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Maxime Leboeuf[1] and Bob Fay[2]

[1]Financial Markets Department
[2]International Economic Analysis Department
Bank of Canada
Ottawa, Ontario, Canada K1A 0G9
mleboeuf@bankofcanada.ca
bfay@bankofcanada.ca

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Abstract

The recovery in private business investment globally remains extremely weak more than seven years after the financial crisis. This paper contributes to the ongoing policy debate on the factors behind this weakness by analyzing the role of growth prospects and uncertainty in explaining developments in non-residential private business investment in large advanced economies since the crisis. Augmenting the traditional models of investment with measures of growth expectations for output and uncertainty about global demand improves considerably the ability to explain investment growth. Our results suggest that the main driver behind the weakness in global investment in recent years is primarily a pessimistic outlook on the part of firms regarding the strength of future demand. Lower levels of uncertainty have supported investment growth modestly over 2013–14. Similarly, diminishing credit constraints, lower borrowing costs and relatively stronger corporate profits have also supported the recovery in business investment from 2010 onward. Our findings have two important implications for the global outlook for investment. First, the expected improvements in global growth should support a recovery in investment; however, a slowdown in growth in emerging-market economies or further growth disappointment in advanced economies could restrain this recovery. Second, the ongoing recovery in investment remains vulnerable to uncertainty shocks.

JEL classification: C23, C33, D24, E22, D80, D84, F01, G31
Bank classification: Business fluctuations and cycles; Central bank research; Domestic demand and components; Economic models; International topics; Recent economic and financial developments; Uncertainty and monetary policy

Résumé

La reprise de l'investissement des entreprises privées à l'échelle mondiale reste anémique plus de sept ans après la crise financière. Notre étude contribue au débat actuel sur les causes de cette faiblesse en explorant le rôle des perspectives de croissance et de l'incertitude comme facteurs explicatifs de l'évolution de l'investissement privé non résidentiel dans les grandes économies avancées depuis la crise. L'intégration à des modèles d'investissement traditionnels de mesures des prévisions de croissance de la production et de l'incertitude entourant la demande mondiale accroît considérablement la capacité de ces modèles à expliquer la dynamique de la croissance de l'investissement. Nos résultats montrent que le pessimisme des entreprises quant à la vigueur de la demande future est en grande partie responsable de l'atonie générale de l'investissement. Un recul de l'incertitude a favorisé un léger redressement de l'investissement durant la période 2013-2014. De la même façon, l'assouplissement des conditions du crédit, la

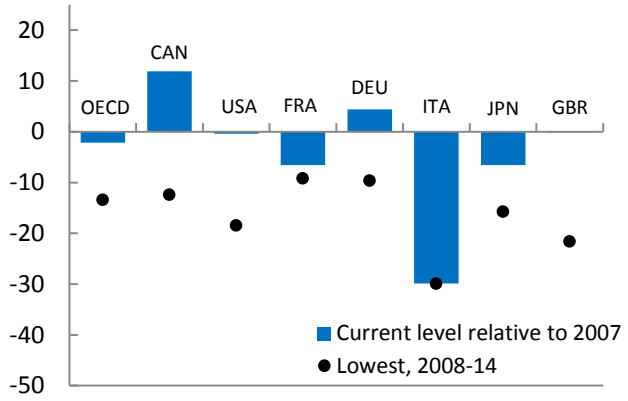
réduction des coûts d'emprunt et la croissance relativement plus forte des bénéfices ont facilité son redémarrage à compter de 2010. Deux conclusions importantes pour les perspectives mondiales d'investissement ressortent de nos résultats. Premièrement, le raffermissement anticipé de la croissance mondiale devrait contribuer à la reprise de l'investissement. Une décélération de l'activité dans les économies émergentes ou une croissance qui décevrait à nouveau les attentes dans les économies avancées pourrait cependant la limiter. Deuxièmement, le redressement en cours de l'investissement reste vulnérable à des chocs d'incertitude.

Classification JEL : C23, C33, D24, E22, D80, D84, F01, G31
Classification de la Banque : Cycles et fluctuations économiques; Recherches menées par les banques centrales; Demande intérieure et composantes; Modèles économiques; Questions internationales; Évolution économique et financière récente; Incertitude et politique monétaire

1 Recent Developments in Private Business Investment

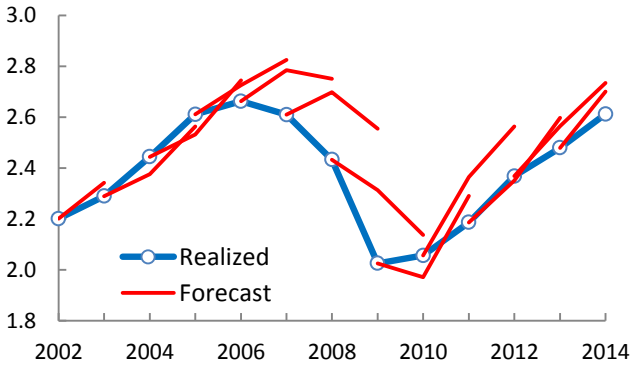
The global financial crisis resulted in a broad-based collapse of business investment, with the level of investment falling well over 10 per cent in most member countries of the Organisation for Economic Co-operation and Development (OECD). An uneven recovery followed, led by oil-exporting regions, which benefited from a rebound in energy prices (**Chart 1**). The post-crisis recovery in business investment has been underwhelming. Annual investment growth in OECD countries averaged a mere 2.2 per cent between 2010 and 2014, compared to around 3.5 per cent in the decade leading up to the financial crisis. The bulk of this weakness was unexpected, and has resulted in investment consistently underperforming relative to forecasts of both public and private forecasters (**Chart 2**). Over the past few years, several institutions, including the OECD, the International Monetary Fund (IMF), the Bank for International Settlements and the Banque de France, have investigated this "investment puzzle" to identify some of the factors that standard models might fail to capture. This paper builds on the work of these institutions, and contributes to the ongoing debate by investigating the role of both domestic and foreign growth prospects in driving private non-residential business investment, and comparing various proxies for uncertainty.

