



# How do sovereign credit rating changes affect private investment?



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## ABSTRACT

Sovereign credit rating changes have an influence on real private investment of re-rated countries. We find significant increases in private investment growth following upgrades in sovereign ratings. These increases, however, are transitory. We also find significant, temporary declines in private investment growth following sovereign rating downgrades. The results hold after accounting for re-rated countries' growth opportunities, endogeneity, and other factors that could affect private investment. The irreversible nature of investment may be the explanation for the temporary changes in the growth rates of physical capital investment associated with revisions in sovereign credit ratings.

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## 1. Introduction

Sovereign risk, a key indicator in international financial markets, has recently attracted considerable attention. As sovereign credit ratings reflect a country's perceived willingness and ability to repay its sovereign debt, they are used as a reference measure of country risk. Reinhart (2002) indicates that sovereign credit ratings play a crucial role in determining rated countries' access to international capital markets and the terms of that access, and are useful in predicting sovereign defaults. Gande and Parsley (2005) and Dittmar and Yuan (2008) argue that sovereign bonds serve as the benchmark for the valuation of corporate bonds or other financial instruments and that sovereign bond yield spreads reflect the default risk and other risks of borrowing countries. Thus, understanding the nature of sovereign credit rating changes is of fundamental importance. The recent sovereign rating downgrades of several European countries by major credit rating agencies have highlighted the importance of examining how sovereign credit problems affect re-rated countries' real macroeconomic conditions. When Fitch downgraded Spain's sovereign debt on May

28, 2010, because of sluggish economic growth outlook, this immediately pushed down the euro and world stock markets amid doubts about the prospects for weaker Southern European economies.<sup>1</sup>

Prior research on sovereign rating changes focuses mainly on their short-term announcement effects on financial markets (e.g., Cantor and Packer, 1996; Kaminsky and Schmukler, 2002; Gande and Parsley, 2005). To the best of our knowledge, there have been no studies to date to examine the impact of sovereign rating changes on private investment in the re-rated country. Yet this is critical if we are to understand how changes in sovereign credit ratings affect real macroeconomic outcomes, because physical capital investment is an important determinant of a country's long-run growth rate (Levine and Renelt, 1992; Sala-i-Martin et al., 2004; Rancière et al., 2008). Endogenous growth theory emphasizes the important role of physical investment in a country's growth process (Romer, 1986, 1987; Lucas, 1988).

A sovereign credit rating change may affect physical investment through its effect on the cost of capital. A flight-to-quality will induce investors to shift capital away from riskier investments to the safest possible investment vehicles (Bernanke et al., 1996; Hartmann et al., 2004; Pavlova and Rigobon, 2008). It usually occurs because of uncertainty in international financial markets.

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<sup>1</sup> See *Financial Times* (May 28, 2010).

Caballero and Krishnamurthy (2008) assert that severe flight-to-quality episodes are attributable to uncertainty about the environment, such as liquidation shocks, not just risk about asset payoffs. Reinhart and Rogoff (2004) argue that flows of capital from rich countries to poor countries are governed largely by sovereign countries' credit track records. When a sovereign rating is downgraded (and country risk is higher), investors might shift investments from high-risk countries with political disorder and volatile economic conditions to less risky markets in other countries. Therefore, we expect sovereign rating downgrades to be associated with an increase in net capital outflows, which raises the risk-free rate and the cost of capital (Henry, 2000a, 2003; Sandleris, 2008; Broner et al., 2010). An increase in a country's cost of capital will transform some investment projects with positive net present values (NPVs) before downgrades into negative NPV projects after downgrades, leading to a reduction in private capital investment following sovereign rating downgrades. The converse holds for sovereign rating upgrades.

Another way sovereign credit rating changes can affect the cost of capital and hence private investment is through risk premiums. First, if country risk cannot be entirely diversified away, there should be an extra premium assessed for country risk. For example, Bekaert and Harvey (1995) analyze factors that affect expected stock returns in integrated and segmented markets, and find that country risk is priced. Second, capital flows affect the liquidity of financial markets and hence risk premiums. Levine and Zervos (1998) document that capital flows affect stock market liquidity, and Amihud and Mendelson (1986) and Amihud et al. (1997) show that liquidity affects the equity premium. Beber et al. (2009) document similar evidence for the bond market. Thus, we expect that increases in country risk and net capital outflows associated with sovereign rating downgrades will raise risk premiums and the cost of capital, which in turn reduces real private investment, and vice versa.

We examine how sovereign credit rating changes affect re-rated countries' private investment growth. In a sample of sovereign rating changes provided by Standard & Poor's (S&P) for 48 countries during 1983–2009, we find that countries experience significant declines in their private investment growth following downgrades in sovereign ratings. However, the declines are temporary and occur only in the downgrade year and in the following year. After that, private investment growth exhibits no significant changes. We also find symmetric responses to sovereign rating upgrades. That is, after an upgrade there are significant and temporary increases in private investment growth in that year and in the following year. There are no significant changes in private investment growth in the second and third years after the upgrade. We show that sovereign rating changes affect the re-rated country's private investment through their effects on the cost of capital. The temporary effects of sovereign rating changes on real private investment are robust after accounting for re-rated countries' growth opportunities and the potential endogeneity problem. The results also hold after controlling for other potential effects, such as world business cycles, domestic economic fundamentals, financial liberalization, financial crises, different rating agencies, degree of rating changes, crossing of the investment-grade threshold, rating outlooks, and credit watches.

One possible explanation for the temporary changes in the growth rates of private investment associated with revisions in sovereign ratings is based on the theory of irreversible choice under uncertainty (Bernanke, 1983; Caballero, 1991; Pindyck, 1991; Abel and Eberly, 1994; Kogan, 2001; Bloom et al., 2007; Chirinko and Schaller, 2009). This theory indicates that the irreversible nature of investment and the potential value of waiting make investment behavior especially sensitive to various forms of risk. Sovereign rating downgrades increase a country's risk and add to

uncertainty, and agents choose to wait for the arrival of new information and not invest. Thus we observe a temporary reduction in private investment growth following sovereign rating downgrades. Conversely, when there is a sovereign rating upgrade, agents will accelerate investment projects with reduction of sovereign risk and uncertainty. We provide supporting evidence by showing that sovereign rating downgrades reinforce the negative impact of country uncertainty on private investment growth in the downgrade year and in the following year. We also document a decline in the negative effect of country uncertainty on private investment growth in the short period immediately after sovereign rating upgrades.

Section 2 of the paper describes data and methodology. We report the main results in Section 3 and provide additional analyses in Section 4. The findings are summarized in the final section.

## 2. Data description and methodology

### 2.1. Sample

We collect data on S&P long-term foreign currency sovereign ratings from its website. The sample covers changes in sovereign credit ratings during 1983–2009. If a country experiences several rating changes in the same year, we include only the earliest rating change in order to reduce potential problems associated with overlapping data. We exclude rating changes for countries that experience both upgrades and downgrades in the same year, as our focus is on the effects of pure upgrades or downgrades on private investment. We collect data on private investment and related macroeconomic variables from the World Bank's World Development Indicators (WDI) and Global Development Finance (GDF), IHS Global Insight, Economic and Financial Affairs' AMECO, the International Monetary Fund's International Financial Statistics (IFS), Datastream, the United Nations Statistics Division, Barro and Lee (2010), and Reinhart and Rogoff (2011a).

Our final sample consists of 116 rating upgrades and 62 rating downgrades for 48 countries. Table 1 presents the sample distribution. The vast majority of rating changes are to neighboring levels of upgrades and downgrades; about 96.6% of upgrades and 96.8% of downgrades involve changes of only one notch. Only 8 upgrades and 4 downgrades cross the investment-grade threshold, which is defined by an S&P rating of BBB–.

### 2.2. Measuring the impact of sovereign rating changes on private investment

We start with a benchmark panel regression, and we then modify it to account for potentially important omitted variables. The regression model is estimated for rating changes in both directions: rating upgrades and downgrades. The regression is:

$$\ln vGrowth_{i,t} = \alpha_i + \eta_t + \beta_1 RC_{i,t} + \beta_2 AfterRC1_{i,t} + \beta_3 AfterRC2_{i,t} + \beta_4 AfterRC3_{i,t} + \varepsilon_{i,t} \quad (1)$$

$\ln vGrowth_{i,t}$  is the growth rate of real private investment of country  $i$  in year  $t$ . Real private investment is nominal private investment (in local currency) divided by the domestic GDP deflator.<sup>2</sup> Following Barro (1990), Henry (2000b), and Alesina et al. (2002), we use the first-difference specification as the growth rate of private investment. The independent variables include  $RC$ ,  $AfterRC1$ ,  $AfterRC2$ , and  $AfterRC3$ , which are a binary variable with a value of one in the year of rating change; in the first year after the change; in the

<sup>2</sup> To check the robustness of our results, we also use purchasing power parity (PPP) of Penn World Table adjusted growth rate of private investment as an alternative dependent variable, and yield similar results.

**Table 1**  
Sample distribution of sovereign rating changes.

	Upgrade	Downgrade	Total
<i>Rating changes occurring in</i>			
1983	0	1	1
1985	0	1	1
1986	0	1	1
1989	1	1	2
1990	0	1	1
1991	4	2	6
1992	0	2	2
1993	1	3	4
1994	3	0	3
1995	4	0	4
1996	4	0	4
1997	3	3	6
1998	4	7	11
1999	7	6	13
2000	6	2	8
2001	10	3	13
2002	8	5	13
2003	11	0	11
2004	19	2	21
2005	11	1	12
2006	8	3	11
2007	8	1	9
2008	3	8	11
2009	1	9	10
Total	116	62	178
<i>Number of notches</i>			
1	112	60	172
2	2	1	3
3	1	0	1
4	0	1	1
>5	1	0	1
<i>Investment-grade threshold</i>			
Crossed	8	4	12
Non-crossed	108	58	166

This table presents the sample distribution of 116 Standard & Poor's sovereign credit rating upgrades and 62 rating downgrades for 48 countries during 1983–2009. S&P's investment-grade threshold is the BBB – grade.

second year after the change; and in the third year after the change, and zero otherwise. This specification makes it possible to determine more precisely whether private investment changes follow the rating revisions. If private investment is influenced by sovereign rating upgrades or downgrades, the coefficients  $\beta_1$ ,  $\beta_2$ ,  $\beta_3$ , and  $\beta_4$  will be statistically significant. We account for time-invariant country heterogeneity and a time trend by including country fixed effects and time dummies ( $\alpha_i$  and  $\eta_t$ ) because we perform the Hausman test and reject the use of random effects models. We also consider both a homoskedastic, diagonal, and a seemingly unrelated regression (SUR) error structure for this regression to control for cross-country correlations of the error terms.

