A New Test for the Presence of Capital Market Imperfections in Transition Economies*

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Abstract

We construct and simulate an investment model with non-convex capital adjustment costs and cash accumulation. The model suggests that investment-cash flow sensitivities are unlikely to be informative indicators of the presence of capital market imperfections. However, savings-cash flow sensitivities are. Our model's predictions are supported within a panel of 4223 Bulgarian, Czech, Polish, and Romanian firms, over the period 1998-2005, for which we document significant evidence of both capital market imperfections and fixed capital adjustment costs.
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1 Introduction

A large body of empirical work has established the significance of financial variables in influencing firm level investment. In this work, measures of internal finance have been found to be important determinants of investment, even after controlling for investment opportunities (see Schiantarelli (1995); Hubbard (1998); and Bond and Reenen (2006), for surveys). For example, within an augmented Q model of investment, Fazzari et al. (1988) find that the sensitivity of investment to cash flow is much higher for firms which are a priori expected to be liquidity constrained. This finding has proven remarkably robust: it has been reported in a variety of datasets, different countries, and time periods. Accordingly, investment-cash flow sensitivities have been frequently interpreted as evidence of capital market imperfections that disturb firms' investment from the frictionless neoclassical benchmark.

However Kaplan and Zingales (1997), Cleary (1999), and others have challenged this view, claiming that firms more likely to face financing constraints face lower investment-cash flow sensitivities than their financially healthier counterparts. More recent work by Erickson and Whited (2000, 2002, 2010), Gomes (2001), Cooper and Ejarque (2003), Abel and Eberly (2003), Cummins et al. (2006) and Tsoukalas (2010) also cast doubt on the validity of investment-cash flow sensitivities as valid indicators for the presence of capital market imperfections. Some of this work highlights that cash flow may be a significant determinant of investment simply because it captures investment opportunities not properly accounted for by Tobin's Q[1]. Alternatively, positive and significant sensitivities of investment to cash flow have been attributed to specification errors present in reduced form investment equations, which arise because the simple neoclassical investment framework based on the assumption of convex adjustment costs may miss several important aspects of firm level investment.

One particular feature of investment spending, which has been extensively documented in

[1] Yet, D'Espallier and Guariglia (2009) show that the investment opportunity bias is not a serious problem for unlisted firms.

earlier work is its lumpy nature (see, for example, Doms and Dunne (1998); and Cooper and Haltiwanger (2006), for evidence on plant level data which exhibit this characteristic, due to fixed capital adjustment costs). A distinct conclusion from this line of work is that investment spending is sporadic, i.e. periods of investment inaction are followed by periods of investment (or dis-investment) bursts. Nonetheless, the interaction of lumpy investment with capital market imperfections has received little attention.[2] Our paper fills this gap in the literature.

We construct a simple investment model with fixed adjustment costs, costly external finance and cash accumulation that gives rise to two investment regimes: an active regime and an inactive regime. We then simulate this model and investigate the following two issues. First, we ask whether, high investment-cash flow sensitivities in reduced form investment equations augmented with cash flow can be considered as reliable indicators for the presence of capital market imperfections (CMI). Not surprisingly we find that these sensitivities are not reliable indicators of CMI. The fundamental reason for this finding is mis-specification in the linear investment-Q regression. This mis-specification arises because in the presence of fixed adjustment costs, the optimal investment rule in the model is non-linear and cash flow simply helps with the fit of a misspecified equation.