Chart 1: Private investment in most OECD countries remains below its pre-crisis level
Level of investment relative to 2007, per cent



Source: OECD Last observation: 2014Q4

Chart 2: U.S. private investment has serially disappointed since 2008
Forecasts for real private fixed-investment growth



Source: IMF (U.S. Article IV, annual) Last observation: 2014

2 Regression Models of Private Business Investment

2.1 The standard accelerator model of investment

Our starting point for the analysis of the drivers of business investment is the standard accelerator model, in which changes in the level of capital can be explained by changes in the level of output. Accordingly, investment growth is regressed on lags of real GDP growth:[1]

[1] As noted in Banerjee et al. (2015), in the presence of potential structural changes and large disparity across countries, growth rates are likely more robust than levels, since they avoid potentially inappropriate restrictions. This is particularly relevant in the

$$\Delta\log(I_{i,t}) = \alpha_i + \beta_1\Delta\log(Y_{i,t-1}) + \beta_2\Delta\log(Y_{i,t-2}) + \varepsilon_{i,t}, \quad (1)$$

where $\Delta\log(I_{i,t})$ represents the quarter-over-quarter change in the log of real private non-residential business investment, $\Delta\log(Y_{i,t})$ is the change in the log of real GDP (excluding investment), i is the country dimension (5 in our study) and t represents the time subscript (in quarters). α_i is a country fixed-effect. Our measure of investment aims to abstract from the impact of the various housing crises and the potential countercyclical response of government investment.[2]

2.2 The financial-variable augmented model of investment

In a second step, we augment the accelerator model with explanatory variables based on similar studies on the determinants of private business investment (see Barkbu et al. 2015; Banerjee et al. 2015; Lewis et al. 2014; Bussière et al. 2015).[3] One important variable is the real user cost of capital, which corresponds to the minimum return that a firm needs to cover depreciation, taxes and the opportunity costs of the funds used to finance the project. Lower user costs typically translate into higher investment levels. Corporate profits are also often mentioned in the literature, since they aim to capture the availability of internal funds as well as balance sheet effects. Finally, credit conditions behind the supply of credit from financial institutions can affect investment outcomes. The unprecedented tightening of credit conditions during the global financial crisis and the European debt crisis highlighted the key role of credit supply in channelling investment. The financial-variable augmented model of investment takes the following form:

$$\begin{aligned}\Delta\log(I_{i,t}) = \alpha_i + \beta_1\Delta\log(Y_{i,t-1}) + \beta_2\Delta\log(Y_{i,t-2}) + \beta_3(RR10_{i,t-1}) + \\ \beta_4\,\Delta\log(\Pi_{i,t}) + \beta_5 CC_{i,t-1} + \varepsilon_{i,t},\end{aligned} \quad (2)$$

where $RR10_{i,t}$ is the real 10-year government bond yield and acts as a proxy of the real user cost of capital,[4] $\Pi_{i,t}$ is a measure of real corporate profits, and $CC_{i,t}$ represents credit conditions. We use the net tightening of credit standards available from national bank lending surveys (also known as senior loan officer surveys) as a proxy for credit availability, since the

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context of this study, given that our sample is relatively short and includes the global financial crisis. We exclude a lagged dependent variable to focus on the main determinants. Note that the results are broadly unchanged by the inclusion of a lagged dependent variable, both in terms of the size of coefficients and standard errors.

[2] Since one of the main objectives of this paper is to identify global and persistent shocks that affected business investment in recent years, we did not include time fixed-effects dummy variables. The multicollinearity between these global shocks and time dummies prevents a proper identification.

[3] A full description of the variables, sources and transformations is provided in Table A1 in the Appendix.

[4] We acknowledge that there are several other ways to measure the user cost of capital. We opted for a relatively simple and commonly used measure (e.g., Lewis et al. 2014).

commonly used credit growth endogenously depends at least to some extent on investment intentions.

2.3 The role of growth expectations and uncertainty in investment decisions

In addition, we extend the financial-variable augmented standard accelerator model of business investment in two dimensions. First, in order to take into account the forward-looking nature of the firm's decision to invest, we investigate the role of domestic and foreign growth expectations in driving business investment decisions. The addition of this variable reflects the fact that business investment spending usually takes time to be completed and to translate into actual profits. Consequently, expected future demand growth is an important consideration for the firm to give the go-ahead to invest.

Second, despite being forward looking in their investment intentions, business owners also face uncertainty surrounding these expectations. A period of high uncertainty could cause business leaders to delay or cancel investment projects. Accordingly, we have considered a wide range of uncertainty measures, from financial market variables to news-based indices, and measures based on stochastic volatility models (see the Appendix).

2.3.1 Growth expectations

More specifically, to compute foreign growth expectations, forecasts from Consensus Economics of real GDP growth are gathered for 29 countries. Each country's foreign outlook variable is calculated by taking the export-weighted average of its main trading partners' real GDP growth forecasts for the upcoming year:

$$FO_{i,t} = \sum_{\substack{j=1 \\ j \neq i}}^{29} \frac{x_{ij,t}}{\sum_j x_{ij,t}} * \Delta \log\left(Y_{jt}^{*}\right), \tag{3}$$

where $x_{ij,t}/\sum_j x_{ij,t}$ is the share of aggregate exports of country i going to country j in quarter t, and $\Delta \log\left(Y_{i,t}^{*}\right)$ represents the Consensus Economics forecasts of foreign real GDP. Quarterly values are derived from the survey conducted in the last month of each quarter.[5] For example, foreign growth prospects for 2015Q1 are computed as the export-weighted annual GDP growth forecast for the calendar year 2016, taken from the March 2015 survey. Similarly, values for

[5] In the main regression (4), we use the lagged value of $FO_{i,t}$ to take into account the time lag between the moment a business leader makes an investment decision based on the foreign growth prospects and the moment the investment materializes. Also, the contemporaneous values are likely to suffer from endogeneity, since growth forecasts from consensus at time *t* could reflect the performance of investment at time *t*. Note that the second lag was not statistically significant.

15Q2, 15Q3 and 15Q4 represent the average 2016 growth forecasts of the country's main trading partners, taken from the June, September and December surveys, respectively.[6]

We also consider the role of domestic growth prospects, proxied using each country's domestic GDP growth forecast from Consensus Economics. Due to trade and financial linkages, the domestic and the foreign outlook variables are strongly correlated.

2.3.2 Uncertainty

While uncertainty is often cited as one of the main factors holding back business investment in recent years, little empirical work has been done to compare the impact of various commonly used proxies of uncertainty on investment decisions.[7]

We first consider uncertainty measures derived from financial markets, including variables such as VIX indexes, stock price volatility and financial market stress indices from the Federal Reserve Bank of Cleveland and the Federal Reserve Bank of St. Louis.[8] While financial variables have the advantage of being very timely, easily accessible and generally well understood by market participants, they are likely to respond endogenously to changes in real activity variables or policy changes, biasing our interpretation of uncertainty shocks.[9] Moreover, aggressive countercyclical actions by central banks since the global financial crisis have boosted equity and bond prices, and dampened volatility, likely leading to a structural break in the relationship of these variables with investment growth.

