large increases in the VIX are not necessarily offset by subsequent declines—can help quantify uncertainty's influence on the current economic recovery. The VIX had three large jumps during the recovery, and these increases in uncertainty may have slowed growth. To measure uncertainty's influence on the pace of economic activity, this section uses the regression results to estimate the CFNAI and employment growth that would have occurred if the VIX had not spiked so dramatically during the three key episodes from 2010 to 2013. This counterfactual exercise indicates that both the CFNAI and employment growth would have been higher absent the three VIX spikes.

Chart 5 shows the realized VIX since 2008 and a counterfactual VIX that assumes smaller, more gradual increases in uncertainty in May 2010, August 2011, and June 2013. Specifically, the counterfactual VIX replaces large increases in the realized VIX with half their

Chart 6
COUNTERFACTUAL CFNAI



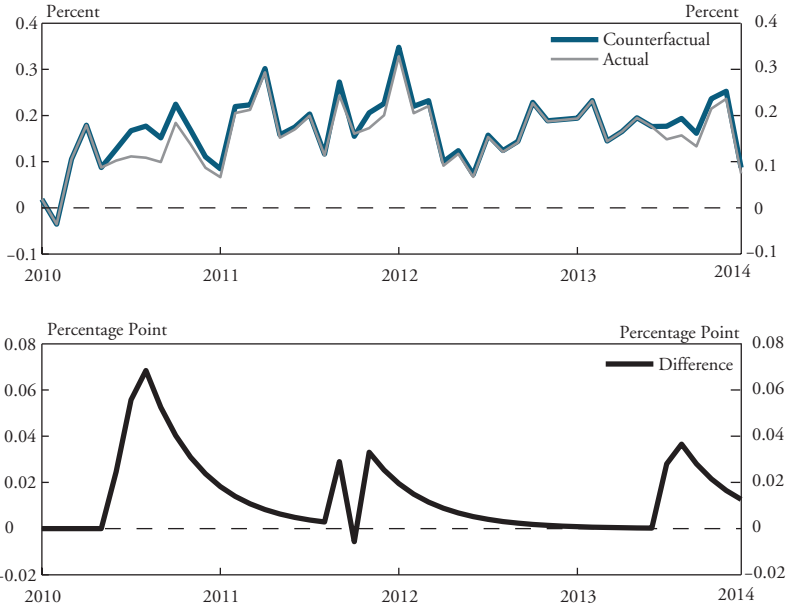
Sources: Federal Reserve Bank of Chicago and author's calculations.

value, thus dampening movements in uncertainty without eliminating them entirely.⁴

When combined with the counterfactual VIX, the asymmetric regression results suggest the CFNAI would have been higher throughout most of the period. Chart 6 shows the counterfactual CFNAI implied by the counterfactual VIX from Chart 5. The top panel shows what the CFNAI would have been compared to the actual CFNAI, and the lower panel shows the difference between the counterfactual and the actual. The plots show that under the alternative assumption for the VIX, the CFNAI would have been around 0.3 points higher when the European sovereign debt crisis hit in May 2010. That difference would have declined gradually until the U.S. debt ceiling debate, when the counterfactual VIX was over 0.2 points higher. The difference again decays until the “taper tantrum” episode, when the difference jumps to almost 0.2 points. For comparison, a unit increase of the CFNAI

Chart 7

COUNTERFACTUAL EMPLOYMENT GROWTH



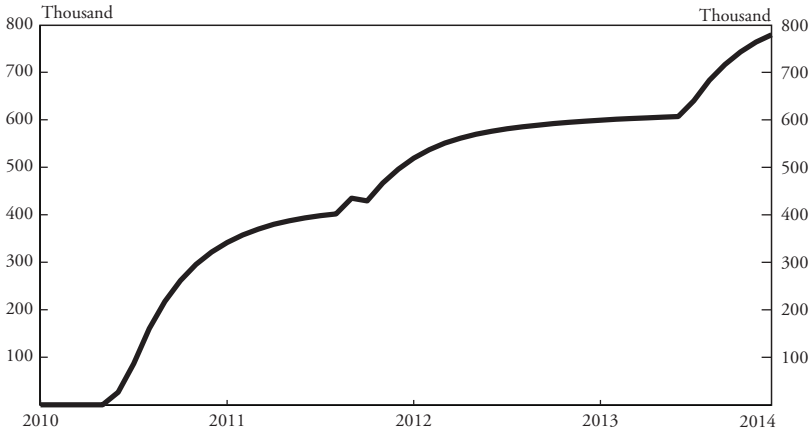
Sources: Bureau of Labor Statistics and author's calculations.

corresponds to growth in economic activity that is 1 standard deviation higher than average. Since the CFNAI measures growth, the results suggest growth would have been higher had these episodes not produced so much uncertainty.