We further include additional variables suggested in the literature that may affect private investment. Barro (1991, 2000) argue that initial income produces a negative effect on investment, because a low level of per capita income reflects a low capital intensity that implies a high rate of return to fixed capital formation. Becker et al. (1990), Lucas (1990), and Romer (1990) suggest that an increase in the initial stock of human capital tends to raise the ratio of physical investment to GDP. Warner (1992), Cohen (1993), Blomström et al. (1996), and Henry (2000b) indicate that global business cycles (proxied by real US interest rates and OECD output growth rates) and domestic macroeconomic fundamentals (proxied by the growth rate of GDP and inflation) may also affect the growth rate of private investment. In addition, the debt overhang literature suggests a negative correlation between a country's level of debt and its investment (Sachs, 1989). Debt acts as a tax on an economy and too much debt may produce an adverse effect on

domestic investment (Bulow and Rogoff, 1991; Deshpande, 1997). In the 1980s, the attempt to service debt by heavily indebted countries created tremendous domestic pressures that drove country investments down. Cohen (1993), however, argues that the service of debt may not crowd out investment. If a country has a high level of debt that it does not expect to service, investment will not be crowded out. Even if the country services its debt, the impact of the service of the debt on investment will be ambiguous, and depend on the efficiency of its rescheduling strategy.

After accounting for the potentially influential factors, we have the equation<sup>3</sup>:

$$\ln vGrowth_{i,t} = \alpha + \beta_1 RC_{i,t} + \beta_2 AfterRC1_{i,t} + \beta_3 AfterRC2_{i,t} + \beta_4 AfterRC3_{i,t} + \gamma' Controls_{i,t} + \varepsilon_{i,t} \quad (2)$$

where *Controls* denotes the vector of control variables. Specifically, the control variables include the logarithm of real GDP per capita in 1980 (*InitialIncome*), the average years of secondary schooling attained in 1980 (*HumanCapital*), the contemporaneous real US Treasury bill rate (*TBrate*), the contemporaneous growth rate of OECD industrial production (*OECDgrowth*), the two lags of the growth rate of real GDP (*GDPgrowth*), the lagged percentage change in the consumer price index (*Inflation*), and the lagged external debt level as a percentage of GDP (*ExternalDebt*).<sup>4</sup> We also adjust the standard error in Eq. (2) with a homoskedastic, diagonal, and a SUR error structure.

### 2.3. Identification

Our country regressions may be subject to endogeneity problems. That is, both sovereign rating changes and the growth rate of real private investment may be determined by an omitted factor. For example, the positive impact of sovereign rating upgrades on private investment could occur because of the contemporaneous implementation of other economic reforms or market expectations for future growth opportunities. Or, private investment might affect sovereign rating changes. For example, rating agencies might upgrade a country's sovereign rating in response to its high investment demand and growth rates in previous years. They might also upgrade ratings in anticipation of positive future shocks to a country's marginal productivity of capital. In these circumstances, there would be a correlation between rating changes and the country-specific error term, which would bias the estimated coefficients.

We use a dynamic panel data approach, a system generalized method of moments (system GMM), suggested by Arellano and Bo-ver (1995) and Blundell and Bond (1998). This approach is helpful to amend the bias induced by omitted variables and inconsistency caused by endogeneity (Quinn and Toyoda, 2008; Rancière et al., 2008). The system GMM technique constructs a system of two equations in both levels and first differences. Lagged first-differences of the regressors are used as instruments for levels equation, and lags of the levels of regressors and dependent variables are used as instruments for equation in first differences. The instruments for the differenced equations are lags 2–5 of the regressors. The system GMM combines these two equation to form a more efficient “system estimator”. Specifically, we jointly estimate the following dynamic system:

<sup>3</sup> Because initial GDP levels and initial secondary schooling attained can control country-specific effects, we do not include country dummies in Eq. (2). Similarly, year dummies are excluded in Eq. (2), due to US Treasury bill rate and OECD industrial production growth rate are used to proxy for world business cycles.

<sup>4</sup> Contemporaneous and lagged GDP growth rates are not included as control variables to avoid simultaneity bias (Henry, 2000b). Our empirical specification is similar to those used by Barro (1990), Cohen (1993), Henry (2000b), and Schularick and Steger (2010).

**Table 2**

Summary statistics on the growth rate of private investment around sovereign rating changes.

	Pre-rating-change period (years –3 to –1)	Year 0	Year + 1	Year + 2	Year + 3
<i>Panel A. Levels of growth rates of private investment</i>					
<i>A.1. Upgrade</i>					
Mean	0.045***	0.082***	0.078***	0.061***	0.038***
Median	0.057***	0.088***	0.085***	0.069***	0.070***
Number of events	114	116	108	105	95
<i>A.2. Downgrade</i>					
Mean	0.032**	–0.115***	–0.101***	0.047*	0.031
Median	0.021**	–0.054***	–0.014**	0.054***	0.040**
Number of events	62	62	53	45	44
	Year 0	Year + 1	Year + 2	Year + 3	
<i>Panel B. Differences in growth rates between the pre-rating-change period and year t</i>					
<i>B.1. Upgrade</i>					
Mean difference	0.037**	0.032**	0.016	–0.007	
Median difference	0.030***	0.027***	0.011	0.012	
<i>B.2. Downgrade</i>					
Mean difference	–0.147***	–0.133***	0.015	–0.001	
Median difference	–0.075***	–0.036***	0.033	0.018	

This table shows summary statistics on the growth rate of real private investment in the 3-year pre-rating-change period (years –3 to –1), the year sovereign rating was changed (year 0), and each of the three subsequent years (years + 1, +2, and +3). *t*-tests and Wilcoxon signed-rank tests are used to test the hypotheses that the means and medians are equal to zero. Differences in mean and median are assessed using a *t*-test and a Wilcoxon rank-sum test. The number of observations varies because of data availability.

\* Represent 10% significance levels.

\*\* Represent 5% significance levels.

\*\*\* Represent 1% significance levels.

$$InvGrowth_{i,t} = \beta_0 InvGrowth_{i,t-1} + \beta_1 RC_{i,t} + \beta_2 AfterRC1_{i,t} + \beta_3 AfterRC2_{i,t} + \beta_4 AfterRC3_{i,t} + \gamma' Controls_{i,t} + \varepsilon_{i,t} \quad (3)$$

$$\Delta InvGrowth_{i,t} = \beta_0 \Delta InvGrowth_{i,t-1} + \beta_1 \Delta RC_{i,t} + \beta_2 \Delta AfterRC1_{i,t} + \beta_3 \Delta AfterRC2_{i,t} + \beta_4 \Delta AfterRC3_{i,t} + \gamma' \Delta Controls_{i,t} + \Delta \varepsilon_{i,t} \quad (4)$$

where  $\Delta$  denotes the first-difference. Based on the works of Cohen (1993), Cantor and Packer (1996), Butler and Fauver (2006), and Mora (2006), we use the indicators of a country's default history and economic development as additional instruments. The indicator of default history is a binary variable that equals one if a country has ever defaulted on foreign currency debt, and zero otherwise. The indicator of economic development is a binary variable that equals one if a country is classified as a developed economy, and zero otherwise.<sup>5</sup> We use robust standard errors adjusted for panel-specific autocorrelation and heteroskedasticity. Hansen's (1982) *J*-statistic is used to test over-identifying restrictions. We also use the Arellano–Bond (1991) test for residual autocorrelation.

We address endogeneity concerns using two different approaches. First, Bekaert et al. (2007) propose several exogenous measures of a country's growth opportunities and present strong evidence that these measures can predict future output and investment growth. They measure a country's growth opportunities by the price-to-earnings (PE) ratios of global industry portfolios weighted by the country's industrial mix, reflecting country-specific growth prospects at the global level. Such measures can avoid endogeneity problems because they do not use local price information. Thus, we include the lagged exogenous growth opportunities measures in Eq. (2) to deal with the potential endogeneity concern. We obtain the global industry PE ratios and country-specific industry weights from Datastream.

Second, following Quinn and Toyoda (2008), we employ a model in which the “expected” component of private investment growth is excluded from the original dependent variable of Eq. (2), which becomes “unexpected private investment growth”. Specifically,

we assume that investors use current investment growth to forecast future investment opportunity sets. We define unexpected private investment growth as the current year's private investment growth rate minus the last 10-year average private investment growth rate.

### 3. Empirical results

#### 3.1. Preliminary findings

Table 2 shows summary statistics on the growth rate of real private investment in the 3-year pre-rating-change period (years –3 to –1), the year sovereign rating was changed (year 0), and each of the three subsequent years (years + 1, +2, and +3). The number of observations varies with data availability. Panel A shows that, for our sample of upgrade events, the average growth rates of private investment are 4.5% in the pre-rating-change period and 8.2%, 7.8%, 6.1%, and 3.8% in years 0 to +3, which are all significantly different from zero at the 1% level according to *t*-tests. The median figures also show significantly positive growth rates in private investment in the years surrounding the rating upgrade. Panel B shows that the mean differences in the growth rates of private investment between the pre-rating-change period and years 0 and +1 are 3.7% and 3.2%, both statistically significant at the 5% level according to *t*-tests. Equal median growth rates can also be rejected at the 1% level using a Wilcoxon rank-sum test. Both mean and median growth rates in years +2 and +3 are not significantly different from those in the pre-rating-change period. Our results indicate that sovereign rating upgrades are associated with significant and temporary increases in the growth rates of private investment in the upgrade year and in the first year after the upgrade.