We also consider various non-financial market uncertainty measures: specifically, the widely used Economic Policy Uncertainty Index (Baker et al. 2015), and a measure of cross-sectional dispersion in the Consensus Economics forecasts. While the latter is unlikely to be affected meaningfully by central bank actions and endogeneity issues, it assumes that high uncertainty leads to uncertain economic outcomes and large forecast dispersion, although this could reflect heterogeneous but not uncertain beliefs. There could also be herding in uncertain times.[10]

More recently, several studies have estimated macroeconomic uncertainty using stochastic volatility models.[11] We consider the Jurado et al. (2015) and Jo and Sekkel (forthcoming) measures of macroeconomic uncertainty. By focusing on the volatility in the unforecastable

[6] To account for the fact that the forecast horizon changes from the first quarter to the last quarter of the year (i.e., the 2016 annual growth forecast for all of the quarters in 2015 in the example above), we tried a fixed-horizon forecast of one year using the methodology proposed by Dovern et al. (2009). While our results are robust to the use of this measure, it was found to be inferior in terms of R-squared, coefficient size and overall fit.

[7] In an attempt to capture global movements in macroeconomic uncertainty and due to limited data availability, for most uncertainty variables, we take the first principal component of the countries available. See Table A1 in the Appendix for a detailed description of the uncertainty variables.

[8] We also tried U.S. TED spreads. Results are not reported, since they were similar to those of the stress index from the Federal Reserve Bank of Cleveland and the Federal Reserve Bank of St. Louis.

[9] Note that it is true for all measures of uncertainty, but the endogeneity issue is likely to be worst for financial variables.

[10] See Jo and Sekkel (forthcoming) for a more extensive discussion of uncertainty measures.

[11] See Scotti (2013), Aruoba et al. (2009), Jurado et al. (2015) and Jo and Sekkel (forthcoming).

component of a large number of economic indicators, these measures may be less likely to suffer from endogeneity issues.[12] One drawback of these variables is that they focus solely on the United States, although this is mitigated by the importance of the United States in the global economy and the global nature of most uncertainty shocks. Relative to popular uncertainty proxies, they point to less frequent, larger and more persistent uncertainty shocks.

Lastly, we combine uncertainty measures into two separate groups – financial and non-financial – using principal components.

Our chosen measure of macroeconomic uncertainty is a common factor simultaneously affecting the size of unpredictable changes in four U.S. indicators, estimated using a factor stochastic volatility model. The sensitivity of our results to various measures of uncertainty is explored in section 4.

In light of this discussion, we augment model (2) as follows:

$$\begin{aligned}\Delta\log(I_{i,t}) = \ & \alpha_i + \beta_1\Delta\log(Y_{i,t-1}) + \beta_2\Delta\log(Y_{i,t-2}) + \beta_3(RR10_{i,t-1}) + \\ & \beta_4\Delta\log(\Pi_{i,t}) + \beta_5 CC_{i,t-1} + \beta_6 FO_{i,t-1} + \beta_7 U_{i,t-1} + \varepsilon_{i,t},\end{aligned} \tag{4}$$

where $FO_{i,t}$ is a country's foreign outlook and $U_{i,t}$ is a measure of uncertainty.

3 What Is Responsible for the Weakness in Business Investment?

There is currently no consensus on whether the weakness in business investment in the post-crisis period is in line with what is suggested by business investment fundamentals. Barkbu et al. (2015) and Lewis et al. (2014) find evidence of underinvestment, but conclude that uncertainty explains a large portion of this weakness. By contrast, using a novel approach based on instrumental variables that examines the historical relationship between investment and output, the April 2015 IMF *World Economic Outlook* finds no evidence of underinvestment given the weakness in economic activity. More recently, using a panel of 22 advanced economies and annual data on investment, IMF forecasts and stock price volatility, Bussière et al. (2015) find that expected future demand and uncertainty play a key role in driving business investment decisions.

We attempt to shed light on these issues by estimating three versions of the model presented in section 2. We use a panel of five countries (G7 minus Italy and the United Kingdom[13]),

[12] We are grateful to Jurado et al. (2015) and Jo and Sekkel (forthcoming) for kindly providing us with their updated uncertainty series.

[13] Italy is excluded because data do not allow for a split of business investment and residential investment. Data for the United Kingdom are highly volatile.

estimated on quarterly data from 2003Q2 to 2014Q4 using Driscoll and Kraay (1998) standard errors, which are robust to heteroskedasticity and cross-sectional correlation in country fixed-effects regressions.[14,15]

The estimation results are presented in **Table 1**. Results for the standard accelerator model are shown in column (1) and those for the financial-variable augmented model in column (2); our preferred specification with foreign outlook and uncertainty is detailed in column (3). Our main results are as follows:[16]

- In our preferred specification, all coefficients have the expected sign. Specifically, we find a positive relationship between investment growth and lagged output growth, profits, and expected foreign demand growth, while a tightening of credit standards, a rise in the cost of capital and heightened uncertainty are associated with a fall in investment.
- All variables are statistically significant at the 10 per cent level of significance, except for the cost of capital variable.[17]
- The foreign outlook variable is also statistically significant, pointing to the importance of growth expectations in the investment decision. When both the domestic and foreign variables are included in the regression model (Table 1, regression (5)), the domestic outlook variable becomes insignificant, and its coefficient is less than half of that of the foreign outlook variable.

[14] Specifically, our panel includes the United States, Canada, Germany, France and Japan. The relatively small size of our panel mainly reflects data limitation with respect to the credit supply variable and our measure of investment, which is fairly narrow. However, we believe that our sample is fairly representative of the behaviour of investment in advanced economies, since it includes large and diverse economies and is not disproportionally weighted toward European countries.

[15] A Hausman-type test robust to heteroskedasticity and cross-sectional correlation indicated the presence of country fixed-effects. See Hoechle (2007) for details on the Hausman test and panel regression estimation with Driscoll and Kraay standard errors.

[16] In most cases, both the contemporaneous value and first lag of each variable were found to be statistically significant when included in separate regressions, but insignificant when included in the same regression. As a rule of thumb, we favoured lagged values of the explanatory variables to reflect the usual time lags and delays associated with investment decisions, and to limit potential endogeneity associated with contemporaneous values of explanatory variables. Note that results presented in the paper are robust to alternative lag specifications.

[17] Weak relationships between financial variables and investment growth are not uncommon for similar models.