The counterfactual VIX also implies that aggregate employment growth would have been higher after 2010. Chart 7 shows the employment growth implied by the counterfactual VIX. The top panel shows what employment growth would have been, and the lower panel plots the difference between the counterfactual and the actual. The plots show a similar pattern to that of the CFNAI, with peaks of over 0.06 percent during May 2010, and a smaller 0.04 difference in August 2011 and June 2013. To put these numbers in perspective, the average rate of employment growth from 2010 to 2013 was 0.15 percent per month. These results suggest that employment growth would have been higher during these episodes if uncertainty were lower.

Chart 8

CUMULATIVE EMPLOYMENT COST OF UNCERTAINTY



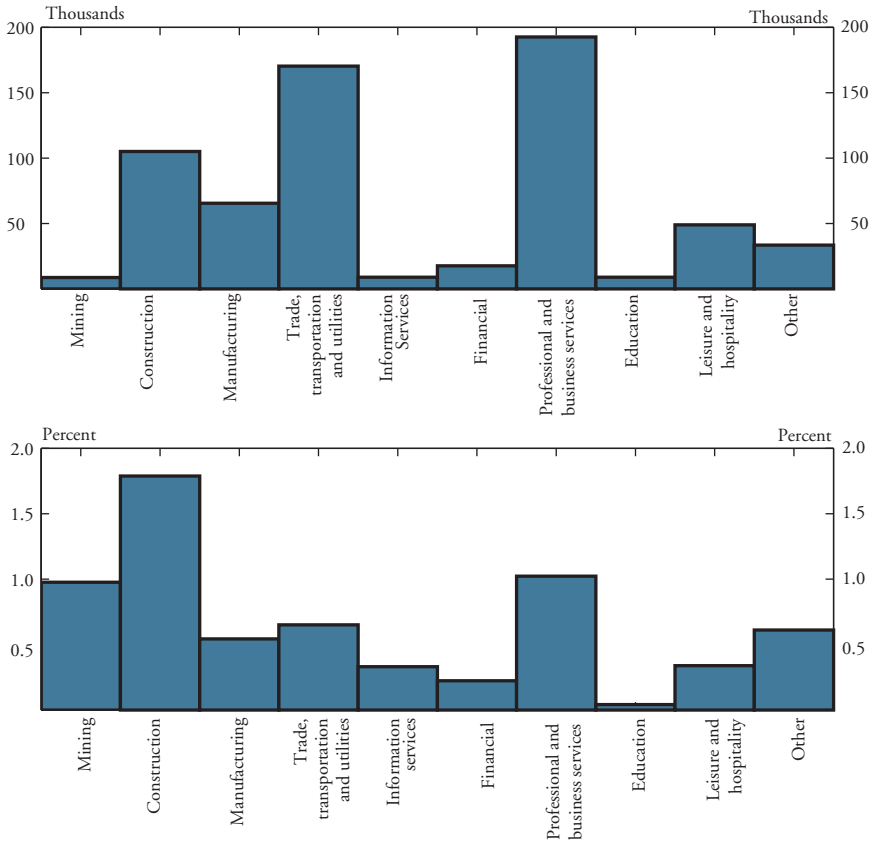
Source: Author's calculations.

Higher employment growth in the counterfactual scenario implies the level of employment would have risen after 2010 were it not for the three VIX spikes. Chart 8 translates the differences in employment growth shown in Chart 7 to level terms, plotting the cumulative cost in terms of aggregate employment. Lower employment growth leads to increasingly large employment losses over time. The results suggest that under the counterfactual VIX, 400,000 more people would have been employed following the European sovereign debt crisis, 600,000 more after the U.S. debt ceiling crisis, and 800,000 more by the end of 2013. This cumulative deficit at the end of 2013 is equivalent to about 16,000 fewer jobs gained per month from 2010 to 2013 because of these three uncertainty episodes.

