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Global

Global Economics View

Policy Uncertainty and Investment—How Much Lower Must Real Interest Rates Go?

- **Economic policy makers geared up with new policy strategies and tools to try to bolster the tepid post-crisis recovery. Unfortunately, an unintended consequence was that the investment share of GDP declined, contributing to potential "secular stagnation."**
- **Monetary, fiscal, and regulatory policy makers globally have had to discard historical practices and become more discretionary, politically contentious, and interventionist.**
- **The Federal Reserve has turned to using unconventional policies. Yet the September 2013 "tapering debacle" shows that the Fed has not yet mastered the use of forward guidance. Fiscal measures provided little lasting stimulus, but contributed greatly to stirring political infighting among Congressional representatives. This led to legislative impasses and heightened financial market concerns about possible default on US Treasury obligations. In Europe, where regulatory reforms focused on banking union, there remains tremendous scope for stalled or incomplete reforms that generate uncertainties holding back bank restructuring and recapitalization.**
- **Economic uncertainty is often used as the "catch-all" explanation for poor economic performance. Fortunately, using the economic policy uncertainty (EPU) index, we can measure and quantify changes in policy uncertainty.**
- **For the United States and the Euro Area, post-crisis levels of uncertainty have risen by approximately fifty percent. The inverse relationship between investment and uncertainty, clearly evident in US and German data, implies policy uncertainty likely restrained investment and the post-crisis expansion.**
- **Econometric estimates confirm that along with GDP growth and the real interest rate, the policy uncertainty index is also significant in explaining changes in the investment-to-GDP ratio (investment share)**.
- **Simulations imply that during the five-year period from 2007 to 2012, the rise in uncertainty accounted for 57 and 36 percent of the investment share declines in the United States and Germany, respectively.**
- **There is substantial evidence that investment has been weak because of the uncertainty stemming from the dizzying array of policy measures taken in the United States and Europe since the crisis. Offsetting the costly impact of uncertainty on investment would require large reductions in real interest rates and/or sizable increases in GDP growth.**

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Policy Uncertainty Reduced US and Euro Area Investment Shares

Economic policy makers geared up with new approaches and policy tools to try to bolster the recovery. Unfortunately, their efforts may have worsened the decline in investment shares.

Over four years have passed since the end of the Great Recession of 2007-2009, yet the tepid expansions in Advanced Economies continue to disappoint. Growth has benefited from better consumption and housing demand, but investment spending as a share of GDP has not recovered to pre-recession levels despite highly stimulative financial conditions that include “once-in-a-generation” low levels for global interest rates. Unless investment reverses its recent sharp decline, the likelihood of improving productivity growth to support higher wages and incomes diminishes, along with the hope for more robust sustainable long-term growth. In response, economic policy makers geared up with new approaches and policy tools to try to forestall such a dismal outcome. Unfortunately “no good deed goes unpunished,” as the unintended consequences of their efforts may have inadvertently worsened the investment decline.

The first part of this note surveys sources of increased uncertainty stemming from the numerous monetary, fiscal, and regulatory policies enacted after the 2008 crisis. Then an analytical and quantitative analysis of the impact of uncertainty on investment is conducted in several stages. First, a measure of policy uncertainty is introduced for the United States and the Euro Area. Data are presented to demonstrate that this measure of uncertainty explains well the decline in investment for the Unites States and the Euro Area. An econometric model is estimated to quantitatively gauge the extent to which investment is lowered by uncertainty, taking into account the effects of real interest rates and GDP growth. The last two sections summarize the findings, especially concerning the large estimated changes to real interest rates and GDP growth that would be required to offset the deleterious effects of policy uncertainty.

Post-Crisis Policy Uncertainty Runs Rampant

Monetary, fiscal, and regulatory policy makers globally have had to discard historical practices and become more discretionary, politically contentious, and interventionist.

The desire to limit the severity of the Great Recession prompted policy makers to implement unprecedented economic policies to bolster aggregate demand and reinforce the global financial system. Globally, the post-crisis financial environment has become less familiar. Interest rates have plummeted down to their theoretical limits, and European banks continue to regroup as supervisors and regulators reassess asset quality and capital requirements.

In response, monetary, fiscal, and regulatory policy makers globally have had to discard historical practices and become more discretionary, politically contentious, and interventionist. On net, these policy developments collectively have heightened global uncertainty even as the recovery muddles along.

The Federal Reserve has turned to using unconventional policies to encourage investor risk-taking and “reach for yield” behavior.