Table 2 also shows that, for our sample of downgrade events, the average growth rates of private investment are 3.2% in the pre-rating-change period and –11.5%, –10.1%, 4.7%, and 3.1% in years 0 to +3. The mean differences in the growth rates of private investment between the pre-rating-change period and years 0 and +1 are –14.7% and –13.3%, both statistically significant at the 1% level. The mean differences in the growth rates between

<sup>5</sup> Economic development status is classified as developed markets and emerging markets according to the International Finance Corporation (IFC). For the upgrades, our sample includes 15 developed markets and 30 emerging markets and for the downgrades 15 developed markets and 22 emerging markets.



**Table 3**

The relation between private investment growth and sovereign rating changes.

	Upgrade		Downgrade	
	(1)	(2)	(1)	(2)
<i>RC</i>	0.045*** (0.017)	0.040** (0.017)	−0.103*** (0.020)	−0.112*** (0.020)
<i>AfterRC1</i>	0.032** (0.015)	0.034** (0.015)	−0.101*** (0.023)	−0.104*** (0.022)
<i>AfterRC2</i>	0.018 (0.016)	0.010 (0.016)	0.020 (0.018)	0.028 (0.020)
<i>AfterRC3</i>	−0.014 (0.019)	−0.013 (0.018)	0.005 (0.020)	0.013 (0.020)
<i>InitialIncome</i>		−0.017** (0.008)		−0.025*** (0.006)
<i>HumanCapital</i>		0.014* (0.008)		0.015** (0.006)
<i>OECDgrowth</i>		1.770*** (0.197)		1.623*** (0.165)
<i>TBrate</i>		−0.944*** (0.330)		−0.945*** (0.258)
<i>GDPgrowth</i>		0.326** (0.163)		0.104 (0.145)
<i>Inflation</i>		−0.156** (0.075)		−0.088 (0.065)
<i>ExternalDebt</i>		−0.010 (0.007)		−0.007 (0.006)
<i>Country dummies</i>	Yes	No	Yes	No
<i>Year dummies</i>	Yes	No	Yes	No
<i>Adjusted R<sup>2</sup></i>	0.289	0.234	0.333	0.316
<i>F-value</i>	4.963***	18.445***	5.729***	25.686***
<i>Observations</i>	799	677	703	625

The dependent variable is the growth rate of private investment. Regressions are estimated with a pooled ordinary least squares (OLS) method. We consider seemingly unrelated regression (SUR) error structure for heteroskedasticity and contemporaneous correlation adjustment. All regressions include a constant term (unreported). The independent variables *RC*, *AfterRC1*, *AfterRC2*, and *AfterRC3* are binary, with a value of one in the year of the rating revision, the first year after the revision, the second year after the revision, and the third year after the revision, and zero otherwise. *InitialIncome* is the logarithm of real GDP per capita in 1980, *HumanCapital* is the average years of secondary schooling attained in 1980, *OECDgrowth* is the growth rate of OECD industrial production, *TBrate* is the real US Treasury bill rate, *GDPgrowth* is the growth rate of real GDP, *Inflation* is the percentage change in the consumer price index, and *ExternalDebt* is the country's external debt level as a percentage of GDP. *Country dummies* and *Year dummies* denote country- and year-specific dummy variables. SUR standard errors are reported in parentheses.

\* Represent 10% significance levels.

\*\* Represent 5% significance levels.

\*\*\* Represent 1% significance levels.

years +2 and +3 and the pre-rating-change period are not significantly different from zero. Results are similar for median differences. Our evidence suggests that the negative and significant effects of sovereign rating downgrades on the growth rate of private investment occur in the downgrade year and in the first year after the downgrade.

### 3.2. Panel regressions

In Table 3, we present the estimation results of Eqs. (1) and (2). The first two columns show the results for sovereign rating upgrades and the last two columns the results for downgrades. Table 3 shows that, for rating upgrades, the coefficients on *RC* are positive and statistically significant at the 5% level or better for both regression models. The coefficients on *AfterRC1* are also positive and significant at the 5% level for both regression models, but the coefficients on *AfterRC2* and *AfterRC3* are both statistically insignificant. Our results show a significantly positive relation between rating upgrades and real investment in the upgrade year and in the first year after the upgrade. The  $R^2$ s for upgrade regressions are 0.289 for Eq. (1) and 0.234 for Eq. (2), suggesting that our model has significant explanatory power.

Table 3 also shows that, for sovereign rating downgrades, the coefficients on *RC* and *AfterRC1* are both negative and statistically significant at the 1% level in both regression models. The coefficients on *AfterRC2* and *AfterRC3* are, however, statistically insignificant. Our evidence indicates a significantly negative relation between rating downgrades and real investment in the downgrade year and in the first year after the downgrade. The  $R^2$ s for downgrade regressions are 0.333 for Eq. (1) and 0.316 for Eq. (2), suggesting that our model for downgrades also has significant explanatory power.

The overall evidence in Table 3 reveals that sovereign credit rating revisions are associated with significant changes in private investment growth. Changes in country risk and capital flows associated with sovereign rating revisions result in changes in the risk-free rate and the risk premium, which in turn affect cost of capital and hence real private investment. Table 3, however, shows that the changes in private investment growth are only temporary.

Four control variables in Table 3 are consistently significant in explaining private investment growth. The coefficients on *HumanCapital* and *OECDgrowth* are significantly positive and the coefficients on *InitialIncome* and *TBrate* are significantly negative for both rating upgrades and downgrades. The signs of these four control variables are consistent with what would be expected.

In Table 4, we present the system GMM panel estimation results after also accounting for a country's growth opportunities. Following Bekaert et al. (2005, 2006, 2007), we use four measures of country growth opportunities: *GGO*, *GGO\_MA*, *GEGO*, and *GEGO\_MA*. *GGO* is country-specific growth opportunities implied by the global markets and is measured by the log of the inner product of the vector of global industry PE ratios and the vector of country-specific industry weights. *GGO\_MA* is *GGO* less a 60-month moving average. *GEGO* is a global measure of country-specific growth opportunities in excess of world growth opportunities. *GEGO\_MA* is *GEGO* less a 60-month moving average.

Table 4 shows that after accounting for potential endogeneity concerns, the coefficients on *RC* and *AfterRC1* are still significantly positive for upgrades and significantly negative for downgrades. The coefficients on *AfterRC2* and *AfterRC3* are statistically insignificant for both upgrades and downgrades. The coefficients on the four growth opportunities measures are all significantly positive for upgrades and downgrades, consistent with findings in Bekaert et al. (2007). The diagnostic statistics support our chosen specification: the Hansen test of over-identifying restrictions shows no evidence against the validity of the instruments, and the serial-correlation tests indicate first-order autocorrelation of the differenced residuals but no traces of higher-order autocorrelation. The overall evidence in Table 4 indicates that sovereign credit rating revisions are associated with significant, temporary changes in private investment growth after accounting for re-rated countries' future growth expectations.

Table 5 presents the system GMM panel estimation results using unexpected private investment growth as the dependent variable in Eq. (2). Our conclusions remain unchanged. The coefficients on *RC* and *AfterRC1* remain significantly positive for sovereign rating upgrades and significantly negative for sovereign rating downgrades. The coefficients on *AfterRC2* and *AfterRC3* remain insignificant for upgrades and downgrades.

### 3.3. Transmission channel

So far we have provided consistent evidence that re-ratings of sovereign debt are associated with changes in private investment growth. Sovereign rating downgrades raise the cost of capital and have a negative impact on the NPV of some investment projects, which in turn results in a reduction in real private capital investment. The converse holds for sovereign rating upgrades. We have

**Table 4**

The relation between private investment growth and sovereign rating changes: system GMM estimation and country growth opportunities.

	Upgrade				Downgrade			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
RC	0.032*** (0.007)	0.035*** (0.006)	0.041*** (0.007)	0.039*** (0.008)	−0.106*** (0.031)	−0.108*** (0.030)	−0.107*** (0.030)	−0.109*** (0.031)
AfterRC1	0.040*** (0.023)	0.045*** (0.027)	0.053*** (0.025)	0.050*** (0.029)	−0.094*** (0.046)	−0.099*** (0.048)	−0.095*** (0.047)	−0.101*** (0.049)
AfterRC2	0.010 (0.021)	0.014 (0.023)	0.021 (0.020)	0.016 (0.024)	0.030 (0.023)	0.026 (0.026)	0.028 (0.026)	0.023 (0.025)
AfterRC3	0.008 (0.016)	0.013 (0.016)	0.018 (0.015)	0.014 (0.017)	0.001 (0.022)	−0.001 (0.021)	0.003 (0.019)	−0.0002 (0.021)
GGO	0.057* (0.033)				0.063* (0.036)			
GGO_MA		0.078* (0.048)				0.040* (0.024)		
GEGO			0.154*** (0.045)				0.076* (0.042)	
GEGO_MA				0.156*** (0.052)				0.168*** (0.059)
InitialIncome	−0.010 (0.008)	−0.011 (0.009)	−0.016** (0.008)	−0.011 (0.009)	−0.022*** (0.008)	−0.025*** (0.009)	−0.027*** (0.009)	−0.026*** (0.009)
HumanCapital	0.011 (0.007)	0.011 (0.007)	0.012 (0.007)	0.011 (0.008)	0.015* (0.007)	0.014* (0.007)	0.014* (0.007)	0.014* (0.008)
OECDgrowth	1.503*** (0.188)	1.593*** (0.212)	1.528*** (0.173)	1.495*** (0.171)	1.436*** (0.209)	1.489*** (0.206)	1.496*** (0.195)	1.477*** (0.193)
TBrate	−0.586 (0.361)	−0.898** (0.387)	−0.877** (0.353)	−0.629* (0.343)	−0.634 (0.414)	−0.737 (0.468)	−0.737* (0.424)	−0.524 (0.435)
GDPgrowth	0.003 (0.204)	0.018 (0.214)	−0.158 (0.200)	−0.064 (0.199)	−0.087 (0.237)	−0.141 (0.241)	−0.182 (0.231)	−0.201 (0.227)
Inflation	0.0002 (0.182)	−0.031 (0.205)	0.028 (0.184)	−0.011 (0.206)	0.058 (0.206)	0.025 (0.204)	0.053 (0.189)	0.062 (0.208)
ExternalDebt	−0.002 (0.005)	−0.001 (0.005)	0.002 (0.005)	−0.001 (0.006)	−0.001 (0.006)	0.0003 (0.006)	0.001 (0.006)	0.0003 (0.007)
Specification tests								
Hansen test	22.71 [0.159]	19.78 [0.137]	27.52 [0.544]	26.55 [0.596]	21.91 [0.346]	22.09 [0.336]	21.30 [0.848]	20.71 [0.870]
AR(1)	−2.68*** [0.007]	−2.75*** [0.006]	−2.59*** [0.009]	−2.62*** [0.009]	−2.58*** [0.010]	−2.63*** [0.009]	−2.52*** [0.012]	−2.52*** [0.012]
AR(2)	−1.36 [0.172]	−1.35 [0.176]	−1.31 [0.192]	−1.33 [0.185]	−1.08 [0.279]	−1.07 [0.284]	−1.07 [0.287]	−1.04 [0.301]
Observations	584	584	584	584	529	529	529	529