Table 1: Estimation results for models of non-residential private business investment growth

Panel estimation, 2003Q2–2014Q4

Dependent variable: *Investment growth*	Accelerator	Accelerator + Financial	Accelerator + Financial + Growth outlook + Uncertainty		
	(1)	(2)	**(3)**	(4)	(5)
Real GDP growth (*t*-1)	-0.101	0.021	**0.215***	0.194*	0.209*
	(0.51)	(0.79)	**(0.07)**	(0.07)	(0.06)
Real GDP growth (*t*-2)	-0.169	-0.095	**0.055**	0.044	0.050
	(0.14)	(0.24)	**(0.54)**	(0.66)	(0.58)
Real user cost of capital (*t*-1)		-0.001	**-0.002**	-0.002	-0.002
		(0.40)	**(0.18)**	(0.25)	(0.18)
Profit growth (*t*)		0.078**	**0.062*****	0.059***	0.060***
		(0.03)	**(0.01)**	(0.01)	(0.01)
Credit conditions (*t*-1)		-0.001*	**-0.000***	-0.000	-0.000*
		(0.05)	**(0.09)**	(0.11)	(0.09)
Foreign outlook (*t*-1)			**0.016****		0.012**
			(0.01)		(0.03)
Domestic outlook (*t*-1)				0.012**	0.005
				(0.04)	(0.19)
Uncertainty (*t*-1)			**-0.007****	-0.009**	-0.007**
			(0.03)	(0.02)	(0.04)
Constant	0.006	0.006	**0.005****	0.005*	0.005**
	(0.22)	(0.14)	**(0.04)**	(0.06)	(0.04)
R^2 adjusted	-0.01	0.25	**0.49**	0.47	0.50
Number of observations	240	235	**235**	235	235
Number of countries	5	5	**5**	5	5

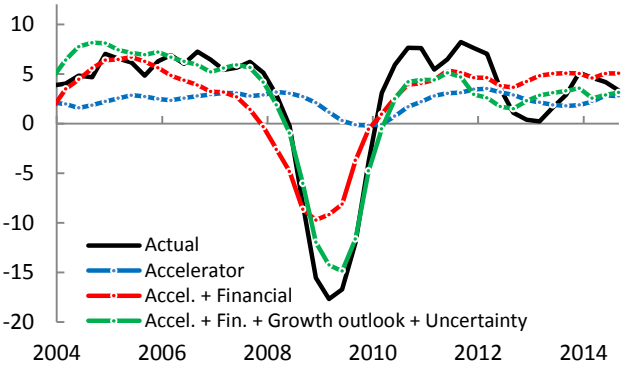
Note: p-values are in parentheses, * p<0.10, ** p<0.05, *** p<0.01.

Chart 3 shows the predicted growth rate of investment, aggregated across the five countries in our panel using an investment-weighted average.[18] **Chart 4** shows the level obtained by cumulating the quarterly growth rates predicted by each model from 2007Q4 onward. **Chart 5** shows the contribution of the main variables to investment growth since 2004.

[18] Although the model's input is expressed as quarter-over-quarter, the figures are presented in year-over-year terms to abstract from the quarterly volatility inherent in private business investment data.

Chart 3: When controlling for uncertainty and expected foreign output growth, the recent weakness in investment is relatively well captured

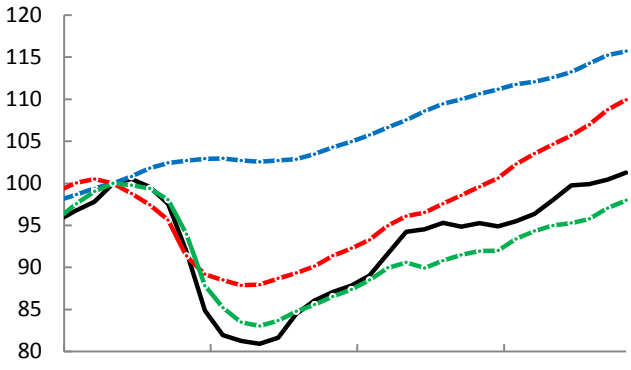
Year-over-year investment growth, weighted average across countries, per cent



Source: Authors' calculations Last observation: 2014Q4

Chart 4: Based on our model, there is little evidence of unexplained weakness in the level of investment since 2007

Cumulative change in investment since 2007Q4, 2007Q4=100



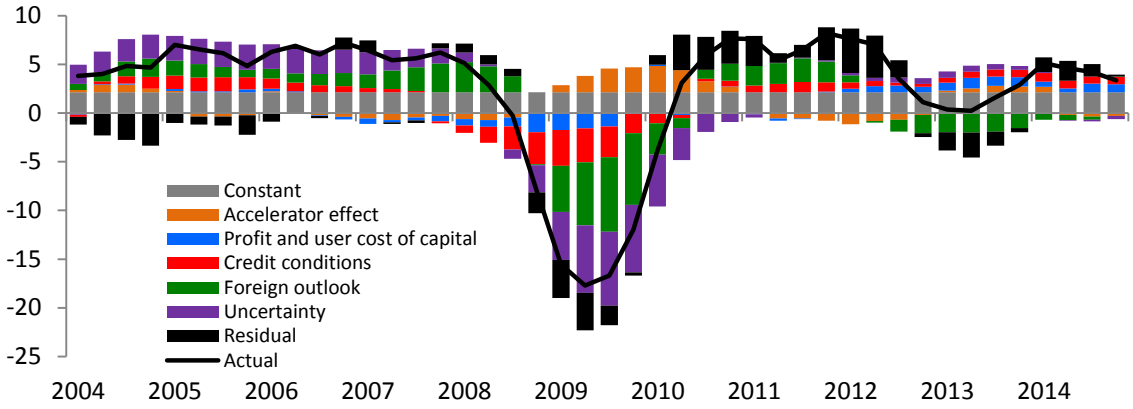
In summary:

- Before the global financial crisis, ample availability of credit, low levels of uncertainty and strong expected future demand supported investment growth.
- The collapse in investment over 2008–09 was primarily driven by a large uncertainty shock and a collapse in expected foreign demand growth, but was also due to a restricted credit supply, falling profits and a high real user cost of capital.
    - The sharp rise in uncertainty reduced the level of investment by almost 10 per cent over 2008–09.
    - The deterioration in the foreign growth outlook subtracted roughly 8.5 percentage points from the level of investment over 2008–09. When both foreign and domestic growth prospects are included in the same regression, they respectively subtracted about 6.4 and 3.8 percentage points over that period.
- The European debt crisis appears to have dampened investment primarily through weaker expected foreign output growth.
- The weakness in investment over the past two years relative to the pre-crisis period mainly reflects lower expectations of foreign output growth, and, to a lesser extent, a higher level of uncertainty.
- Overall, we find little evidence of unexplained weakness in investment since 2007, with our forecast cumulative level broadly in line with the observed data.[19]

[19] This result is robust to an out-of-sample exercise, for which the model is estimated from 2003Q2 to 2010Q4 and fitted values beyond 2010 are obtained using the first part of the sample's coefficients.