Monetary Policy: Having lowered short-term interest rates to the zero-lower bound by the end of 2008, the Federal Reserve has since turned to using unconventional policies (e.g., quantitative easing) to encourage investor risk-taking and “reach for yield” behavior. As investor portfolios shifted away from safe Treasury assets and added risk, corporate issuance of high-yield securities soared, and corporate CFOs were incentivized to repurchase equity rather than invest in new capital, fueling further the considerable gains in equity markets. Other central banks (e.g., the Bank of England, Bank of Japan, and the ECB) have also followed in varying degrees with similar aggressive unconventional policies designed to lower long-term interest rates and raise equity prices. The ultimate purpose for inducing this portfolio shift was to strengthen aggregate demand, particularly by lowering the cost of capital for investment, even at the risk of distorting asset prices.

Central banks lack experience executing monetary policy using their new tools.

Central banks admittedly have had minimal experience executing monetary policy using such tools. Their learning-by-doing has been especially difficult in the current environment where reductions in short-term interest rates are constrained by the zero-lower bound. Nevertheless, monetary policy since the 2008 financial crisis has shifted from familiar rules-based and inflation-targeting frameworks to ones that are considerably less predictable. Consequently, market participants must play a guessing game to anticipate how the world's major central banks will deploy their new policy instruments (e.g., LSAPs ,LTROs, and forward guidance).

The September 2013 "tapering debacle" shows that the Federal Reserve has not yet mastered the use of forward guidance.

Clear credible communication now plays a central role with these new unconventional monetary policy procedures. Unfortunately, the September 2013 "tapering debacle" shows that the Federal Reserve has not mastered the use of forward guidance. Nor has it been able to integrate effective communication strategies with forward guidance to signal effectively the timing of a shift in the policy stance.[1] It appears that Goodhart's Law has returned to plague the Federal Reserve's use of forward guidance with respect to using the unemployment rate as a guide for anticipating policy changes: "When a measure becomes a target, it ceases to be a good measure."

Meanwhile, global markets and other central banks (especially in emerging markets) must learn to be more vigilant in this uncertain environment.

Explaining clearly how the new monetary operations work is a vital first step to reduce the justifiable skepticism surrounding the efficacy of these unconventional monetary policy tools. Also, because these new strategies operate by influencing market expectations about the future, it is vital to be credible in executing announced tactical policy moves. With the anticipated end of quantitative easing, credible forward guidance is all that will be left in the Federal Reserve's unconventional toolkit. It is obvious that more practice is required with this instrument before we retire quantitative easing. Meanwhile, global markets must learn to be more vigilant, and other central banks (especially in emerging markets) must learn to calibrate appropriate responses as their exchange rates and capital flows are buffeted by this uncertain environment.

Fiscal Policy: Globally, fiscal policy turned from austerity programs designed to reverse long-standing and growing concerns about sovereign debt sustainability, and moved toward fiscal forbearance. Targeting higher consumption, post-crisis US fiscal measures provided transitory stimulus with temporary tax cuts and creative one-time expenditure programs (e.g., "Cash for Clunkers"). Unfortunately, these measures did little to spur investment. They certainly did not ensure a more sustainable recovery with credible prospects for higher permanent income, consumption, and productivity.

[1] The potency and appropriate use of forward guidance and other unconventional monetary policy tools is discussed in greater detail in William Lee "Global Economics View - Some Guidance on Forward Guidance: Not Ready to Solo" September 10, 2013. Also, a proposal to incentivize central banks to do as they say is presented in Willem Buiter "Global Economics View - Forward Guidance: More than Old Wine in New Bottles and Cheap Talk?" September 25, 2013.

Fiscal measures contributed to political infighting among Congressional representatives that led to legislative impasses, and heightened financial market concerns about possible default on US Treasury obligations.

Instead, the fiscal measures contributed to political infighting among Congressional representatives that led to legislative impasses, and heightened financial market concerns about possible default on US Treasury obligations.[2] The inability for Congress to come to a consensus about the mix of deficit and debt reduction over the medium term, and more immediate needs for stimulus, raised anxiety about the effectiveness of using US fiscal policy to revive growth. Indeed, the experience with the debt-ceiling debate in October 2013, which closely followed anxiety-provoking fiscal cliff tensions in the fall of 2012 added to financial market nervousness about the breakdown of the US political decision making process.

Similarly, in some of the peripheral countries of Europe, balkanized and contentious political factions prevented implementation and continuation of needed fiscal and structural reforms.

Similarly, in some of the peripheral countries of Europe, balkanized and contentious political factions prevented implementation and continuation of needed fiscal and structural reforms. Growing financial market concerns about the sustainability of euro area membership for some members led the ECB in July 2012 to declare that it would "…do whatever it takes to preserve the euro." While this bold action by the ECB may be a temporary palliative for some sovereign bond rates, there remained significant uncertainty about the implied fiscal burden for the core as well as the peripheral Euro Area countries. Still unknown are the size and distribution of required future official sector bail-ins, as well as the (recapitalization) costs associated with banking union. Moreover, other structural reforms to improve long-term competitiveness among EA members will likely be politically disruptive, and tax heavily the political and economic capital of member countries.