Second, we ask whether we can design a simple and easily implementable alternative test, that is robust to the presence of non-convex adjustment costs and can thus provide reliable answers regarding the importance of CMI. In a simulation environment, we identify a robust way to test for the importance of CMI in the presence of non-convex adjustment costs. This consists in using a regression that focuses on the accumulation of liquid assets and analyzing the sensitivity of savings or cash accumulation to cash flow. The reason why this sensitivity provides reliable evidence as to the presence of capital market imperfections is that with fixed costs of capital adjustment, forward looking firms that face costly external finance will

[2] One notable exception is Whited (2006) who studies the influence of costly external finance on the timing of investment spending.

accumulate cash during periods of inactivity, and use the accumulated savings in periods of investment activity, in order to avoid using costly external finance. By contrast, in the absence of external finance costs, firms will set cash equal to zero at all times and the cash flow sensitivity of savings will be identically zero, since, in this case, saving is dominated by the fact that firms are impatient (i.e. the firms' discount rate is higher than the market interest rate). Thus, this regression can reliably differentiate between two industries that only differ in the degree of CMI that they face.

A clear prediction arising from the model with costly external finance is that the savings cash-flow sensitivity will vary according to the investment regime in which firms operate. This is a useful prediction because it helps to sharpen empirical tests based on the savings regression. Testing this prediction empirically is thus an important consideration since it can give credence to the empirical equation we propose.

We then analyze the investment and cash accumulation behavior of 4223 firms from four transition economies (Bulgaria, the Czech Republic, Poland, and Romania), with the aim of testing the predictions of our model. Our sample is an ideal setting to test for the importance of capital market imperfections because the economic environment in these countries is such that costly external finance is likely to be relevant for a large fraction of firms (de Haas (2001)). In addition there is significant evidence that suggests the presence of non-convex adjustment costs in these transition economies. Thus both features we are interested in are present in our sample. To the best of our knowledge, no paper in the literature has addressed the issue of non-convex adjustment costs in the context of transition economies.

As in previous work (Konings et al. (2003)), we observe positive investment- cash flow sensitivities in all four economies. At first glance, one may interpret this finding as an indicator of the presence of CMI, given that our sample consists of unquoted firms that are expected to face significant costs in raising external finance. However, given the evidence of significant non-convex capital adjustment costs in our sample, we are reluctant to view this finding as a reliable indicator for the presence of CMI. Driven by this consideration and the simulation evidence from the model, we then estimate savings-cash flow augmented equations for our sample. In line with the predictions of the model, we find significant saving-cash flow sensitivities for firms that operate in inactivity regimes and insignificant sensitivities for firms that operate in investment activity regimes. These findings suggest that in the presence of non-convex capital adjustment costs, saving-cash flow sensitivities are better indicators for the presence of CMI than the traditionally used investment-cash flow sensitivities.

The rest of the paper proceeds as follows. In section 2, we describe our model. Section 3 presents simulation results, which motivate our empirical analysis. Section 4 describes our dataset and presents some descriptive statistics. Section 5 illustrates our baseline specifications and estimation methodology. Section 6 presents our main empirical results, and section 7 concludes.

2 The Model

We model an industry with many heterogenous firms that produce, invest in fixed capital, and save in cash, where cash earns a risk free rate of return. As in Cooper and Haltiwanger (2006), investment is subject to both convex and non-convex adjustment costs. These costs are a combination of quadratic and fixed adjustment costs. External finance is available, but only at a premium over the risk free rate. The following sections describe the set-up of our model.

2.1 The firm's problem: production and investment

Firm's j production function is given by:

$$y_{jt} = s_{jt} k_{jt}^{\alpha}, \qquad 0 < \alpha < 1, \tag{1}$$

where production, y_{jt}, depends on capital, k_{jt}, and a productivity disturbance, s_{jt}. The parameter α determines the share of capital in production. The (log of) the productivity disturbance is assumed to follow an AR(1) process of the following type:

$$\ln(s_{jt+1}) = \rho \ln(s_{jt}) + \varepsilon_{jt}, \tag{2}$$

where, ρ is the autoregressive parameter, and ε_{jt} is assumed to be IID $N(0, \sigma)$.

The firm accumulates capital according to the following rule:

$$k_{jt+1} = (1 - \delta_k) k_{jt} + i_{jt}, \qquad 0 \leq \delta_k \leq 1, \tag{3}$$

where i_{jt} is fixed investment and δ_k denotes the depreciation rate of capital.