The dependent variable is the growth rate of private investment. Regressions are estimated using a system generalized method of moments (system GMM). The system GMM constructs a system of two equations: the equation in levels and differences. Lagged first-differences of the regressors are used as instruments for levels equation, and lags of the levels of regressors and dependent variables are used as instruments for equation in first differences. The instruments for the differenced equations are lags 2–5 of the regressors. Additional instruments are the indicators of a country's default history and economic development. All regressions include a constant term (unreported). The independent variables RC, AfterRC1, AfterRC2, and AfterRC3 are binary, with a value of one in the year of the rating revision, the first year after the revision, the second year after the revision, and the third year after the revision, and zero otherwise. GGO is country-specific growth opportunities implied by the global markets; GGO\_MA is GGO less a 60-month moving average; GEGO is a global measure of country-specific growth opportunities in excess of world growth opportunities; and GEGO\_MA is GEGO less a 60-month moving average. InitialIncome, HumanCapital, OECDgrowth, TBrate, GDPgrowth, Inflation, and ExternalDebt are defined in Table 3. Robust standard errors adjusted for panel-specific autocorrelation and heteroskedasticity are reported in parentheses. *p*-Values for specification tests are reported in brackets.

\* Represent 10% significance levels.

\*\* Represent 5% significance levels.

\*\*\* Represent 1% significance levels.

not so far provided an intermediate empirical link. That is, there should be a negative relation between the cost of capital and private investment growth for both sovereign rating upgrades and downgrades. To examine this transmission mechanism, we follow Bekaert and Harvey (2000) and Gande and Parsley (2005), and use dividend yields and sovereign bond yield spreads to proxy for the cost of equity capital and the cost of debt capital. We expect that dividend yields and sovereign bond yield spreads negatively affect private investment growth.

We estimate two equations simultaneously using a three-stage least squares (3SLS) procedure:

$$\ln v\text{Growth}_{i,t} = \alpha + \beta_0 \text{CoC}_{i,t} + \beta_1 \text{CoC}_{i,t-1} + \varepsilon_{i,t} \quad (5)$$

$$\text{CoC}_{i,t} = \gamma + \lambda \text{RC}_{i,t} + \delta_{i,t} \quad (6)$$

where  $\text{CoC}_t$  and  $\text{CoC}_{t-1}$  denote the country's aggregate cost of equity or debt capital in year  $t$  and  $t - 1$ . The cost of equity capital is measured by the change in the log of dividend yield, and the cost of debt

capital is measured by the ratio of the interest rate on sovereign bonds to the interest rate on US Treasury bonds of comparable maturity, minus one. The instrumental variables in the simultaneous equations model are: the logarithm of real GDP per capita in 1980, the average years of secondary schooling attained in 1980, the growth rate of OECD industrial production, and the real US Treasury bill rate. We obtain data on dividend yields from the Datastream database, sovereign bond yields from the World Bank's Global Economic Monitor, and US Treasury bond interest rates from the Federal Reserve Statistical Release. For data availability reasons, we start our analysis on sovereign bond yield spreads in 1994.

Panel A of Table 6 shows that when dividend yield changes are used to proxy for the cost of equity capital, the estimated coefficients on RC are negative for upgrades and positive for downgrades, both results statistically significant at the 1% level. The coefficients on  $\text{CoC}_t$  and  $\text{CoC}_{t-1}$  are significantly negative at the 1% level for both upgrades and downgrades. The evidence in Panel A shows a strong transmission linkage between sovereign rating

**Table 5**

The relation between private investment growth and sovereign rating changes: system GMM estimation and unexpected private investment growth.

	Upgrade	Downgrade
RC	0.045*** (0.008)	−0.109*** (0.030)
AfterRC1	0.055** (0.026)	−0.104** (0.047)
AfterRC2	0.028 (0.022)	0.025 (0.026)
AfterRC3	0.015 (0.020)	−0.005 (0.019)
InitialIncome	0.002 (0.006)	−0.006 (0.006)
HumanCapital	−0.002 (0.005)	−0.002 (0.003)
OECDgrowth	1.673*** (0.204)	1.624*** (0.188)
TBrate	−0.611* (0.313)	−0.783** (0.335)
GDPgrowth	−0.364** (0.175)	−0.428** (0.196)
Inflation	0.028 (0.144)	0.105 (0.139)
ExternalDebt	−0.017* (0.009)	−0.014* (0.008)
Specification tests		
Hansen test	25.75 [0.137]	24.90 [0.355]
AR(1)	−2.95*** [0.003]	−2.94*** [0.003]
AR(2)	−1.08 [0.280]	−0.55 [0.583]
Observations	667	617

The dependent variable is unexpected private investment growth. Regressions are estimated using a system generalized method of moments (system GMM). All regressions include a constant term (unreported). The independent variables RC, AfterRC1, AfterRC2, and AfterRC3 are binary, with a value of one in the year of the rating revision, the first year after the revision, the second year after the revision, and the third year after the revision, and zero otherwise. InitialIncome, HumanCapital, OECDgrowth, TBrate, GDPgrowth, Inflation, and ExternalDebt are defined in Table 3. Robust standard errors adjusted for panel-specific autocorrelation and heteroskedasticity are reported in parentheses. *p*-Values for specification tests are reported in brackets.

\* Represent 10% significance levels.

\*\* Represent 5% significance levels.

\*\*\* Represent 1% significance levels.

changes and cost of equity capital and private investment growth. Sovereign debt rating revisions lead to changes in the re-rated country's cost of equity capital and hence affect its growth in private capital investment.

Panel B of Table 6 examines the transmission mechanism when sovereign yield spreads are used to proxy for the cost of debt capital. Here the coefficient on RC is negative for upgrades and positive for downgrades, both statistically significant at the 1% level. We also find that the coefficients on CoC<sub>t</sub> and CoC<sub>t−1</sub> are significantly negative at the 5% level or better for both upgrades and downgrades. The overall results in Panel B support the idea that sovereign rating changes affect the re-rated country's private investment growth via their intermediate effects on the cost of debt capital.

### 3.4. One explanation for temporary changes in investment growth

The irreversible nature of investment may explain the temporary changes in the growth rates of private investment associated with revisions in sovereign ratings. Pindyck (1991, 1993) and Caballero and Pindyck (1996) indicate that most investment expenditures have two important characteristics. First, they are

**Table 6**

The relation among sovereign rating changes, cost of capital, and private investment growth.

	Upgrade		Downgrade	
	InvGrowth	CoC	InvGrowth	CoC
<i>Panel A. Dividend yield changes</i>				
CoC <sub>t</sub>	−0.886*** (0.061)		−1.029*** (0.073)	
CoC <sub>t−1</sub>	−0.068*** (0.015)		−0.084*** (0.015)	
RC		−0.131*** (0.026)		0.180*** (0.031)
Adjusted R <sup>2</sup>	0.057	0.004	0.045	0.001
F-value	21.140***	3.860**	15.370***	1.330
Observations	665		605	
<i>Panel B. Sovereign yield spreads</i>				
CoC <sub>t</sub>		−0.419*** (0.074)		−0.149** (0.062)
CoC <sub>t−1</sub>		−0.190*** (0.015)		−0.041** (0.020)
RC		−0.253*** (0.083)		5.249*** (1.886)
Adjusted R <sup>2</sup>	0.020	−0.004	0.039	0.024
F-value	3.450**	0.000	4.590**	5.440**
Observations	243		179	

A simultaneous equations model is constructed and estimated using three-stage least squares (3SLS) regressions to address the relation between sovereign rating changes and cost of capital and private investment growth. The dependent variables are the growth rate of private investment and the cost of capital. The instrumental variables include the logarithm of real GDP per capita in 1980, the average years of secondary schooling attained in 1980, the growth rate of OECD industrial production, and the real US Treasury bill rate. All regressions include a constant term (unreported). The independent variable RC is a binary variable with a value of one in the year of the rating revision, and zero otherwise. CoC<sub>t</sub> denotes the current cost of equity or debt capital, measured by dividend yields and sovereign debt yield spreads. CoC<sub>t−1</sub> is the 1-year lagged cost of capital. For data availability reasons, we start our analysis on sovereign bond yield spreads in 1994. Standard errors are reported in parentheses.

\* Represent 10% significance levels.

\*\* Represent 5% significance levels.