In 2008, regulatory uncertainty ballooned regarding the execution of the "too big to fail" doctrine.

Regulatory Policy: Large financial institutions were at the center of the 2008 crisis and have become the focal point of regulatory actions attempting to reduce systemic risk and financial vulnerabilities. In 2008, regulatory uncertainty ballooned regarding the execution of the "too big to fail" doctrine (especially concerning the on-off-on sequence of events whereby the Fed and US Treasury rescued creditors of Bear Stearns and AIG but not Lehman). Also, regulatory legislation (and its implementation) has added to market uncertainty. Indeed, post-crisis legislation evolved from the 3-page request for $700 billion to fund the Troubled Asset Relief Program (TARP) in 2008, to the 2300 page Dodd-Frank Act passed in 2010 and the subsequent implementation of the 400+ mandated rules by the fractured US regulatory system.[3]

European financial regulatory reform has focused on restoring European banks to sufficient soundness so as to be able to resume their role as financial intermediaries. A key milestone is banking union, whereby bank supervision as well as crisis management and resolution will be clarified and unified. The objective is to sever the link between sovereigns and banks to limit "too big to fail" government interventions. The adoption of the Single Supervisory Mechanism by the EU Council in October 2013 placed the ECB at the fulcrum of Euro Area bank supervision, a precursor to full bank recapitalization.

[2] Further discussion and model simulations of the macro impact of political impasse, high structural deficits, and high debt levels (the "trifecta of looming fiscal issues") is in: Robert DiClemente and William Lee "Global Economics View - Debt Limit—Indecision Raises Long-Term Risks" October 10, 2013."

[3] By comparison, the Federal Reserve Act and Glass-Steagall Act were 31 and 37 pages, respectively.

In Europe, where still-to-be-implemented regulatory reforms focused on achieving banking union, there remains tremendous scope for stalled or incomplete reforms.

Unfortunately, with so little done, and so much to do, there remains tremendous scope for stalled or incomplete reforms. The lengthy run-up to even initial asset quality assessments (e.g., the forthcoming Asset Quality Review) foreshadows an even lengthier road before there is agreement and implementation of burden sharing, and the use of the European Stability Mechanism (ESM) for full bank recapitalization. Uncertainty rises as the timetable lengthens for implementing these and other reforms (including Basel III regulations and their extensions). Concern grows about how such numerous and overwhelming forces may reshape the future operating environment for European banks.

Measuring Policy Uncertainty and Its Impact

Economic uncertainty is often used as the "catch-all" explanation for poor economic performance.

Economic uncertainty is often used as the "catch-all" explanation for poor economic performance. Like the weather, economic policy uncertainty is perceived to have become more severe since the 2008 crisis. In part, this view is reinforced by the wide range of interventionist policies enacted to protect the global financial system from future shocks and crises (as discussed above), and by headline-grabbing political impasses owing to the balkanization of political factions.[4] Fortunately, we can do more than just talk abstractly about uncertainty because economic researchers have advanced our ability to measure and quantify changes in uncertainty, especially as related to policy.[5]

The economic policy uncertainty (EPU) index was constructed to provide a time series proxy for policy uncertainty in the United States and selected countries in the Euro Area.

The economic policy uncertainty (EPU) index was constructed to provide a time series proxy for policy uncertainty in the United States and selected countries in the Euro Area. The index is aggregated from three components: (1) newspaper accounts of economic uncertainty; (2) the number of federal tax code provisions set to expire in the next three years; and (3) dispersions among economists' forecasts for key variables. The news media coverage component, which receives half the weighting among the components, counts the number of articles containing the word "uncertainty" and mentions one or more of a set of words that suggest policy uncertainty (e.g., deficit, regulation, or Federal Reserve). The tax code expiration component is a source of uncertainty because of Congress's penchant for last-minute extensions that undermine certainty and stability in the expected path for future taxes. The third component measures policy uncertainty as reflected in the dispersion of forecasts of government expenditures and inflation in the Survey of Professional Forecasters conducted by the Philadelphia Federal Reserve.

The EPU index certainly has limitations as a proxy for policy uncertainty because it is difficult to distinguish between policy and other sources of uncertainty. [6] Using news articles mentioning uncertainty relies on accurate reporting and identification of the specific sources for uncertainty. Indeed, it may be likely that fallout from the global financial crisis has left financial markets with higher levels of residual uncertainty, which the EPU may be measuring.[7]