The cumulative employment cost of uncertainty differs across industries. The counterfactual VIX and employment growth by industry imply different cumulative losses in employment, as shown in Chart 9. The top panel shows the difference at the end of 2013 in level terms across industries, while the bottom panel shows the difference in percentage terms. The top panel illustrates that Professional and Business Services were hit hardest by increases in uncertainty, with a drop in cumulative employment of almost 200,000. This industry is relatively large in employment terms, so 200,000 represents around 1 percent

Chart 9

CUMULATIVE EMPLOYMENT COST OF UNCERTAINTY, BY INDUSTRY



Source: Author's calculations.

of the employment. Four industries—Construction; Manufacturing; Trade, Transportation, and Utilities; and Leisure and Hospitality—have cumulative losses of around 50,000 jobs or more. The relative losses are the largest for construction, with increases in uncertainty producing a nearly 1.8 percent decline in cumulative employment. Education is the lone industry in which employment did not respond to higher uncertainty; most industries had employment losses of around 0.25 percent or higher from 2010 to 2013.

IV. CONCLUSION

High uncertainty during the current recovery has led to a relatively modest recovery by historical standards. Economic theory suggests that when uncertainty increases, firms and consumers postpone their decisions, lowering economic activity. When uncertainty decreases, economic activity may rebound, but not necessarily immediately. The empirical evidence presented in this article suggests that uncertainty has asymmetric effects and that decreases in uncertainty do not necessarily offset increases. As a result, spikes in uncertainty may produce persistent declines in economic activity.

Uncertainty's asymmetric effects imply that the large VIX increases associated with the European sovereign debt crisis and the U.S. debt ceiling crisis—and, to a lesser extent, the taper tantrum—led to lower growth in economic activity and employment during the recovery. Combined, these three episodes resulted in a substantial cumulative loss in employment.

ENDNOTES

¹Other theories as to why uncertainty matters include the view that high uncertainty increases borrowing costs for firms (Christiano and others). Bloom provides a thorough review of several theories and the evidence for and against them.

²Uncertainty associated with economic policy is a subset of economic uncertainty, but may have particularly potent effects; see Baker and others, Davig and Foerster, and Fernandez-Villaverde and others.

³This paper focuses on changes in uncertainty rather than levels, which helps isolate periods in which uncertainty changed rapidly. In Chart 1, for example, the “taper tantrum” did not produce high levels in the VIX, but from Chart 2, it is clear that because the level of the VIX was low beforehand, the change still created a significant movement.

⁴Mathematically, the counterfactual VIX is recursively constructed as $\widetilde{VIX}_t = \widetilde{VIX}_{t-1} + (VIX_t - \widetilde{VIX}_{t-1}) / 2$ if $VIX_t - \widetilde{VIX}_{t-1} > 3.67$ and $\widetilde{VIX}_t = VIX_t$ otherwise.

REFERENCES

- Baker, Scott R., Nicholas Bloom, and Stephen J. Davis. 2013. "Measuring Economic Policy Uncertainty," Stanford University working paper.
- Basu, Susanto, and Brent Bundick. 2011. "Uncertainty Shocks in a Model of Effective Demand," NBER Working Paper No. 18420.
- Bernanke, Ben. 1983. "Irreversibility, Uncertainty, and Cyclical Investment," *The Quarterly Journal of Economics*, vol. 98, no. 1, pp. 85-106.
- Bloom, Nicholas. 2014. "Fluctuations in Uncertainty," *Journal of Economic Perspectives*, vol. 28, no. 2, pp. 153-176.
- _____, Max Floetotto, Nir Jaimovich, Itay Saporta-Eksten, and Stephen Terry. 2012. "Really Uncertain Business Cycles," NBER Working Paper No. 18245.
- _____. 2009. "The Impact of Uncertainty Shocks," *Econometrica*, vol. 77, no. 3, pp. 623-685.
- _____, Stephen Bond, and John Van Reenen. 2007. "Uncertainty and Investment Dynamics," *Review of Economic Studies*, vol. 74, no. 2, pp. 391-415.
- Christiano, Lawrence, Roberto Motto, and Massimo Rostagno. 2014. "Risk Shocks," *American Economic Review*, vol. 104, no. 1, pp. 27-65.
- Davig, Troy, and Andrew Foerster. 2014. "Uncertainty and Fiscal Cliffs," Federal Reserve Bank of Kansas City working paper.
- Fernandez-Villaverde, Jesus, Pablo Gerron-Quintana, Keith Kuester, and Juan Rubio-Ramirez. 2011. "Fiscal Volatility Shocks and Economic Activity," NBER Working Paper No. 17317.
- Leduc, Sylvain, and Zheng Liu. 2012. "Uncertainty Shocks are Aggregate Demand Shocks," Federal Reserve Bank of San Francisco working paper.