Chart 5: Weaker expectations of foreign demand and heightened uncertainty explain most of the decline in investment during the financial crisis

Contribution to year-over-year investment growth, weighted average across countries, percentage points



Source: Authors' calculations Last observation: 2014Q4

There is considerable cross-country variance in both the direction and the magnitude of the errors, especially from 2008 onward. Graphs for individual countries are provided in the Appendix (**Charts A1 to A5**). This heterogeneity points to an important role for country- or sector-specific developments, which are difficult to capture in a panel setting. Nevertheless, important insights can be drawn from individual country results, including the following:

- In Canada, the recovery in investment following the collapse in 2011 has been stronger than predicted by our model, which likely reflects the strong rebound in commodity prices over that period that boosted investment in the oil and gas sector. However, over 2013 and 2014, investment growth averaged a mere 0.5 per cent (y/y), much lower than the 3.8 per cent predicted by our model.
- Similarly, in the United States, private investment growth has been stronger than our model's predictions, potentially due to the rapid development of the U.S. shale oil industry over that period.
- In Germany, our model overpredicted investment in the most recent period, reflecting the persistent weakness in German investment despite relatively strong fundamentals. In France, investment dynamics are well captured by our model.
- Our model does not capture well investment dynamics in Japan since 2011. This could reflect various events such as the tsunami in March 2011 (and the reconstruction efforts), the aggressive monetary easing and expansionary fiscal policies that accompanied Abenomics, and the VAT hike in April 2014.

4 How Do Different Measures of Uncertainty Affect Investment?

We estimate separate versions of equation (4) with the uncertainty variables described in section 2.3.2. Uncertainty variables were standardized to facilitate a comparison of the size of

the coefficients. Regression results are reported in **Table A2** in the Appendix. Our findings are as follows:

- Measures of uncertainty based on stochastic volatility models, which are available only for the United States, are very strong predictors of global movements in investment (highest R-squared and coefficients). This could reflect the following:
    - The important role of U.S. uncertainty shocks in influencing global investment decisions.
    - A positive correlation between U.S. and global uncertainty.
    - The fact that the main uncertainty shock in our sample originated from the United States (global financial crisis).
- Traditional financial market-based uncertainty proxies are weak predictors of movement in investment.
    - All variables (*VIX*, *Stress indexes*, *Stock volatility*) have the expected sign. However, only the *Stock volatility* variable is significant.
    - This could be due to the actions of central banks, which had a strong impact on several financial markets (i.e., reducing volatility).
- The Economic Policy Uncertainty Index (Baker et al. 2015), which is often cited as a relevant measure of uncertainty, has the wrong sign and is not statistically significant.[20]
- Forecast dispersion from Consensus Economics and various groups of uncertainty variables (principal component) have the expected sign but are not significant.

Charts 6a and 6b show the contributions of the main uncertainty variables to year-over-year investment growth since 2004 and 2011, respectively:[21]

- Overall, results suggest that low levels of uncertainty supported investment growth before the financial crisis, and that uncertainty was the main factor driving the collapse in business investment during the crisis. During the European crisis, most variables point to a drag from uncertainty, except for the *Jurado* and *Stochastic volatility* measures, which likely reflect the fact that they are focused on the United States.
- Evidence suggests that the low levels of uncertainty over 2014 contributed up to 1.5 percentage points to investment growth. There is little evidence that uncertainty is currently holding investment back.

[20] This is also the case if we apply the U.S. Policy Uncertainty Index to all countries.
[21] Chart A6 in the Appendix shows the contribution to growth of other uncertainty variables.

Chart 6a: Uncertainty was a large drag on investment growth during the financial crisis...

Contribution to year-over-year investment growth, weighted average across countries, percentage points

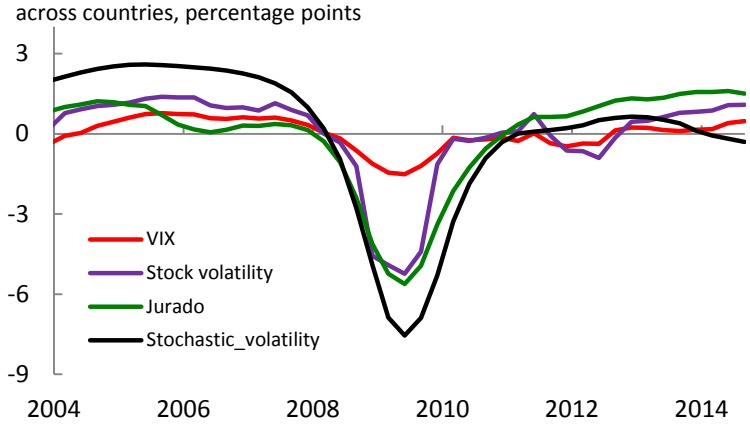
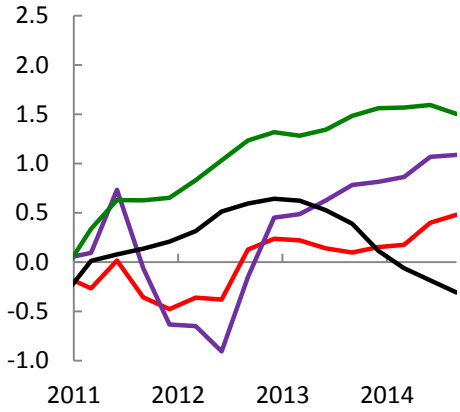


Chart 6b: ...whereas it has supported investment growth over the past two years



Source: Authors' calculations

Last observation: 2014Q4

5 Subcomponents of Investment

In this section, we investigate whether the drivers of aggregate private business investment hold for its components, by applying our preferred specification (Table 1, regression (3)) to four subcomponents.[22] Regression results are presented in **Table 2**. Our findings are as follows:

- Our model explains movements in investment in machinery and equipment (M&E) and transportation relatively well, with adjusted R-squared of 0.48 and 0.24, respectively.[23]
- The foreign outlook and profits positively and significantly affect investment in M&E, transportation and structures. Transportation appears to be more sensitive to developments in foreign demand, as indicated by its higher coefficient.
- Uncertainty primarily affects investment in M&E. It also affects dwellings, which could reflect the housing crisis in the United States or households' higher sensitivity to uncertainty.
- Credit supply is significant for transportation and dwellings.

[22] The subcomponents of investment include both private and public investment.