Adjusting the capital stock is assumed to be costly. Specifically, as in Cooper and Haltiwanger (2006), we assume the firm faces both convex and non-convex adjustment costs. Specifically, the adjustment costs consist of two components: a variable cost component, $c_v(i_t, k_t)$, which takes a quadratic form:

$$c_v(i_{jt}, k_{jt}) = \frac{\gamma}{2} \left(\frac{i_{jt}}{k_{jt}} \right)^2 k_{jt}, \qquad \gamma \geq 0. \tag{4}$$

and a non-convex component which is given by:

$$c_f(k_{jt}) = \left\{ \begin{array}{cc} F k_{jt} & \text{for } i_{jt} \neq 0 \\ 0 & \text{for } i_{jt} = 0 \end{array} \right\}, \qquad F \geq 0, \tag{5}$$

where F denotes a fixed cost incurred by the firm during investment or (dis)investment episodes. This component is scaled by the capital stock, k_t, to eliminate any size effects.

In addition to the real decisions described above, firms also make a financial decision.

Specifically, in each period each firm decides the amount of cash to hold, b_{jt}. By definition, this amount is constrained to be non-negative, i.e. firms can only save. Saving earns a post-tax risk-free interest rate of r. Firms can obtain external funds to finance expenditure but only at a premium over the rate offered on savings. Specifically, as in Gomes (2001) and Whited (2006) we assume firms can obtain external funds at a cost. This is a parsimonious and tractable way to introduce costly external finance in the model. Whenever a firm's expenditure exceeds the available sources of income, the firm pays a premium over the risk-free rate. Formally, let

$$div_{jt} = s_{jt}k_{jt}^{\alpha} - k_{jt+1} + (1-\delta_k)k_{jt} - Fk_{jt} - \frac{\gamma}{2}\frac{(k_{jt+1} - (1-\delta_k)k_{jt})^2}{k_{jt}} + (1+r)b_{jt} - b_{jt+1} \tag{6}$$

denote the firm's net cash flow or dividend. We assume the firm pays a cost of obtaining external finance, which takes the following form:

$$\begin{aligned} f_t^{ext}(-div_{jt}) =& fincost(-div_{jt})^2 = fincost(k_{jt+1} - (1-\delta_k)k_{jt} - s_{jt}k_{jt}^{\alpha} \\ & + Fk_{jt} + \frac{\gamma}{2}\frac{(k_{jt+1} - (1-\delta_k)k_{jt})^2}{k_{jt}} - (1+r)b_{jt} + b_{jt+1})^2 \end{aligned} \tag{7}$$

where $f_t^{ext}(\bullet) > 0$ if $div_{jt} < 0$, and $f_t^{ext}(\bullet) = 0$ otherwise. In the expression above, $fincost$ is a parameter capturing the premium the firm pays above the risk-free rate in order to use external funds. Notice that the expression in the external finance cost function is simply expenditures minus internal sources of funds. This cost is assumed to be quadratic. Also note that other things being equal, a higher level of cash, b_{jt} helps to reduce the cost of external finance.

Given the structure of the problem above, the firm will find itself in either of two investment regimes: an active investment where it invests or (dis) invests, and an inactive investment regime where it does not undertake any investment. Let the value function describing each regime be given by, $V^a(s_t, k_t, b_t)$ and $V^i(s_t, k_t, b_t)$ for the active and the inactive regime, respectively (dropping the subscript j for convenience). The firm then solves the following problem:

$$V(s_t, k_t, b_t) = \max\{V^a(s_t, k_t, b_t), V^i(s_t, k_t, b_t)\}$$

The value functions for the active and inactive regimes are given respectively by:

$$\begin{aligned} V^a(s_t, k_t, b_t) =& s_t k_t^\alpha - k_{t+1} + (1-\delta_k)k_t - \frac{\gamma}{2}\frac{(k_{t+1} - (1-\delta_k)k_t)^2}{k_t} \\ & - Fk_t + (1+r)b_t - b_{t+1} - f_t^{ext}(\bullet) + \beta E_{s_{t+1}|s_t} V(s_{t+1}, k_{t+1}, b_{t+1}), \end{aligned}$$

and

$$V^i(s_t, k_t, b_t) = s_t k_t^\alpha - f_t^{ext}(\bullet) + (1+r)b_t - b_{t+1} + \beta E_{s_{t+1}|s_t} V(s_{t+1}, k_t(1-\delta_k), b_{t+1})).$$

where $f_t^{ext}(\bullet)$ is given by 7 above. In the value function formulation above, β denotes the discount factor and E the expectation operator. One particular and important feature of the solution concerns the behavior of cash, b_t. In the simulation exercise described below, we assume that $\beta(1+r) < 1$ so that absent any cost in obtaining external funds, the firm will never hold positive cash balances (equivalently, it will always distribute profits to owners). In fact, cash balances will always be set equal to zero in this case. If however, there is a premium for using external funds—as captured by the $f_t^{ext}(\bullet)$ function—then the firm will find it optimal to save in order to reduce or eliminate the future external finance cost when investing. We will return to this point below. Due to the nature of capital adjustment costs, the firm will invest sporadically and will accumulate cash in periods of investment inactivity.

2.2 Solution and calibration

We solve the dynamic programming problem above using value function iteration. The details of the solution and the calibration of parameters are given in Appendix A. The model is parameterized assuming the time period is one year. The outcome of this problem are policy functions for investment and cash. These policy functions are given by, $I_t = I(k_t, b_t, s_t)$, and $b_{t+1} = b(k_t, b_t, s_t)$ respectively. We use the policy functions to simulate panels that are broadly in line with the characteristics of our data sample (see Appendix A, and Section 4).[3]

It is useful to briefly comment on the policy functions. First, investment displays a non-monotonic relationship to capital given the fixed cost of adjustment. It is well known that with fixed costs of adjustment, there will be periods of inactivity followed by periods of positive (or negative) investment activity. For example, the firm will adjust its capital stock upward, either when it is hit by a sufficiently high and persistent productivity shock, or when the capital stock declines below a critical level, and the productivity of capital becomes very high. This is the well known (S,s) adjustment rule, which operates in the presence of fixed costs, as illustrated in Abel and Eberly (1996), Caballero and Engel (1999), and others.

The important characteristic of the solution that we will exploit in the empirical section below concerns the behavior of cash. Under costless external finance, the firm sets cash balances equal to zero (at all times and states), as it discounts the future more heavily compared to the return earned on cash (recall the assumption $\beta(1 + r) < 1$). However, this changes when there is a premium on external funds as captured by the external finance cost,

[3] The model we use is quite stylized. Its value lies in illustrating the main forces behind investment and cash accumulation, rather than in providing a complete and accurate description of investment behavior in our sample of firms.

$f_t^{ext}(\bullet)$. In this scenario, the firm holds positive cash balances (more precisely positive saving) from time to time. It does so in periods of investment inactivity. It then uses the proceeds to finance investment activity. This behavior is a direct consequence of the firm's incentive to minimize the need to use external funds when investing. Consequently, the sensitivity of savings to cash flow varies according to the investment regime the firm is operating in. It is positive in periods of inactivity as the firm builds up cash balances in anticipation of future investment needs, and negative or zero in periods of investment activity as the firm uses the accumulated cash to invest. We will use this feature of our solution later in the empirical section of the paper in order, to design an empirical test that will enable us to reliably detect the presence of CMI in transition economies.

3 Simulation results

Our goal in this section is to illustrate the implications of the presence of fixed adjustment costs for various reduced form empirical specifications commonly used in the literature. In addition, we wish to explore which type of reduced form specification may be robust (in the presence of fixed costs) when testing for capital market imperfections.