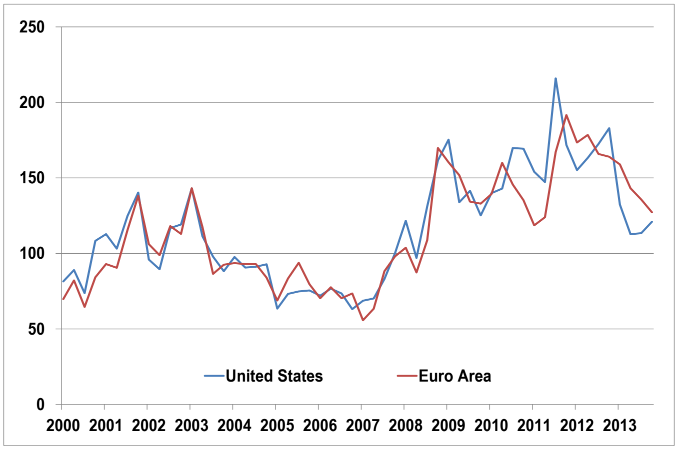
[4] It is assumed that economic uncertainty encompasses all financial and economic variables and their interplay in the global economic and financial system. Economic policy uncertainty is a subset centered on the future course of fiscal, monetary, and regulatory variables.

[5] Pioneering work was done by Scott Baker, Nicolas Bloom, and Steven Davis "Measuring Economic Policy Uncertainty" unpublished paper May 19, 2013 found on their web site. http://www.policyuncertainty.com/media/BakerBloomDavis.pdf where they have generously made available to the public their uncertainty index series as well as other related data.

[6] Methodologically, it would be better to use more behavioral measures based on decisions of economic agents at the micro level.

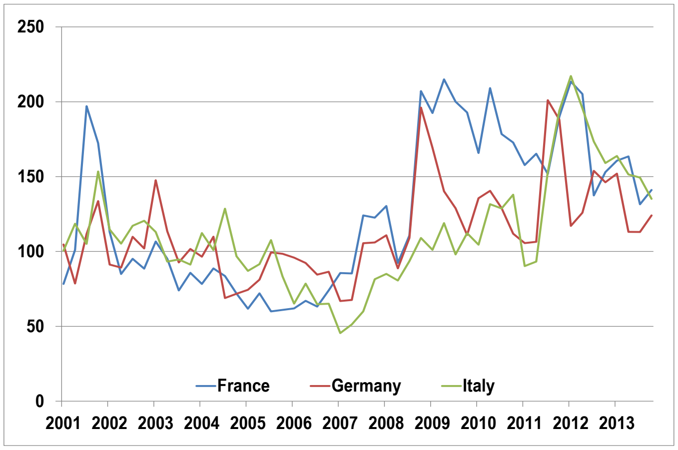
[7] Statistical tests of the time-sequencing of co-movements (Granger causality tests) between the uncertainty indices and US real interest rates and European credit growth imply movements in the

Figure 1. US and Euro Area Policy Uncertainty Indices



Source: Economic Policy Uncertainty website of Scott Baker, Nicolas Bloom, and Steven Davis http://www.policyuncertainty.com/index.html and Citi Research

Figure 2. Selected Euro Area National Policy Uncertainty Indices



Source: Economic Policy Uncertainty website of Scott Baker, Nicolas Bloom, and Steven Davis http://www.policyuncertainty.com/index.html and Citi Research

For the United States and the Euro Area collectively, post-crisis levels of uncertainty have risen by approximately fifty percent.

For the United States and the Euro Area collectively, the respective EPU indices imply post-crisis levels of uncertainty have risen by approximately fifty percent. As expected, relative spikes for the US index can be seen during the time of the 2008-2009 TARP cum banking crisis and the 2011 debt ceiling impasse. For the Euro Area, relative spikes show the December 2008 EU stimulus enacted following the Lehman collapse, the May 2010 Greek bail out, the September 2011 sovereign rating cut for Italy, and the November 2011 resignation of the Papandreou government (Figure 1).

Interestingly, the national uncertainty indices for selected countries in the Euro Area suggest uncertainty levels varied considerably among the Euro Area countries (Figure 2). This suggests that assessing the economic impact of policy uncertainty within the Euro Area should be done on a country-by-country and not on an aggregated basis, which is the strategy adopted in the following section.

Post-Crisis Investment Shares Drop Sharply

Most accounts of the post-crisis recovery inevitably focus on why the revival in economic growth has been so slow. Some popular explanations say slow growth regularly follows the very deep downturn following a global financial crisis.[8] More recently, the secular stagnation hypothesis has been revived to highlight the need for very low, perhaps negative, real interest rates to spur investment. [9]

EPU are not influenced by past changes in US real rates or European credit growth (except possibly in France).

[8] This is the Reinhart and Rogoff thesis (Kenneth Rogoff and Carmen Rhinehart. 2009 This Time is Different, Princeton University Press). Despite its popularity, there is contrary evidence from US history—see discussion in John Taylor (2014) "The Role of Policy in the Great Recession and the Weak Recovery," American Economic Review, Papers and Proceedings, May 2014.