[23] In the United States, M&E accounts for 58 per cent of the sum of the four subcomponents of investment considered, compared to 21 per cent for transport, 12 per cent for structures and 8 per cent for dwellings.

Table 2: Model for private business investment growth – Subcomponents of investment

Panel estimation, 2003Q2–2014Q4

Dependent variable: *Investment growth*	**Total**	M&E	Transportation	Structures	Dwellings
Real GDP growth (*t*-1)	**0.215***	0.322*	0.361	-0.033	0.231*
	(0.07)	(0.05)	(0.30)	(0.78)	(0.09)
Real GDP growth (*t*-2)	**0.055**	0.188	0.256	0.059	0.153
	(0.54)	(0.24)	(0.39)	(0.51)	(0.36)
Real user cost of capital (*t*-1)	**-0.002**	-0.002	-0.000	-0.002*	0.001
	(0.18)	(0.16)	(0.84)	(0.07)	(0.46)
Profit growth (*t*)	**0.062*****	0.040*	0.199***	0.047**	-0.022
	(0.01)	(0.08)	(0.00)	(0.02)	(0.44)
Credit conditions (*t*-1)	**-0.000***	-0.000	-0.001*	-0.000	-0.000**
	(0.09)	(0.55)	(0.08)	(0.54)	(0.03)
Foreign outlook (*t*-1)	**0.016****	0.022***	0.037*	0.008**	0.001
	(0.01)	(0.01)	(0.08)	(0.04)	(0.87)
Uncertainty (*t*-1)	**-0.007****	-0.012**	0.001	-0.001	-0.007*
	(0.03)	(0.01)	(0.86)	(0.78)	(0.05)
Constant	**0.005****	0.005*	0.005	0.002	-0.002
	(0.04)	(0.09)	(0.42)	(0.24)	(0.56)
R^2 adjusted	**0.49**	0.48	0.24	0.09	0.11
Number of observations	**235**	231	231	235	235
Number of countries	**5**	5	5	5	5

Note: p-values are in parentheses, * p<0.10, ** p<0.05, *** p<0.01.

6 Conclusion

The weakness in global private sector investment has been a puzzle. The analysis in this paper suggests that investment dynamics are relatively well explained when foreign growth prospects and uncertainty are included. Nevertheless, ample room remains for further research. At the individual country level, there are still interesting differences in investment patterns that are not well captured in the panel model. In addition, analysis at the sectoral level suggests that an examination of factors relevant to particular sectors could help shed further light on investment weakness. Finally, there are interesting implications for policy. If investment is relatively well explained by the model presented in this paper, then there is a clear role for policy-makers to take measures that both boost growth and create a more stable economic environment. Nevertheless, periods of relatively greater uncertainty go well beyond what policy-makers can do in advance – but a quick reaction could help to minimize the impact on investment.

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Appendix

Table A1: Variable description and sources

Variable	Description	Source	Transformation*
Investment growth	Real private non-residential gross fixed capital formation	OECD via Haver	Log, FD
Real GDP growth	Real GDP minus real private non-residential gross fixed capital formation	OECD via Haver	Log, FD
Real user cost of capital	10-year government bond yield less annual growth rate of the GDP deflator multiplied by the ratio of the investment deflator to the GDP deflator	Bloomberg; OECD and national sources via Haver	Demeaned
Real profit growth	Corporate profits (gross operating surplus) deflated by GDP deflators	OECD via Haver	Log, FD, Demeaned
Credit conditions	Net tightening of credit standards on business loans from national bank lending surveys	National central banks via Haver	Net percentage balance
Foreign outlook	The trade weighted consensus forecast for next year's real GDP growth of each country's main trading partners. The survey for the last month of the quarter is used as the quarterly value.	Consensus Economics	Demeaned
Domestic outlook	Consensus forecast for next year's real GDP growth for the domestic economy. The survey for the last month of the quarter is used as the quarterly value.	Consensus Economics	Demeaned
VIX	First principal component of VIX indexes for the US, the euro area and Japan	Bloomberg	Standardized
Stock volatility	First principal component of squared standard deviation of MSCI daily share price index in local currency of 24 countries	Bloomberg	Standardized
Stress index	First principal component of the stress indexes from the Federal Reserve Bank of Cleveland and the Federal Reserve Bank of St. Louis	FRB Cleveland via Haver	Standardized
Policy uncertainty	First principal component of news-based Economic Policy Uncertainty Index for the United States, the euro area and the UK (Baker et al. 2015)	Economic Policy Uncertainty via Haver	Standardized
Consensus deviation	First principal component of the standard deviation of the consensus forecast for next year's GDP growth forecast of 29 countries. The survey for the last month of the quarter is used as the quarterly value.	Consensus Economics	Standardized
Jurado	Stochastic volatility of forecast error from a factor model (Jurado et al. 2015)	Authors	Standardized
Stochastic volatility	Volatility of a common factor simultaneously affecting the size of unpredictable changes in 4 US indicators (Jo and Sekkel, forthcoming)	Authors	Standardized
Uncertainty (all)	First principal component of all uncertainty variables		Standardized
Uncertainty (financial)	First principal component of financial uncertainty measures		Standardized
Uncertainty (non-financial)	First principal component of non-financial uncertainty measures		Standardized

*FD stands for *First difference.*

Table A2: Accelerator model for private business investment growth – The role of uncertainty