We use the policy functions obtained in the previous section in order to generate samples of firms that differ according to the history of idiosyncratic shocks they receive and initial size (as measured by the capital stock). We simulate two industries each consisting of 25,000 firm-year observations. One industry faces a premium for external funds (as specified in 7), while the other industry does not. We undertake two experiments. First, we specify an investment-Q equation augmented with cash flow and estimate it separately for each of the two industries. This is a very popular specification appearing in numerous empirical studies (e.g Fazzari et al. (1988); Kaplan and Zingales (1997) and Konings et al. (2003)). Second, we specify two versions of a savings-cash flow equation and also estimate each version separately for each industry.

Formally we estimate the following investment-Q equation:

$$\frac{I_{it}}{k_{it}} = \alpha_0 + \alpha_1 \frac{Q_{it}}{k_{it}} + \alpha_2 \frac{CashFlow_{it}}{K_{it}} + \epsilon_{it} \tag{8}$$

and the following savings equations:

$$\frac{\Delta b_{it+1}}{b_{it} + k_{it}} = \beta_0 + \beta_1 \frac{Q_{it}}{b_{it} + k_{it}} + \beta_2 \frac{CashFlow_{it}}{b_{it} + k_{it}} + \epsilon_{it} \tag{9}$$

$$\frac{\Delta b_{it+1}}{b_{it} + k_{it}} = \beta_0 + \beta_1 \frac{Q_{it}}{b_{it} + k_{it}} + \beta_2 \frac{CashFlow_{it}}{b_{it} + k_{it}} + \beta_3 (b_{it} + k_{it}) + \epsilon_{it} \tag{10}$$

In all specifications above we use sales growth as a measure of Q for consistency with the empirical work we undertake in the sections that follow. The first savings equation is identical to the investment-Q equation above except for the left hand side variable. The second savings regression is a generalized version of the first and includes the state variables, capital and cash as right hand side variables. The main empirical specification we use in the empirical section below is the second savings regression but we present simulation results from the simpler specification as well to check whether the latter can identify the presence of CMI.[4]

Table 1 reports the investment-Q regression results. As is clearly evident, this regression is inadequate to reliably detect the presence of costly external finance. The cash flow coefficients in both industries are in fact positive, significant and not statistically different between the two industries (see columns 1 and 2). This result is consistent with the arguments presented in Gomes (2001) and many others that question the ability of investment–cash

[4]For robustness, we have also used Tobin's Q, computed from the model simulations, defined as the value of the firm over its capital stock instead of sales growth as a right hand side variable. The regression results from this specification were qualitatively similar to those presented in Table 1 and Table 2 and are not reported for brevity.

flow sensitivities to identify capital market imperfections. In our model, the investment decision rule is a non-linear function of fundamentals, and cash flow is simply a proxy for the specification error that arises when a linear regression framework is used. Hence, no reliable conclusion as to the presence of capital market imperfections can be drawn from this specification.

Table 2 reports the results of the savings regressions. This regression is similar to that proposed by Almeida et al. (2004) and subsequently used by Khurana et al. (2006) and Riddick and Whited (2009). The results from this regression clearly illustrate the ability of the savings-cash flow regression to detect the presence of costly external finance in the simulated panels. This can be seen comparing the sensitivities in columns 1 and 3 (or 2 and 4) in the top panel of Table 2. These sensitivities are positive and statistically significant in the industry with costly external finance but identically zero in the industry with costless finance. Clearly, this regression constitutes a reliable test for the capital markets imperfection hypothesis under the assumption of fixed adjustment costs. The intuition for this follows directly from the solution of the model with and without costly external finance. When a premium on using external finance is present, savings are accumulated during periods of investment inactivity, and run down during periods of activity. In contrast, in the model without costly external finance, saving is zero in all periods.