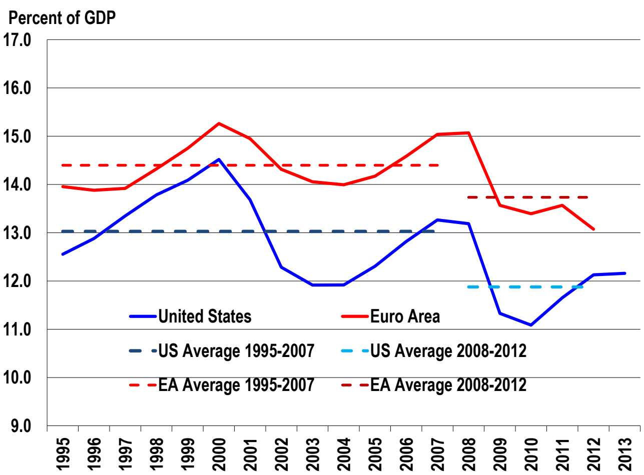
[9] Larry Summers has been the champion of this view (a summary is found on his Reuters blog: Larry Summers "On Secular Stagnation" December 16, 2013 http://blogs.reuters.com/lawrencesummers/2013/12/16/on-secular-stagnation/). Also, an analytical and empirical discussion of whether this thesis applies globally, and some novel policy options is found in Willem Buiter, Ebrahim Rahbari, and Joe Seydl Global Economics View - Secular Stagnation: Only If We Really Ask For It January 13, 2014.

The heart of Summer's stagnation thesis is that aggregate demand, especially investment, has collapsed.

The heart of Summer's stagnation thesis is that aggregate demand, especially investment, has collapsed. A host of reasons may explain the investment decline: (1) increased risk aversion following the near-financial collapse and the remaining large debt overhang; (2) fears of deflation that may raise real interest rates; (3) secular slowdowns in labor force growth and labor productivity; and (4) concerns about ill-timed overly-aggressive fiscal consolidation reducing GDP growth too much to free "animal spirits."

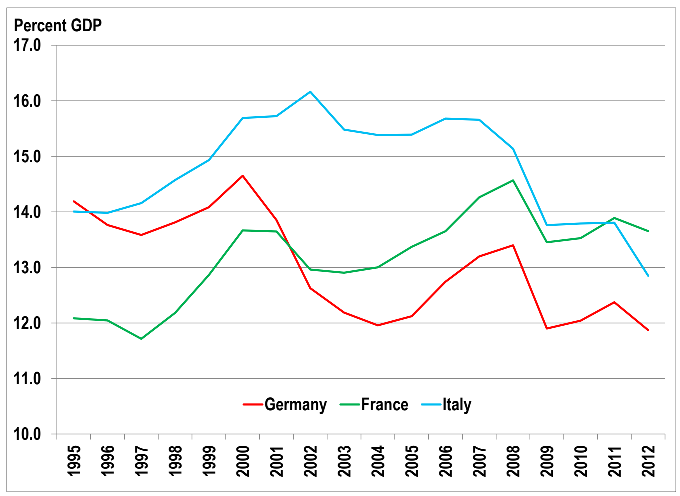
The main task in assessing these explanations for the stagnation involves finding the (exogenous) source of the investment shock. The main hypothesis here is that policy uncertainty may be a prominent shock of this sort. So the following sections first describe the extent of the investment decline. After assessing the role of policy uncertainty as an important exogenous shock, an investment model is then estimated to quantitatively gauge the extent to which changes in measured policy uncertainty can explain the size and timing of the investment decline.

Figure 3. US and EA Non-Residential Fixed Investment Shares Decline



Source: Haver and Citi Research

Figure 4. National Non-Residential Fixed Investment Shares Vary



Source: Haver and Citi Research

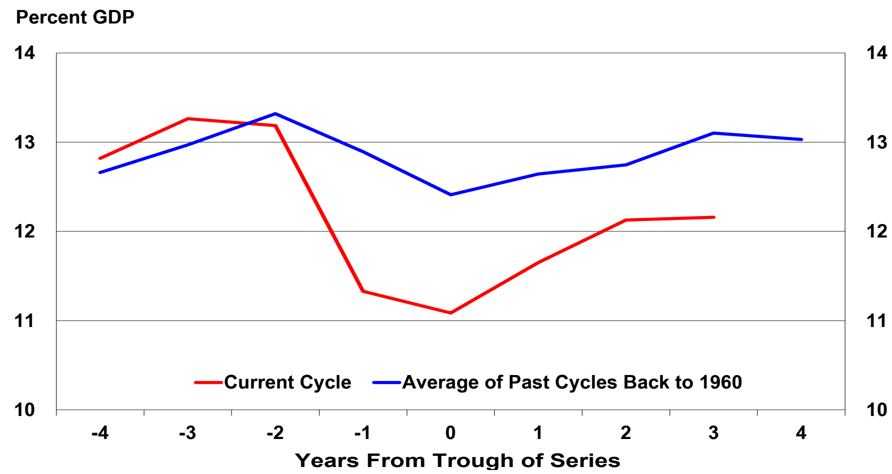
The US and Euro Area investment-GDP ratio declined sharply following the 2008 crisis.