Panel regression, 2003Q2–2014Q4

Dep: Investment growth	(1)	(2)	(3)	(4)	(5)	(6)	**(7)**	(8)	(9)	(10)
Real GDP growth (*t*-1)	0.159	0.141	0.157	0.161	0.157	0.181*	**0.215***	0.173	0.155	0.192*
	(0.11)	(0.11)	(0.11)	(0.11)	(0.12)	(0.10)	**(0.07)**	(0.10)	(0.11)	(0.09)
Real GDP growth (*t*-2)	0.006	-0.006	0.001	0.003	0.003	0.024	**0.055**	0.019	0.002	0.038
	(0.94)	(0.94)	(0.99)	(0.97)	(0.97)	(0.78)	**(0.54)**	(0.83)	(0.98)	(0.67)
Real user cost of capital (*t*-1)	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	**-0.002**	-0.002	-0.002	-0.002
	(0.18)	(0.23)	(0.19)	(0.20)	(0.17)	(0.26)	**(0.18)**	(0.22)	(0.21)	(0.22)
Profit growth (*t*)	0.065**	0.058*	0.066**	0.066**	0.066**	0.061**	**0.062*****	0.064**	0.063**	0.067**
	(0.04)	(0.06)	(0.03)	(0.04)	(0.04)	(0.02)	**(0.01)**	(0.02)	(0.04)	(0.01)
Credit conditions (*t*-1)	-0.000*	-0.000*	-0.000**	-0.000**	-0.000**	-0.000*	**-0.000***	-0.000*	-0.000*	-0.000*
	(0.05)	(0.07)	(0.05)	(0.03)	(0.03)	(0.10)	**(0.09)**	(0.08)	(0.08)	(0.07)
Foreign outlook (*t*-1)	0.021***	0.016***	0.020***	0.023***	0.022***	0.018***	**0.016****	0.017***	0.019***	0.017***
	(0.00)	(0.01)	(0.00)	(0.00)	(0.01)	(0.00)	**(0.01)**	(0.00)	(0.00)	(0.01)
Constant	0.005**	0.006**	0.005**	0.005**	0.005**	0.005**	**0.005****	0.005**	0.005**	0.005**
	(0.04)	(0.04)	(0.04)	(0.03)	(0.04)	(0.04)	**(0.04)**	(0.04)	(0.04)	(0.04)
Uncertainty measures (*t*-1)	**-0.002**	**-0.006***	**-0.002**	**0.001**	**-0.000**	**-0.005***	**-0.007****	**-0.005**	**-0.004**	**-0.005**
	(0.57)	**(0.07)**	**(0.45)**	**(0.52)**	**(0.97)**	**(0.09)**	**(0.03)**	**(0.15)**	**(0.29)**	**(0.14)**
R^2 adjusted	0.46	0.48	0.46	0.46	0.46	0.48	**0.49**	0.47	0.47	0.47
Number of observations	235	235	235	235	235	235	**235**	235	235	235
Number of countries	5	5	5	5	5	5	**5**	5	5	5

Note: p-values in parentheses, * p<0.10, ** p<0.05, *** p<0.01.

Variable	Description	Country coverage
(1) VIX	Factor of VIX indexes for the US, the euro area and Japan	Common
(2) Stock volatility	Factor of squared standard deviation of MSCI daily share price index	Common
(3) Stress index	Factor of the Cleveland and St. Louis Fed financial stress index	Common
(4) Policy uncertainty	Factor of the News-Based Policy Uncertainty Index (US, euro area, Japan)	Common
(5) Consensus deviation	Factor of the standard deviation consensus forecast for GDP	Common
(6) Jurado	Stochastic volatility of forecast error from a factor model	United States
(7) Stochastic volatility	Volatility of a common factor of unpredictable changes in 4 US indicators	United States
(8) Uncertainty (all)	Factor of all uncertainty measures	Common
(9) Uncertainty (financial)	Factor of financial uncertainty measures	Common
(10) Uncertainty (non-financial)	Factor of non-financial market uncertainty measures	Common

Table A3: Summary statistics

Statistic	Investment growth	Real GDP growth	Real user cost of capital	Real profit growth	Credit conditions	Foreign outlook	Domestic outlook	Jurado	Stochastic volatility
Mean	0.006	0.003	0.017	0.007	-0.249	0.029	0.019	0.697	0.161
SD	0.026	0.009	0.022	0.074	19.643	0.010	0.009	0.112	0.137
Min	-0.162	-0.046	-0.082	-0.817	-49.638	-0.010	-0.013	0.595	0.036
Max	0.076	0.026	0.157	0.443	83.600	0.053	0.044	1.117	0.627

Note: Summary statistics presented are prior to standardizing some of the variables.

Table A4: Cross-correlation of uncertainty variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) VIX	1.00	0.78	0.75	0.45	0.62	0.70	0.74	0.88	0.92	0.78
(2) Stock volatility	0.78	1.00	0.76	0.32	0.61	0.77	0.72	0.88	0.92	0.78
(3) Stress index	0.75	0.76	1.00	0.29	0.77	0.82	0.74	0.91	0.91	0.86
(4) Policy uncertainty	0.45	0.32	0.29	1.00	0.29	0.01	0.30	0.38	0.39	0.34
(5) Consensus deviation	0.62	0.61	0.77	0.29	1.00	0.70	0.67	0.82	0.73	0.87
(6) Jurado	0.70	0.77	0.82	0.01	0.70	1.00	0.87	0.89	0.83	0.91
(7) Stochastic volatility	0.74	0.72	0.74	0.30	0.67	0.87	1.00	0.90	0.80	0.94
(8) Uncertainty (all)	0.88	0.88	0.91	0.38	0.82	0.89	0.90	1.00	0.97	0.97
(9) Uncertainty (financial)	0.92	0.92	0.91	0.39	0.73	0.83	0.80	0.97	1.00	0.88
(10) Uncertainty (non-financial)	0.78	0.78	0.86	0.34	0.87	0.91	0.94	0.97	0.88	1.00