\*\*\* Represent 1% significance levels.

at least in part irreversible. Investment expenditures are mostly sunk costs that cannot be recovered if market conditions turn out to be worse than expected. Second, investment projects can be delayed until new information about prices, costs, and other market conditions arrives. Investment expenditures are very sensitive to uncertainty over future payoffs. Bernanke (1983) documents that when investment projects are irreversible, agents will make investment timing decisions that trade off the extra returns from early commitment against the benefits of increased information that may be gained by waiting. Since sovereign rating downgrades are associated with increases in a country's risk and uncertainty, agents will choose to wait for the new information and are reluctant to invest. Therefore, a temporary decline in private investment growth following sovereign rating downgrades would be expected. Conversely, facing sovereign rating upgrades, agents will accelerate committed investment projects due to the reduction of sovereign risk and uncertainty.

In their empirical examination of the relationship between country uncertainty and aggregate investment, Pindyck and Solimano (1993) show that investment responds, in the short run, to changes in the volatility of the marginal profitability of capital (MPC), when MPC volatility is below the critical threshold required to trigger investment. Hence, an increase in the volatility of MPC should at least cause a temporary decline in investment. Following Pindyck and Solimano (1993) and Caballero and Pindyck (1996), we consider a competitive economy characterized by a Cobb–Douglas aggregate production function with constant returns to scale. We can thus express the output of the following equation:

**Table 7**

Threshold, uncertainty, and private investment growth.

	DBMAX	DBDEC	DBQUINT	DBKMAX	DBKDEC	DBKQUINT
<i>Panel A. Cross-sectional regressions of threshold against the volatility of the log of marginal profitability of capital</i>						
Intercept	−0.023 <sup>*</sup> (0.013)	−0.016 (0.010)	−0.002 (0.004)	−0.088 <sup>***</sup> (0.028)	−0.074 <sup>***</sup> (0.025)	−0.040 <sup>***</sup> (0.014)
STD( $\Delta mpc$ )	1.932 <sup>***</sup> (0.209)	1.735 <sup>***</sup> (0.160)	1.315 <sup>***</sup> (0.046)	1.886 <sup>***</sup> (0.342)	1.763 <sup>***</sup> (0.344)	1.141 <sup>***</sup> (0.166)
Adjusted R <sup>2</sup>	0.896	0.924	0.950	0.507	0.613	0.599
F-value	207.510 <sup>***</sup>	292.300 <sup>***</sup>	459.680 <sup>***</sup>	25.650 <sup>***</sup>	38.950 <sup>***</sup>	36.900 <sup>***</sup>
Observations	25	25	25	25	25	25
	Upgrade			Downgrade		
	(1)	(2)		(1)	(2)	
<i>Panel B. Panel regressions of private investment growth against the volatility of the log of marginal profitability of capital</i>						
STD( $\Delta mpc$ )		−0.547 <sup>***</sup> (0.235)	−1.100 <sup>***</sup> (0.450)	−0.920 <sup>**</sup> (0.426)		−1.204 <sup>**</sup> (0.614)
STD( $\Delta mpc$ ) $\times$ RC			0.782 <sup>*</sup> (0.475)			−4.367 <sup>***</sup> (1.465)
STD( $\Delta mpc$ ) $\times$ AfterRC1			2.889 <sup>***</sup> (1.005)			−4.917 <sup>**</sup> (2.369)
STD( $\Delta mpc$ ) $\times$ AfterRC2			−1.551 (1.098)			0.921 (0.829)
STD( $\Delta mpc$ ) $\times$ AfterRC3			−1.244 (1.227)			0.114 (0.440)
<i>Specification tests</i>						
Hansen test		18.44 [0.240]	19.76 [0.841]	13.59 [0.193]		10.98 [0.858]
AR(1)		−3.30 <sup>***</sup> [0.001]	−2.72 <sup>***</sup> [0.007]	−3.02 <sup>***</sup> [0.002]		−2.64 <sup>***</sup> [0.008]
AR(2)		−1.31 [0.189]	−1.37 [0.169]	−1.16 [0.246]		−1.30 [0.195]
Observations		462	462	347		347

In Panel A, the dependent variable is a threshold measure that triggers investment spending, which includes DBMAX, DBDEC, DBQUINT, DBKMAX, DBKDEC, and DBKQUINT. MPC denotes the marginal profitability of capital, DBMAX denotes the maximum value of the log of MPC (*mpc*), DBDEC denotes the average of the top 10% values of the *mpc*, and DBQUINT denotes the average of the top 20% values of the *mpc*. In all cases, we calculate these values relative to the country mean of the *mpc*. DBKMAX, DBKDEC, and DBKQUINT are calculated in the same manner except that the values of *mpc* now correspond to the maximum, the top 10%, and the top 20% values of changes in the real capital stock. The independent variable STD( $\Delta mpc$ ) is the volatility of *mpc*. We estimate these regressions using ordinary least squares (OLS). In Panel B, the dependent variable is the growth rate of private investment. Regressions are estimated using a system generalized method of moments (system GMM). All regressions include a constant term (unreported). The independent variables RC, AfterRC1, AfterRC2, and AfterRC3 are binary, with a value of one in the year of the rating revision, the first year after the revision, the second year after the revision, and the third year after the revision, and zero otherwise. Robust standard errors adjusted for panel-specific autocorrelation and heteroskedasticity are reported in parentheses. *p*-Values for specification tests are reported in brackets.

<sup>\*</sup> Represent 10% significance levels.

<sup>\*\*</sup> Represent 5% significance levels.

<sup>\*\*\*</sup> Represent 1% significance levels.

$$Y_t = A_t K_t^\alpha L_t^{1-\alpha} \quad (7)$$

where  $Y_t$  is the real GDP,  $K_t$  is the real capital stock,  $L_t$  is the total labor force, and  $\alpha$  is the share of capital. Given this expression for output, the marginal profitability of capital is then given by:

$$MPC(t) = \alpha(1 - \alpha)^{\frac{(1-\alpha)}{\alpha}} A_t^{\frac{1}{\alpha}} W_t^{\frac{(1-\alpha)}{\alpha}} \quad (8)$$

Let  $W_t$  denote the real prices of the labor materials. We solve for  $A_t$  from the Cobb–Douglas production function and substitute into the marginal profitability of capital equation:

$$MPC(t) = \alpha(1 - \alpha)^{\frac{(1-\alpha)}{\alpha}} \left( \frac{Y_t}{K_t^\alpha L_t^{1-\alpha}} \right)^{\frac{1}{\alpha}} W_t^{\frac{(1-\alpha)}{\alpha}} \quad (9)$$

Next, we will work with logarithm of MPC (*mpc*):

$$mpc_t = \log \left[ \alpha(1 - \alpha)^{\frac{(1-\alpha)}{\alpha}} \right] + \frac{a_t}{\alpha} - \frac{(1 - \alpha)}{\alpha} w_t \quad (10)$$

$$a_t = y_t - \alpha k_t - (1 - \alpha) l_t \quad (11)$$

where lowercase letters represent logs of the corresponding variables.

The theory of irreversible choice under uncertainty suggests that irreversible investment combined with aggregate uncer-

tainty implies a higher threshold required rate of return to undertake an investment project. To assess the impact of uncertainty on investment, we use cross-sectional regressions to examine the relation between the investment threshold and the volatility of changes in *mpc*, STD( $\Delta mpc$ ), which proxies for country uncertainty (Eq. (12)). We then use system GMM panel regressions to relate private investment growth to STD( $\Delta mpc$ ) (Eqs. (13) and (14)). Data on MPC come from Version 6.3 of the Penn World Table (PWT), and the share of capital comes from Caselli and Feyrer (2007).

$$u_i = \alpha + \beta STD(\Delta mpc)_i + \varepsilon_i \quad (12)$$

$$\begin{aligned} \ln vGrowth_{i,t} = & \beta_0 \ln vGrowth_{i,t-1} + \beta_1 STD(\Delta mpc)_{i,t} \\ & + \beta_2 [STD(\Delta mpc)_{i,t} \times AfterRC1_{i,t}] + \beta_3 [STD(\Delta mpc)_{i,t} \\ & \times AfterRC2_{i,t}] + \beta_4 [STD(\Delta mpc)_{i,t} \times AfterRC3_{i,t}] \\ & + \gamma' Controls_{i,t} + \varepsilon_{i,t} \end{aligned} \quad (13)$$

$$\begin{aligned} \Delta \ln vGrowth_{i,t} = & \beta_0 \Delta \ln vGrowth_{i,t-1} + \beta_1 \Delta STD(\Delta mpc)_{i,t} \\ & + \beta_2 \Delta [STD(\Delta mpc)_{i,t} \times AfterRC1_{i,t}] + \beta_3 \Delta [STD(\Delta mpc)_{i,t} \\ & \times AfterRC2_{i,t}] + \beta_4 \Delta [STD(\Delta mpc)_{i,t} \times AfterRC3_{i,t}] \\ & + \gamma' \Delta Controls_{i,t} + \Delta \varepsilon_{i,t} \end{aligned} \quad (14)$$



**Table 8**

The relation between private investment growth and sovereign rating changes after controlling for stock market liberalization and financial crisis.