Gauging the Investment Decline

While investment is expected grow at the same pace as GDP in equilibrium, the data show that investment has actually grown substantially slower than GDP for some time since the 1980s.[10] However, the drop in the investment-GDP ratio accelerated sharply following the 2008 crisis. Compared with its 1995-2007 average value of 13 percent of GDP, the US investment share averaged 1.1 percentage points lower in the 2008-2012 period (Figure 3). In the Euro Area, the investment share decline was less severe (0.7 percentage points), and averaged 13.9 percent in the post-crisis period. This more moderate drop in the Euro Area aggregate was in part caused by the rise in France's investment share (0.9 percentage points), which partly offset the substantial declines in Germany and Italy (e.g., 0.9 and 1.3 percentage points, respectively) (Figure 4).

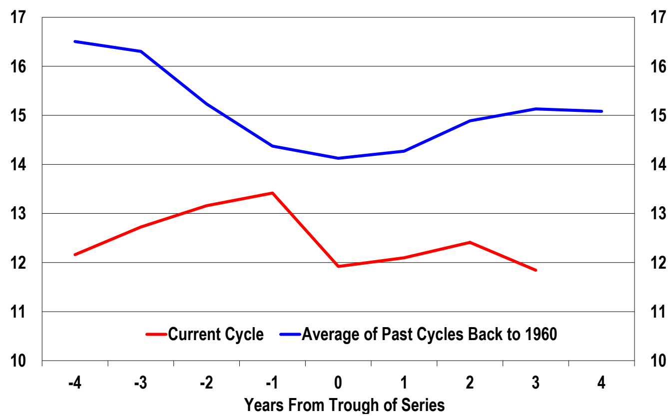
[10] This may reflect the impact of technological progress that reduced the (physical) capital-intensiveness of production in favor of human capital. Throughout this note, investment refers to non-residential fixed investment.

Figure 5. US Non-Residential Fixed Investment Recovery Lags Previous Cycles



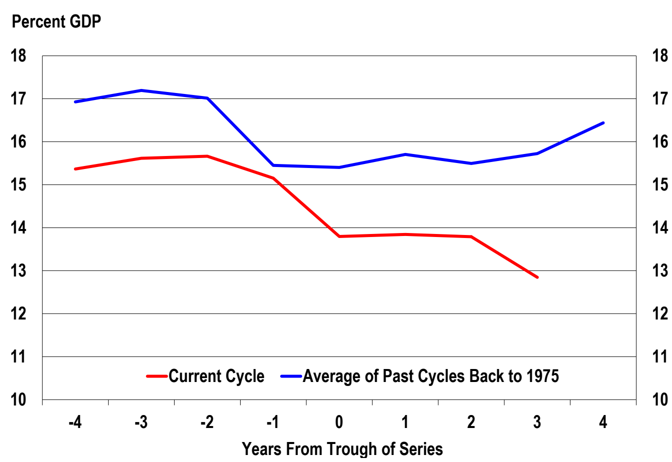
Source: Haver, Citi Research

Figure 6. Germany: Non-Residential Investment Cycle



Source: Haver, Citi Research

Figure 7. Italy: Non-Residential Fixed Investment Cycle



Source: Haver Citi Research

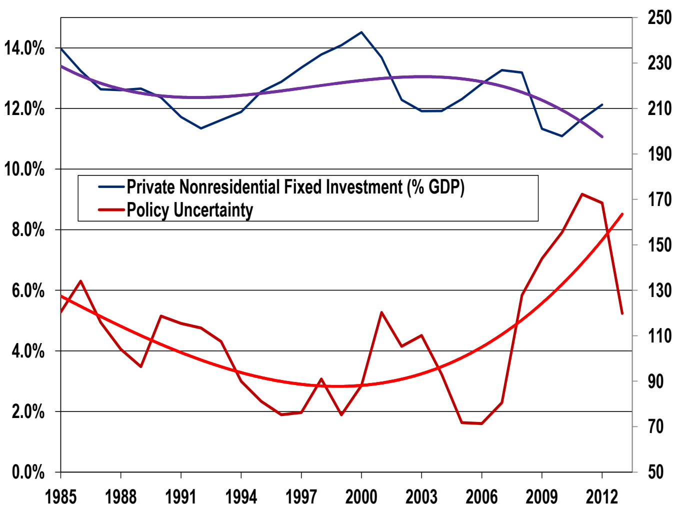
The severity of the investment share decline after the crisis is especially clear when this period is compared with earlier cycles. The US investment share at its trough in 2009 was 1.3 percentage points of GDP lower than at a similar trough during earlier cycles (Figure 5). In the Germany and Italy, the investment share fell substantially below earlier cycles for the entire cycle (Figures 6 and 7). Although GDP declined sharply following the financial crisis, it is unlikely this factor alone can explain the sharp drop in investment.