Chart A1: Canada - Fitted versus realized values

Year-over-year investment growth, per cent

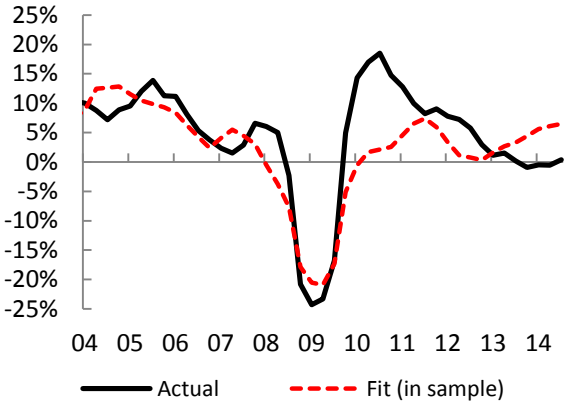


Chart A2: United States - Fitted versus realized values

Year-over-year investment growth, per cent

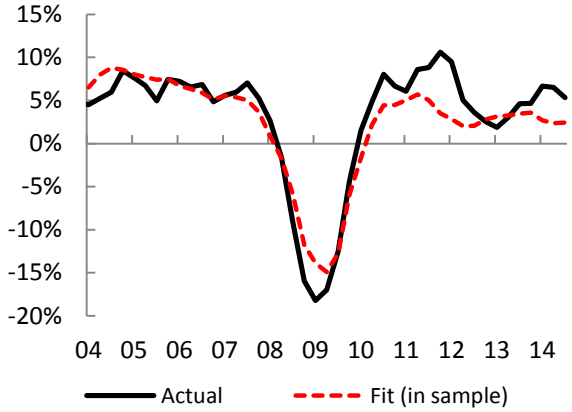


Chart A3: Japan - Fitted versus realized values

Year-over-year investment growth, per cent

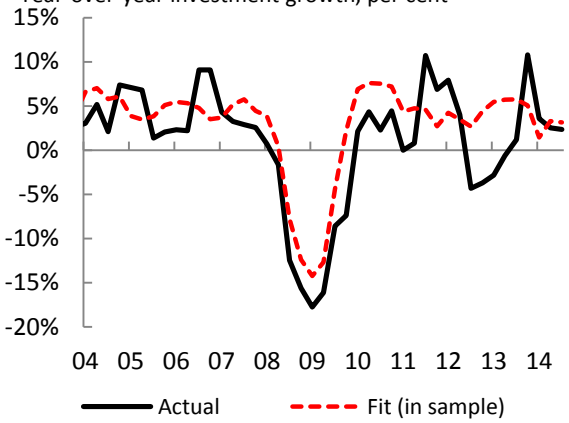


Chart A4: France - Fitted versus realized values

Year-over-year investment growth, per cent

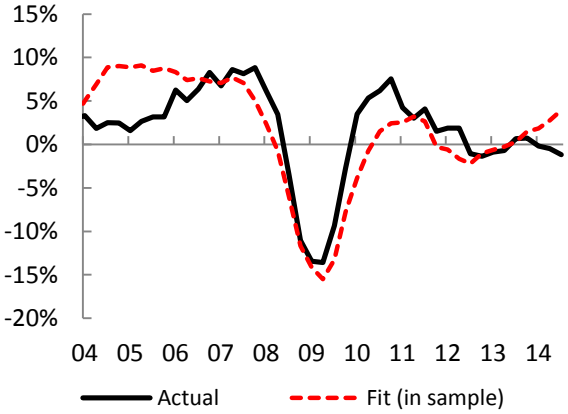


Chart A5: Germany - Fitted versus realized values

Year-over-year investment growth, per cent

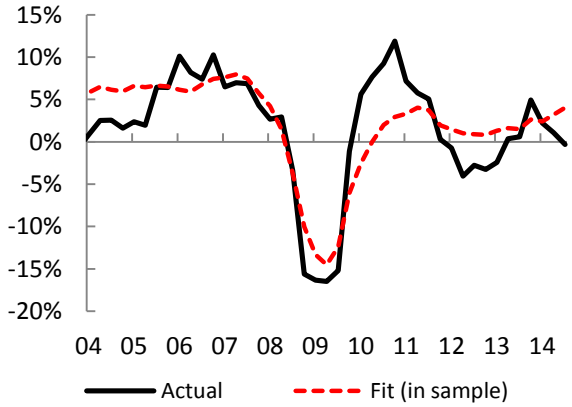
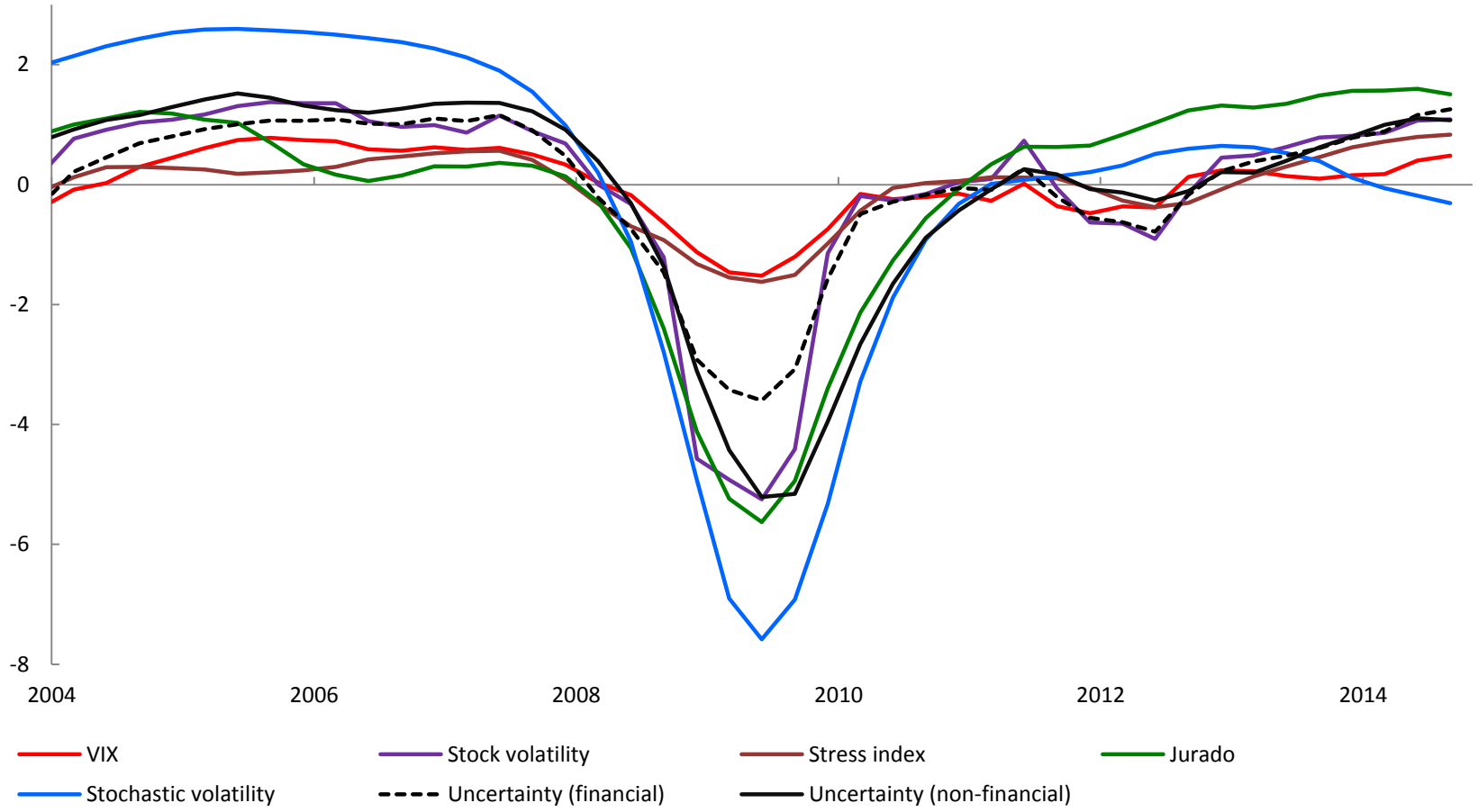


Chart A6: Uncertainty was a large drag on investment growth during the financial crisis

Contribution to year-over-year investment growth, weighted average across countries, percentage points



Source: Authors' calculations

Last observation: 2014Q4