In addition, since the sensitivity of savings to cash flow crucially depends on the investment regime, we also estimate our saving specifications separately for firm-year observations characterized by investment activity, and firm-year observations characterized by investment inactivity. We will also use this distinction in the empirical application below in order to sharpen our empirical test and link it with our theoretical model. The bottom part of Table 2 reports the results. As expected, only firms in the inactivity regime exhibit positive savings-cash flow sensitivities, while firms in the activity regime exhibit negative sensitivities.

Last, we note that the regression specification we propose is not equipped to yield a precise prediction as to the exact magnitude of the saving-cash flow sensitivity, since the savings decision rule in the model is also non-linear. Its usefulness lies in the fact that it can reliably detect the presence of capital market imperfections. In the next section, we test the predictions of the model in a panel of four transition economies.

4 Data and summary statistics

Our data set is drawn from the annual accounting reports taken from the AMADEUS database, published by Bureau Van Dijk Electronic Publishing (BvDEP). The database includes balance sheet and profit and loss information for over 11 million public and private companies in 41 European countries over the period 1998-2005. Our focus is on the four transition economies also studied by Konings et al. (2003): Bulgaria, the Czech Republic, Poland and Romania. The sample we choose to work with is particularly well suited for evaluating the ability of competing empirical specifications in testing for the presence of capital market imperfection. As documented below, the transition economies we examine have poorly developed credit markets, and are likely to exhibit fixed capital adjustment costs. These considerations serve to illustrate that costly external finance and/or financial constraints are expected to be particularly severe in these economies.

de Haas (2001) and Arellano et al. (2009) document that capital markets are poorly developed in transition economies. Specifically, Arellano et al. (2009) measure financial development with the level of private credit to GDP and order the 22 countries in their sample according to this measure. They find that Romania (whose level of private credit to GDP is 11%) ranks last, while Bulgaria (with 22%) ranks nineteenth, and the Czech Republic (with 37%) ranks sixteenth. For comparison, Denmark, which ranks first, has a percentage of private credit to GDP of 147%.

We drop observations with negative sales, as well as observations with negative total assets. Firms that do not have complete records on our main regression variables are also dropped. To control for the potential influence of outliers, we exclude observations in the one percent tails for each of our regression variables. Finally, we drop all firms with less than 5 years of consecutive observations. Our final panel, which is unbalanced, covers 462 firms for Bulgaria (corresponding to 2314 observations), 1539 firms for the Czech Republic (corresponding to 7757 observations), 1208 firms for Poland (corresponding to 5629 observations), and 1014 firms for Romania (corresponding to 4656 observations). The majority of these firms are unlisted, and hence particularly likely to face costly external finance and/or financing constraints (Guariglia (2008)).

4.1 Summary statistics

Table 3 presents descriptive statistics of all variables used in our investment models for the entire sample. A list of variable definitions is provided in appendix A.2. Table 4 provides similar statistics for the variables used in our cash models. The average investment to capital ratio ranges from a minimum of 17.2% in Romania, to a maximum of 31.9% in Bulgaria. These rates are much higher than those characterizing Western European countries. For instance, focusing on the period 1978-89, Bond et al. (2003) report investment to capital rates of 12.5% in Belgium, 11.1% in France, 12.2% in Germany, and 11.7% in the UK. The high investment rates in transition economies can be justified in the light of the fact that firms operating in these countries need to invest heavily in order to modernize their obsolete capital stock and acquire competitiveness in the global economy (Lizal and Svejnar (2003)).

The average cash flow to capital ratios range from 24.3% in Bulgaria to 35.2% in Poland, and are in line with those reported by Bayraktar et al. (2005) for Germany.[5] The cash to assets ratio ranges from 5.9% in Romania to 7.2% in the Czech Republic. These numbers

[5] Our figures are not directly comparable with those reported in Bond et al. (2003), due to slight differences in cash flow definitions.

are lower than those reported by Almeida et al. (2004) for US firms, which range from 8-9% for unconstrained firms to 15% for their constrained counterparts, but are in line with those reported by Kalcheva and Lins (2007) for countries such as Spain and Portugal. Finally, the cash accumulation to assets ratios range from 0.1% for Romania to 1.0% for Bulgaria.