Uncertainty Accounts for the Sharp Investment Decline

The inverse relationship between investment and uncertainty is evident in the US and German data.

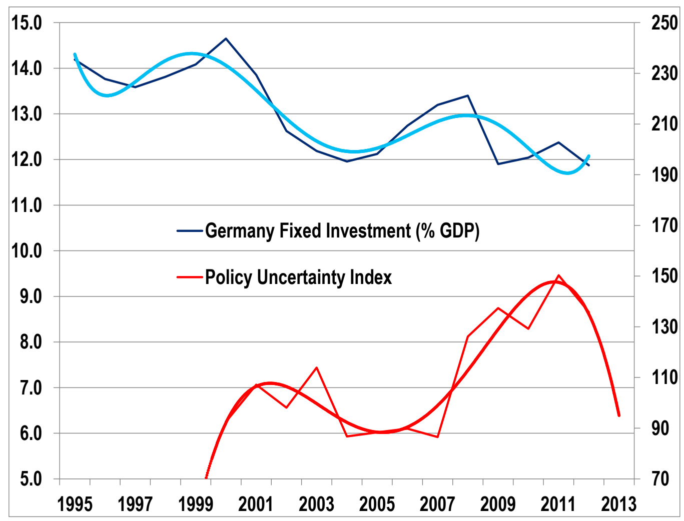
The intuitively appealing inverse relationship between investment and uncertainty is clearly evident in the US and German data (Figures 8 and 9). Moreover, statistical tests confirm that increases in the uncertainty index precede declines in the investment share in the United States as well as for some Euro Area countries including Germany.[11] This result rules out the possibility that the changes in the uncertainty index are measuring overly pessimistic or optimistic investment behavior (i.e., reverse causality).

Figure 8. US Uncertainty Negatively Correlated with Investment Share



Source: Economic Policy Uncertainty website of Scott Baker, Nicolas Bloom, and Steven Davis http://www.policyuncertainty.com/index.html and Citi Research

Figure 9. German Uncertainty Negatively Correlated with Investment



Source: Economic Policy Uncertainty website of Scott Baker, Nicolas Bloom, and Steven Davis http://www.policyuncertainty.com/index.html and Citi Research

Econometric estimates confirm that along with GDP growth and the real interest rate, the policy uncertainty index is also a significant influence on investment.

To assess fully the relative importance of uncertainty compared with economic fundamentals such as GDP growth and the real interest rate, a model for investment was estimated.[12] The coefficient estimates confirm that GDP growth and the real interest rate are statistically significant influences on the investment share. More importantly, the EPU index is also significant.

[11] Granger causality tests confirms this time-sequencing of events for the United States and Germany at the 1 and 5 percent significance levels, respectively. The statistical linkage was weaker at the aggregate Euro Area level, in part because of weak statistical connections for France and Italy.

[12] The annex details the model specification and econometric estimates of the coefficients. Estimates with investment in equipment alone (excluding non-residential structures) yielded similar results for the negative impact of uncertainty, although the real interest rate was a smaller influence on investment.

Figure 10. Post-Crisis Uncertainty Impact on Investment-GDP Ratio (I/Y) (Percentage Points)

	United States	Germany
Changes to Investment Share (2007-2012)		
Actual change in I/Y	-1.1	-1.3
Uncertainty impact on I/Y	-0.6	-0.5
Required changes to offset uncertainty impact on I/Y		
Change in real interest rate	-6.6	—
Change in credit growth	—	8.2
Increase in nominal GDP growth	4.2	4.6

Source: Citi Research

Simulations imply that during the four-year period from 2007 to 2012, the rise in uncertainty accounted for 57 and 36 percent of the investment share decline in the United States and Germany, respectively.

Simulations of the model imply that during the five-year period from 2007 to 2012, the rise in uncertainty accounted for 57 and 36 percent of the investment share decline in the United States and Germany, respectively (Figure 10).[13] While this decline may seem like a small drag on GDP growth, it is equal to 5 and 3 percent reductions in US and German investment, respectively. If continued, such reductions can lower labor productivity, income, and technological innovation (insofar as technological progress is embodied in new capital equipment).

Offsetting the very costly impact of uncertainty on investment would require large reductions in real interest rates and/or considerable increases in GDP growth.

Offsetting the very costly impact of uncertainty on investment would require large reductions in real interest rates and/or considerable increases in GDP growth. To restore the investment share to 2007 levels, US real interest rates would have to decline by over 6 percentage points, or (nominal) GDP growth must rise by over 4 percentage points. For Germany, whose economy is very dependent on credit flows to finance investment, offsetting the impact of uncertainty would require that non-financial credit growth rises by over 8 percentage points, or that GDP growth rises more than 4½ percentage points. Such out-sized changes in real interest rates and GDP growth highlight the damage caused by policy uncertainty since the crisis.[14]

Conclusions

Substantial evidence suggests that investment has been weak because of uncertainty stemming from the dizzying array of unusually active policy measures implemented since the crisis.