	Stock market liberalization		Financial crisis	
	Upgrade	Downdgrade	Upgrade	Downdgrade
RC	0.043*** (0.010)	-0.104*** (0.028)	0.034*** (0.007)	-0.094*** (0.026)
AfterRC1	0.055** (0.025)	-0.093** (0.043)	0.040* (0.022)	-0.087* (0.045)
AfterRC2	0.021 (0.022)	0.020 (0.027)	0.007 (0.020)	0.041 (0.026)
AfterRC3	0.013 (0.013)	0.024 (0.022)	0.003 (0.018)	0.024 (0.022)
Liberalization	0.071* (0.042)	0.096** (0.046)		
Financial Crisis			-0.071*** (0.025)	-0.066*** (0.021)
GEGO_MA	0.133** (0.060)	0.173*** (0.060)	0.130** (0.053)	0.149*** (0.058)
InitialIncome	-0.010 (0.017)	-0.025** (0.010)	-0.016* (0.009)	-0.028*** (0.009)
HumanCapital	0.012 (0.010)	0.019** (0.009)	0.012 (0.008)	0.014* (0.008)
OECDgrowth	1.459*** (0.212)	1.787*** (0.374)	1.542*** (0.176)	1.498*** (0.192)
TBrate	-0.707 (0.473)	-2.521 (2.121)	-0.389 (0.366)	-0.187 (0.446)
GDPgrowth	-0.070 (0.287)	-0.246 (0.240)	-0.173 (0.226)	-0.231 (0.252)
Inflation	-0.222 (0.355)	0.028 (0.200)	0.031 (0.177)	0.082 (0.195)
ExternalDebt	-0.001 (0.007)	-0.0004 (0.009)	-0.002 (0.006)	-0.001 (0.007)
<i>Specification tests</i>				
Hansen test	27.01 [0.356]	21.84 [0.996]	23.87 [0.973]	18.90 [0.996]
AR(1)	-2.07** [0.038]	-2.32** [0.020]	-2.66*** [0.008]	-2.44** [0.015]
AR(2)	-1.45 [0.146]	-1.37 [0.169]	-1.22 [0.222]	-0.96 [0.336]
Observations	584	529	584	529

The dependent variable is the growth rate of private investment. Regressions are estimated using a system generalized method of moments (system GMM). All regressions include a constant term (unreported). The independent variables RC, AfterRC1, AfterRC2, and AfterRC3 are binary, with a value of one in the year of the rating revision, the first year after the revision, the second year after the revision, and the third year after the revision, and zero otherwise. Liberalization equals one if a sovereign debt rating change occurs in the first, second, or third year after stock market liberalization, and zero otherwise. Stock market liberalization dates are taken from Bekaert and Harvey (2000), Henry (2000a), and Bekaert et al. (2005). Financial Crisis is a binary variable that equals one in the year a country experiences a banking or currency crisis or in each of the three subsequent years, and zero otherwise. We obtain financial crisis dates from Frankel and Rose (1996), Kaminsky and Reinhart (1999), Caprio and Klingebiel (2003), Laeven and Valencia (2008), and Reinhart and Rogoff (2011b). GEGO\_MA is defined in Table 4. InitialIncome, HumanCapital, OECDgrowth, TBrate, GDPgrowth, Inflation, and ExternalDebt are defined in Table 3. Robust standard errors adjusted for panel-specific autocorrelation and heteroskedasticity are reported in parentheses. p-Values for specification tests are reported in brackets.

\* Represent 10% significance levels.

\*\* Represent 5% significance levels.

\*\*\* Represent 1% significance levels.

where  $u_i$  is the proxy for the threshold that triggers investment of country  $i$ ; following Pindyck and Solimano (1993) and Caballero and Pindyck (1996), we use extreme value of  $mpc$  as proxy for the threshold. In addition, to examine whether sovereign rating changes induce an incremental uncertainty effect on private investment growth, the interaction terms of  $STD(\Delta mpc)$  and rating change dummies are added into the regression models.

The first three columns of Panel A, Table 7, shows cross-sectional regressions of DBMAX, DBDEC, and DBQUINT against  $STD(\Delta mpc)$  and a constant, where DBMAX denotes the maximum

value of  $mpc$ ; DBDEC denotes the average of the top 10% values of  $mpc$ ; and DBQUINT denotes the average of the top 20% values of  $mpc$ .<sup>6</sup> The coefficients on  $STD(\Delta mpc)$  in all three regressions are significantly positive at the 1% level. The results suggest that the higher volatility of  $mpc$  is associated with a higher threshold, consistent with the findings of Pindyck and Solimano (1993) and Caballero and Pindyck (1996). One potential problem associated with this analysis is that a higher  $STD(\Delta mpc)$  may be coupled with a higher threshold measure. To address this potential concern, we use another set of threshold proxies, DBKMAX, DBKDEC, and DBKQUINT, in the regressions. DBKMAX, DBKDEC, and DBKQUINT are calculated in the same manner as above except that the values of  $mpc$  now correspond to the maximum, top 10%, and top 20% values of changes in real capital stock. The last three columns of Panel A, Table 7, show that the relation between investment threshold and  $STD(\Delta mpc)$  remains significantly positive at the 1% level in all regressions.

Model 1 in Panel B, Table 7, presents the results for system GMM panel estimations that relate the volatility of  $mpc$  to private investment growth for sovereign rating upgrades and downgrades. The coefficients on  $STD(\Delta mpc)$  are significantly negative at the 5% level for both rating upgrades and downgrades. The results indicate that an increase (decline) in the volatility of  $mpc$  will result in a lower (higher) growth rate of private investment.

To examine whether sovereign credit rating revisions have incremental effects on private investment, we also include four interaction terms between  $STD(\Delta mpc)$  and rating change dummies (RC, AfterRC1, AfterRC2, and AfterRC3). Model 2 in Panel B, Table 7, shows that the negative relation between volatility and private investment growth holds after including the four interaction terms. Model 2 also shows that, for rating upgrades, the coefficient on the interaction term  $STD(\Delta mpc) \times RC$  is significantly positive at the 10% level and the coefficient on  $STD(\Delta mpc) \times AfterRC1$  is significantly positive at the 1% level. The coefficients on  $STD(\Delta mpc) \times AfterRC2$  and  $STD(\Delta mpc) \times AfterRC3$  are insignificantly negative. The results suggest that the negative effect of uncertainty on investment is diminished in the short period immediately after sovereign rating upgrades. In the case of rating downgrades, the coefficients on the interaction terms  $STD(\Delta mpc) \times RC$  and  $STD(\Delta mpc) \times AfterRC1$  are both significantly negative at the 5% level or better, while the coefficients on  $STD(\Delta mpc) \times AfterRC2$  and  $STD(\Delta mpc) \times AfterRC3$  are statistically insignificant. That is, sovereign rating downgrades reinforce the negative impact of uncertainty on investment in the downgrade year and in the first year after the downgrade. Taken together, the evidence in Table 7 indicates that the theory of irreversible choice under uncertainty may explain the temporary changes in real private investment growth associated with sovereign rating revisions.

## 4. Additional analyses

### 4.1. Financial liberalization and financial crises

Bekaert and Harvey (2000) and Henry (2000a) document that stock market liberalization reduces a country's cost of equity capital. Henry (2000b) further examines a country's growth rates of real private investment after stock market liberalization. He shows significant increases in private investment in the 3 years immediately following a stock market liberalization. To control for the potential effects of stock market liberalization, we add a dummy variable, Liberalization, to Eq. (2) that equals one in the first, second, or third year after stock market liberalization, and zero otherwise. The liberalization dates include the official liberalization date, the first American Depositary Receipt (ADR) issuance

<sup>6</sup> We calculate these threshold values relative to the country mean of  $mpc$ .

**Table 9**

Summary statistics on the ratio of foreign direct investment to private investment around sovereign rating changes.

	Pre-rating-change period (years –3 to –1)	Year 0	Year + 1	Year + 2	Year + 3
<i>Panel A. Ratios of foreign direct investment to private investment</i>					
<i>A.1. Upgrade</i>					
Mean	0.251***	0.303***	0.355***	0.323***	0.337***
Median	0.198***	0.201***	0.214***	0.216***	0.254***
Number of events	112	113	106	101	93
<i>A.2. Downgrade</i>					
Mean	0.327***	0.370***	0.305***	0.355***	0.161***
Median	0.153***	0.144***	0.136***	0.147***	0.145***
Number of events	59	61	52	44	43
	Year 0	Year + 1	Year + 2	Year + 3	
<i>Panel B. Differences in ratios of foreign direct investment to private investment between the pre-rating-change period and year t</i>					
<i>B.1. Upgrade</i>					
Mean difference	0.052	0.103**	0.072	0.086*	
Median difference	0.003	0.016	0.018	0.056	
<i>B.2. Downgrade</i>					
Mean difference	0.044	–0.022	0.029	–0.166	
Median difference	–0.009	–0.017	–0.006	–0.008	

This table shows summary statistics on the ratio of foreign direct investment to private investment (FDI/PI) in the period surrounding sovereign rating changes, where year 0 denotes the year in which sovereign credit rating changes. *t*-Tests and Wilcoxon signed-rank tests are used to test the hypotheses that the means and medians are equal to zero. Differences in mean and median are assessed using a *t*-test and a Wilcoxon rank-sum test. The number of observations varies because of data availability.

\* Represent 10% significance levels.

\*\* Represent 5% significance levels.

\*\*\* Represent 1% significance levels.

date, and the first country fund date. Stock market liberalization dates are taken from Bekaert and Harvey (2000), Henry (2000a), and Bekaert et al. (2005).

The first two columns in Table 8 show the system GMM panel estimation results.<sup>7</sup> The results are similar to the results so far. The coefficients on *RC* and *AfterRC1* are still significantly positive for rating upgrades and significantly negative for rating downgrades. The coefficients on *AfterRC2* and *AfterRC3* are statistically insignificant for both upgrades and downgrades. Our evidence again indicates that sovereign credit rating revisions are associated with significant, temporary changes in private investment growth, even after we control for the potential effects of stock market liberalization. The coefficients on *Liberalization* are positive and significant for both upgrades and downgrades. The finding suggests that financial liberalization improves private investment growth, consistent with evidence in Henry (2000b).

In the last two columns of Table 8, we also control for the effects of financial crises. Joyce and Nabar (2009) suggest that financial crises are likely to have a significant negative effect on private investment. Our sample countries experienced banking crises and currency crises in the sample period. We control for financial crisis effects by adding a dummy variable, *Financial Crisis*, to Eq. (2) that takes a value of one in the year a country experiences a financial crisis or in each of the three subsequent years, and zero otherwise. We obtain banking and currency crisis dates from Frankel and Rose (1996), Kaminsky and Reinhart (1999), Caprio and Klingebiel (2003), Laeven and Valencia (2008), and Reinhart and Rogoff (2011b). Table 8 shows that the coefficients on *RC* and *AfterRC1* are still significantly positive for rating upgrades and significantly negative for rating downgrades. The coefficients on *Financial Crisis* are significantly negative for both upgrades and downgrades, consistent with Joyce and Nabar (2009).

#### 4.2. Foreign direct investment

Our focus is on private investment and not total investment, which also includes government and foreign direct investment

(FDI). This is because our empirical analyses are based on the theoretical relation between the cost of capital and private investment, which makes no predictions as to government investment behavior. We now examine whether increases in private investment associated with sovereign rating upgrades simply substitute for FDI, or whether both private investment and FDI increase.

Table 9 shows summary statistics on the ratio of FDI to private investment (FDI/PI) in the period surrounding sovereign rating changes. Data on FDI are obtained from WDI and Datastream. The number of observations varies because of data availability. Panel A shows that, for the sample of upgrade events, the average FDI/PI ratios are 25.1% in the pre-rating-change period and 30.3%, 35.5%, 32.3%, and 33.7% in years 0 to +3. Panel B shows that the mean differences in FDI/PI ratios between the pre-rating-change period and years 0 to +3 are 5.2%, 10.3%, 7.2%, and 8.6%. These mean differences are statistically significant in years +1 and +3 and insignificant in years 0 and +2. The significant differences in years +1 and +3 might be due to the effects of outliers. The median differences in FDI/PI ratios between the pre-rating-change period and years 0 to +3 are all insignificantly different from zero. We conclude from Tables 3 and 9 that the increases in private investment associated with sovereign rating upgrades in years 0 and +1 do not simply replace FDI. Both private investment and FDI increase in the upgrade year and in the first year after the upgrade.

We also examine whether FDI may substitute for reductions in private investment associated with sovereign rating downgrades, or whether both private investment and FDI drop. Table 9 shows that, for the sample of downgrade events, the average FDI/PI ratios are 32.7% in the pre-rating-change period and 37.0%, 30.5%, 35.5%, and 16.1% in years 0 to +3. The mean differences in FDI/PI ratios between the pre-rating-change period and the post-rating-change period are all insignificantly different from zero. Median differences also show similar results. The results in Tables 3 and 9 indicate that both private investment and FDI drop in the downgrade year and in the first year after the downgrade.

#### 4.3. Different rating agencies

Our empirical analysis is based on the S&P sovereign credit ratings, but other major international rating agencies also release

<sup>7</sup> In Table 8 and the remaining tables, we use *GEGO\_MA* to measure a country's growth opportunities. The results are similar if we use the other three measures of country growth opportunities.

**Table 10**

The relation between private investment growth and sovereign rating changes by Moody's and Fitch.

	Moody's		Fitch	
	Upgrade	Downgrade	Upgrade	Downgrade
RC	0.057*** (0.018)	−0.134*** (0.036)	0.029** (0.014)	−0.089** (0.042)
AfterRC1	0.022** (0.011)	−0.186** (0.086)	0.042* (0.025)	−0.087* (0.049)
AfterRC2	0.022 (0.014)	−0.018 (0.044)	0.036 (0.024)	0.021 (0.037)
AfterRC3	0.028 (0.019)	−0.002 (0.026)	0.047 (0.035)	0.009 (0.035)
GEGO_MA	0.119** (0.053)	0.185** (0.088)	0.143*** (0.048)	0.232*** (0.083)
InitialIncome	−0.014** (0.006)	−0.027* (0.016)	−0.005 (0.010)	−0.031*** (0.009)
HumanCapital	0.017** (0.007)	0.013 (0.009)	0.008 (0.007)	0.034*** (0.010)
OECDgrowth	1.446*** (0.188)	1.210*** (0.265)	1.480*** (0.182)	1.609*** (0.286)
TBrate	−0.495 (0.344)	−0.497 (0.387)	−0.520 (0.362)	−1.119** (0.522)
GDPgrowth	−0.402** (0.174)	−0.459** (0.200)	−0.114 (0.209)	−0.250 (0.252)
Inflation	0.074 (0.227)	0.030 (0.277)	0.030 (0.198)	0.085 (0.148)
ExternalDebt	0.002 (0.006)	−0.006 (0.005)	0.002 (0.007)	−0.002 (0.006)
Specification tests				
Hansen test	22.53 [0.798]	7.13 [0.895]	24.08 [0.677]	12.12 [0.996]
AR(1)	−2.42** [0.015]	−1.88* [0.061]	−2.65*** [0.008]	−2.20** [0.028]
AR(2)	−1.30 [0.193]	−1.13 [0.259]	−1.35 [0.176]	−1.29 [0.198]
Observations	532	317	544	343

The dependent variable is the growth rate of private investment. Regressions are estimated using a system generalized method of moments (system GMM). All regressions include a constant term (unreported). The independent variables RC, AfterRC1, AfterRC2, and AfterRC3 are binary, with a value of one in the year of the rating revision, the first year after the revision, the second year after the revision, and the third year after the revision, and zero otherwise. GEGO\_MA is defined in Table 4. InitialIncome, HumanCapital, OECDgrowth, TBrate, GDPgrowth, Inflation, and ExternalDebt are defined in Table 3. Robust standard errors adjusted for panel-specific autocorrelation and heteroskedasticity are reported in parentheses. *p*-Values for specification tests are reported in brackets.

\* Represent 10% significance levels.

\*\* Represent 5% significance levels.

\*\*\* Represent 1% significance levels.

information on sovereign ratings. The most representative other rating agencies are Moody's and Fitch. Gande and Parsley (2005) and Hill et al. (2010) indicate that there are non-trivial variations in sovereign ratings information provided by different rating agencies. Cantor and Packer (1996) also show that rating disagreements are more likely for sovereign ratings than for corporate ratings.

To assess whether our results differ according to different rating agencies, we also examine the impact of Moody's and Fitch sovereign credit rating revisions on the growth rate of real private investment. Data on these rating revisions are collected from the Moody's and Fitch websites. Table 10 shows the system GMM panel estimation results for Eq. (2). For both Moody's and Fitch rating revisions, the coefficients on RC and AfterRC1 remain significantly positive for rating upgrades and significantly negative for rating downgrades. As in the case of the S&P sovereign rating revisions, the revisions by Moody's and Fitch are also associated with significant but temporary changes in private investment growth.

#### 4.4. Time-clustering rating changes

Our regression analyses examine the impact of sovereign rating changes on the growth rate of private investment in the year of rat-

ing revision (year 0) and in the 3 years after the revision (years + 1 to +3). Our results could be biased if there is more than one rating revision for the same country within the 7-year (−3, +3) window. To reduce potential problems associated with such overlapping data, we re-estimate our panel regressions using only non-overlapping observations (i.e., only one rating change occurs for each country within the (−3, +3) window).<sup>8</sup> The first two columns in Table 11 present the system GMM panel estimation results. Our conclusion remains unchanged. The coefficients on RC and AfterRC1 are significantly positive for S&P rating upgrades and significantly negative for rating downgrades. The coefficients on AfterRC2 and AfterRC3 are not statistically significant for both upgrades and downgrades.

#### 4.5. Size of rating changes and crossing of investment-grade threshold

Hand et al. (1992) and Brooks et al. (2004) suggest that the effects of rating changes are stronger for multi-grade changes than for single-grade changes. A greater degree rating change may have more of an impact on a country's cost of capital and its private investment than a smaller rating change. To control for the potential impact of the size of rating changes, we add a variable, *Notches*, to Eq. (2), where *Notches* denote the number of notches on the rating scale by which a rated country is upgraded or downgraded.

Column 3 of Table 11 shows that for S&P rating upgrades, the coefficient on AfterRC1 is significantly positive, although the coefficient on RC is statistically insignificant. Column 4 shows that the coefficients on AfterRC1 are significantly negative for rating downgrades. The results indicate that sovereign credit rating revisions are associated with significant and temporary changes in private investment growth even after controlling for the size of rating changes. We find a significantly negative relation between private investment growth and *Notches* for rating downgrades, suggesting that a more severe downgrade leads to a more adverse impact on private investment growth.

In the last two columns of Table 11, we also control for the effects of sovereign rating changes that cross the investment-grade threshold. Holthausen and Leftwich (1986) and Pukthuanthong-Le et al. (2007) suggest that such rating changes are expected to induce stronger effects. We add to Eq. (2) a dummy variable, *Threshold*, that takes a value of one if the S&P rating upgrade or downgrade crosses the investment-grade threshold, and zero otherwise. We find that the coefficients on RC and AfterRC1 remain significantly positive for rating upgrades and significantly negative for rating downgrades. The coefficient on *Threshold* is statistically insignificant, probably because only a tiny fraction of rating changes (under 10%) in the sample cross the investment-grade threshold.

#### 4.6. Rating outlooks and credit watches

Most credit rating agencies not only provide a rating for a sovereign government, but also give an indication of future changes in ratings through a rating outlook and a credit watch (watch list). For example, S&P's CreditWatch indicates the potential direction of a sovereign rating change, dependent on identifiable events and short-term trends, and is typically resolved within 90 days (Sy, 2004). S&P's rating outlook indicates the potential direction of a sovereign rating change within 6 months to 2 years. Moody's also uses Watchlist and rating outlook to provide an indication of the likely direction of sovereign rating changes (Hamilton and Cantor, 2004).

<sup>8</sup> We also perform regressions for non-overlapping observations within the (0, +3) or (−5, +5) window and obtain similar results.

**Table 11**

The relation between private investment growth and sovereign rating changes after accounting for time-clustering rating changes, size of rating changes, and crossing of investment-grade threshold.