Since 2008, muted investment along with a tepid recovery has spawned proposals for more activist and demand-bolstering policies. Unfortunately, substantial evidence suggests that investment has been weak because of the dizzying array of unusually active policy measures implemented in the United States, and the anxiety-provoking anticipation of reform measures in Europe since the crisis. With growing uncertainty about the outcome of these unprecedented policy changes, investment plans were delayed or canceled, and aggregate demand faltered. Indeed, it is time to amend the old maxim that “the path to Hell is lined with good intentions and unintended consequences.”

The evidence implies that doing less and being more predictable may be the best remedy to ease headwinds restraining investment.

The evidence presented here implies that doing less, or at least being more predictable and credible in what is to be done, may be the best remedy to ease the headwinds restraining investment. Otherwise, sizable changes in interest rates, inflation, and GDP growth will be required to offset the uncertainty-related headwinds generated by the otherwise well-intentioned policy initiatives.

[13] In other words, (-0.6/-1.1) and (-0.5/-1.3)—from the first two lines of the table.

[14] To be sure, with the size and scope of the 2008 financial shock, movements in the EPU index may also proxy broader sources of uncertainty that may be restraining investment. Nevertheless, statistical inferences using this series suggest policy uncertainty was (and perhaps remains) a significant and fundamental source of the headwinds restraining investment.

Annex—Econometric Model for Investment

This model uses a modified accelerator specification where investment is assumed to be a function of (the change) in GDP growth, the real rate of interest, and a proxy for (exogenous) technological progress (time trend). Uncertainty is assumed to be an exogenous influence on investment. The real interest rate (computed as the 10-year government bond yield less the CPI inflation rate) proxies for a more complicated expression for the after-tax cost of capital. For convenience, and technical statistical reasons, investment is specified as a ratio to GDP.

The following estimates use annual data from 2000 to 2012. Standard errors for the coefficients are reported in parentheses below each coefficient.

US Specification:

$$\underset{}{INV_t} = \underset{(0.001)}{0.007\Theta} \underset{(0.046)}{-0.098RATE} + \underset{(0.061)}{0.156GDP} + \underset{(0.067)}{0.190GDP(-1)} + \underset{(0.055)}{0.099GDP(-2)}$$

$$\underset{(0.436)}{-0.876UNCERTAINTY(-1)_t}$$

Adjusted R^2 = 0.95
Standard Error of Regression = 0.23
DW Statistic = 1.51

Where:

INV is nominal private non-residential fixed investment (expressed as a percentage of nominal GDP),
Ө is a time trend,
RATE is the real interest rate,
GDP is the annual percentage change in nominal GDP, and
UNCERTAINTY is the natural log of the US economic policy uncertainty index.
Lagged variables are indicated as negative integers in parentheses. A second order serial correlation correction was used.

European Specification:

Recognizing the importance of bank lending to finance investment in Europe, the growth in non-financial credit is used in place of the real interest rate.

$$INV_{it} = \underset{(0.004)}{0.009\Theta_t} \underset{(3.709)}{-4.148\Phi_i} + \underset{(0.012)}{0.059NFCCREDIT_{it}} + \underset{(0.011)}{0.060NFCCREDIT(-1)_{it}} +$$

$$\underset{(0.018)}{0.104GDP_{it}} \underset{(0.450)}{-1.069DEUNCERTAINTY_{it}} \underset{(0.445)}{-0.213DEUNCERTAINTY(-1)_{it}} +$$

$$\underset{(0.257)}{0.435FRUNCERTAINTY_{it}} + \underset{(0.192)}{0.292FRUNCERTAINTY(-1)_{it}} +$$

$$\underset{(0.372)}{0.642ITUNCERTAINTY_{it}} \underset{(0.289)}{-0.822ITUNCERTAINTY(-1)_{it}}$$

Adjusted R^2 = 0.98
Standard Error of Regression = 0.19
DW Statistic = 1.87

Where:

INV is nominal non-housing fixed investment (expressed as a percentage of nominal GDP),
Ө is a time trend,

Φ is a country dummy variable,
NFCCREDIT is the annual percentage change in credit extended to non-financial corporations,
GDP is the annual percentage change in nominal GDP,
DEUNCERTAINTY is the natural log of the German economic policy uncertainty index,
FRUNCERTAINTY is the natural log of the French economic policy uncertainty index, and
ITUNCERTAINTY is the natural log of the Italian economic policy uncertainty index.

Lagged variables are indicated as negative integers in parentheses. A first-order serial correlation correction was estimated.

Appendix A-1

Analyst Certification

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