	Non-overlapping data		Size of rating changes Investment-grade threshold			
	Upgrade	Downgrade	Upgrade	Downgrade	Upgrade	Downgrade
RC	0.065*** (0.016)	−0.096*** (0.024)	−0.019 (0.063)	−0.037 (0.057)	0.036*** (0.011)	−0.106*** (0.035)
AfterRC1	0.038*** (0.018)	−0.144*** (0.062)	0.055*** (0.026)	−0.092*** (0.050)	0.050*** (0.028)	−0.101*** (0.048)
AfterRC2	0.018 (0.016)	−0.005 (0.043)	0.021 (0.023)	0.023 (0.027)	0.016 (0.022)	0.023 (0.027)
AfterRC3	0.029 (0.019)	−0.002 (0.028)	0.016 (0.018)	0.001 (0.021)	0.014 (0.016)	−0.0004 (0.021)
Notches			0.056 (0.061)	−0.065 (0.034)		
Threshold					0.052 (0.085)	−0.034 (0.147)
GEGO_MA	0.153*** (0.052)	0.176*** (0.057)	0.151*** (0.053)	0.169*** (0.059)	0.154*** (0.053)	0.171*** (0.060)
InitialIncome	−0.013 (0.008)	−0.027*** (0.009)	−0.010 (0.009)	−0.026*** (0.009)	−0.010 (0.009)	−0.026*** (0.009)
HumanCapital	0.012 (0.008)	0.014* (0.008)	0.010 (0.007)	0.015* (0.008)	0.011 (0.008)	0.014* (0.008)
OECDgrowth	1.536*** (0.211)	1.520*** (0.194)	1.451*** (0.190)	1.485*** (0.197)	1.485*** (0.177)	1.478*** (0.191)
TBrate	−0.751* (0.412)	−0.508 (0.438)	−0.641* (0.358)	−0.506 (0.427)	−0.652* (0.347)	−0.527 (0.440)
GDPgrowth	−0.001 (0.196)	−0.208 (0.257)	−0.054 (0.192)	−0.220 (0.247)	−0.059 (0.202)	−0.203 (0.244)
Inflation	0.018 (0.191)	0.057 (0.191)	−0.108 (0.168)	0.073 (0.174)	−0.009 (0.207)	0.060 (0.206)
ExternalDebt	−0.002 (0.006)	0.001 (0.007)	−0.002 (0.006)	0.0004 (0.007)	−0.001 (0.006)	0.0002 (0.007)
<i>Specification tests</i>						
Hansen test	22.88 [0.820]	23.56 [0.750]	23.23 [0.971]	20.57 [0.987]	23.80 [0.965]	20.22 [0.984]
AR(1)	−2.70*** [0.007]	−2.50*** [0.013]	−2.64*** [0.008]	−2.47*** [0.014]	−2.64*** [0.008]	−2.48*** [0.013]
AR(2)	−1.29 [0.196]	−1.04 [0.300]	−1.30 [0.194]	−1.03 [0.305]	−1.35 [0.178]	−1.09 [0.276]
Observations	584	529	584	529	584	529

The dependent variable is the growth rate of private investment. Regressions are estimated using a system generalized method of moments (system GMM). All regressions include a constant term (unreported). The independent variables *RC*, *AfterRC1*, *AfterRC2*, and *AfterRC3* are binary, with a value of one in the year of the rating revision, the first year after the revision, the second year after the revision, and the third year after the revision, and zero otherwise. The first two columns show the results for non-overlapping observations within the 7-year (−3, +3) window, where year 0 denotes the year in which sovereign credit rating changes. *Notches* are the size of rating changes. *Threshold* is a binary variable that takes a value of one if the rating revision crosses the investment-grade threshold, and zero otherwise. *GEGO\_MA* is defined in Table 4. *InitialIncome*, *HumanCapital*, *OECDgrowth*, *TBrate*, *GDPgrowth*, *Inflation*, and *ExternalDebt* are defined in Table 3. Robust standard errors adjusted for panel-specific autocorrelation and heteroskedasticity are reported in parentheses. *p*-Values for specification tests are reported in brackets.

\* Represent 10% significance levels.

\*\* Represent 5% significance levels.

\*\*\* Represent 1% significance levels.

Changes in rating outlooks or credit watches (watch lists) may be followed by changes in credit ratings (Kaminsky and Schmukler, 2002). To control for the potential effects of credit outlooks and credit watches, we add two indicator variables, *Outlook* and *Watch*, to Eq. (2). *Outlook* takes a value of one if S&P announces a positive (negative) rating outlook during the 2 years prior to rating upgrades (downgrades), and zero otherwise. *Watch* takes a value of one if S&P announces a positive (negative) credit watch during the 6 months before rating upgrades (downgrades), and zero otherwise. Table 12 provides the estimates of system GMM panel regressions. Sovereign credit rating revisions are still associated with significant, temporary changes in private investment growth. The coefficients on *Outlook* are statistically insignificant and the

**Table 12**

The relation between private investment growth and sovereign rating changes after accounting for rating outlooks and credit watches.

	Rating outlook		Credit watch	
	Upgrade	Downgrade	Upgrade	Downgrade
RC	0.035* (0.019)	−0.078** (0.038)	0.040*** (0.008)	−0.088*** (0.033)
AfterRC1	0.049* (0.029)	−0.089* (0.046)	0.050* (0.029)	−0.104*** (0.049)
AfterRC2	0.015 (0.024)	0.025 (0.025)	0.015 (0.024)	0.023 (0.025)
AfterRC3	0.013 (0.017)	0.006 (0.021)	0.013 (0.017)	−0.002 (0.019)
Outlook	0.008 (0.031)	−0.046 (0.032)		
Watch			−0.015 (0.052)	−0.094* (0.055)
GEGO_MA	0.156*** (0.054)	0.168*** (0.059)	0.157*** (0.052)	0.161*** (0.059)
InitialIncome	−0.011 (0.009)	−0.028*** (0.009)	−0.011 (0.009)	−0.026*** (0.008)
HumanCapital	0.012 (0.008)	0.014* (0.008)	0.011 (0.008)	0.013* (0.007)
OECDgrowth	1.496*** (0.171)	1.450*** (0.184)	1.493*** (0.168)	1.451*** (0.196)
TBrate	−0.633* (0.342)	−0.570 (0.419)	−0.621* (0.343)	−0.509 (0.435)
GDPgrowth	−0.061 (0.197)	−0.178 (0.222)	−0.064 (0.201)	−0.196 (0.224)
Inflation	−0.014 (0.208)	0.061 (0.203)	−0.012 (0.205)	0.075 (0.206)
ExternalDebt	−0.001 (0.006)	0.0002 (0.007)	−0.001 (0.006)	0.001 (0.007)
<i>Specification tests</i>				
Hansen test	26.07 [0.622]	19.29 [0.914]	24.75 [0.691]	21.01 [0.859]
AR(1)	−2.60*** [0.009]	−2.50*** [0.013]	−2.62*** [0.009]	−2.57*** [0.010]
AR(2)	−1.36 [0.173]	−1.01 [0.313]	−1.33 [0.183]	−0.94 [0.346]
Observations	584	529	584	529

The dependent variable is the growth rate of private investment. Regressions are estimated using a system generalized method of moments (system GMM). All regressions include a constant term (unreported). The independent variables *RC*, *AfterRC1*, *AfterRC2*, and *AfterRC3* are binary, with a value of one in the year of the rating revision, the first year after the revision, the second year after the revision, and the third year after the revision, and zero otherwise. *Outlook* takes a value of one if S&P announces a positive (negative) rating outlook during the 2 years prior to rating upgrades (downgrades), and zero otherwise. *Watch* takes a value of one if S&P announces a positive (negative) credit watch during the 6 months before rating upgrades (downgrades), and zero otherwise. *GEGO\_MA* is defined in Table 4. *InitialIncome*, *HumanCapital*, *OECDgrowth*, *TBrate*, *GDPgrowth*, *Inflation*, and *ExternalDebt* are defined in Table 3. Robust standard errors adjusted for panel-specific autocorrelation and heteroskedasticity are reported in parentheses. *p*-Values for specification tests are reported in brackets.

\* Represent 10% significance levels.

\*\* Represent 5% significance levels.

\*\*\* Represent 1% significance levels.

coefficients on *Watch* are significantly negative for rating downgrades but insignificant for rating upgrades.<sup>9</sup>

## 5. Conclusions

Previous research on sovereign rating changes tends to concentrate on their short-term announcement effects on financial markets, with no attention to their impact on the re-rated country's private investment. Yet changes in sovereign ratings affect real macroeconomic outcomes, and physical capital investment plays an important role in determining a country's long-term growth rate.

<sup>9</sup> The rating outlooks and watch lists of Moody's and Fitch yield similar results.



The recent downgrades in sovereign ratings for several countries in Europe have shown how important it is to examine the issue.

Sovereign rating revisions may be associated with changes in country risk and net capital flows, which in turn cause the risk-free rate and the risk premium to vary. Therefore, sovereign rating revisions may lead to changes in a country's cost of capital and the net present values of investment projects. This implies that changes in private capital investment may occur following sovereign rating revisions.

Examination of a sample of Standard & Poor's sovereign rating changes for 48 countries during 1983–2009 reveals that real private investment growth increases significantly following upgrades in sovereign ratings. The increases, however, are temporary, and occur only in the upgrade year and in the first year after the upgrade. Similarly, following downgrades in ratings, private investment growth exhibits significant and temporary declines in the downgrade year and in the first year after the downgrade. There is a strong transmission linkage between sovereign rating changes and cost of capital and private investment growth. In the second and third years after a rating revision, private investment growth does not show any significant change. The transitory effects of sovereign rating changes on private investment growth hold even after accounting for re-rated countries' exogenous growth opportunities and the potential endogeneity problem. Our conclusion remains unchanged if we also control for the potential effects of world business cycles, domestic economic fundamentals, financial liberalization, financial crises, different rating agencies, extent of rating changes, crossing of the investment-grade threshold, rating outlooks, and credit watches.

One possible explanation for the temporary changes in private investment growth associated with sovereign rating revisions is the irreversible nature of investment. We show that the negative impact of country uncertainty on private investment growth strengthens in the short period immediately after a downgrade and lessens after an upgrade. Our results suggest that sovereign rating downgrades boost a country's risk and uncertainty, so agents decide to wait for the arrival of new information and not invest, resulting in a temporary reduction in private investment growth following the downgrade. Conversely, when there are sovereign rating upgrades, agents accelerate committed investment projects because of reduced country risk and uncertainty.

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