4.2 Investment distributions

In this section we describe some features of firm investment rates in our dataset of the four transition economies. Figure 1 shows the investment rates distributions for each country. On immediate inspection the distributions appear to be non-normal. There is a considerable mass around zero, fat tails and some right skewness.[6] We summarize the main features of these distributions in Table 5. First, there is investment inaction. Investment rates near zero (less than 2$ in absolute value) range from around 5% in Poland and Romania to 11.4% in Bulgaria.[7]

These periods of inaction are complemented by periods of investment spikes. We look at various thresholds in order to define an investment spike. In the baseline, we define an investment spike when the investment rate exceeds 50%. This number is considerably higher than the number used, for example, by Cooper and Haltiwanger (2006) to define a spike. We chose this higher threshold because these are transition economies that are expected to have higher investment rates compared to developed economies as they replace obsolete capital (see descriptive statistics above in section 4.1). Investment rates higher than 50% account for a considerable fraction of firm-year observations, ranging from 13.8% for the Czech Republic to 23% for Bulgaria. A similar picture emerges when we consider investment rates above 30%. Based on this threshold, we observe investment spikes ranging from 27% of the observations

[6]The skewness and kyrtosis statistics strongly indicate right skewness and a right fat tail in all countries, thus supporting the non-normality of the investment rate distributions.

[7]We define investment inaction as investment rates less than 2% in absolute value. There are few zero investment rates in our sample given that we have firm level data and aggregation across plants and heterogenous capital goods will likely generate a little bit of investment, e.g. for maintenance reasons.

in the Czech Republic to approximately 35% in Poland and Bulgaria.

We also present an alternative measure of investment spikes based on the percentage of firm-year observations that are 2.5 and 3 times above the firm-level median investment rate for each country. As we can observe from the Table, even using this criterion, a considerable fraction of firm-year observations experience an investment spike. The fractions (for 3 times the median) range from 7% in Poland to 36.4% in Romania. Taken together, these observations strongly suggest that the investment rate data in the four transition economies that we consider are characterized by fixed capital adjustment costs. In the absence of fixed capital adjustment costs, it would be very unlikely to observe so many firm-year observations with investment rates above the investment spike threshold. In a world with convex adjustment costs, most firm-year observations would in fact be characterized by small and continuous investment activity, and very few negative investment episodes. Furthermore, there would be no or very rare evidence of investment inaction.[8]

Finally, it is worth noting the very low serial correlations of investment rates in all four countries. Again, these serial correlations suggest the presence of fixed adjustment costs, because if the data were generated from a model with convex costs only-conditional on the autocorrelation of productivity-we would expect to observe significantly higher serial correlations in investment rates.

In summary, considering that Bulgaria, the Czech Republic, Poland, and Romania are likely to be replacing obsolete with new vintages of capital, we view these facts as signalling the presence of significant fixed costs of adjustment, which may take the form of costs of re-organization, restructuring, or re-training the workforce. This prima facia evidence of fixed capital adjustment costs is the distinctive feature we exploit in our sample in order to evaluate the usefulness of competing econometric specifications that seek to test for the

[8]These outcomes can be generated from a stripped down version of our model with quadratic capital adjustment costs. We do not present results here to save space.

presence of capital market imperfections.

5 Empirical evidence

5.1 Baseline specifications and estimation methodology

5.1.1 Baseline specifications

As in Konings et al. (2003), we initially estimate an equation of the following type:

$$\frac{I_{it}}{K_{it-1}} = \alpha_0 + \alpha_1 \frac{Q_{it}}{K_{it-1}} + \alpha_2 \frac{CashFlow_{it}}{K_{it-1}} + \epsilon_{it} \tag{11}$$

where I_{it} denotes firm i's investment at time t and CF_{it} , its cash flow. Q_{it} represents Tobin's Q, which is included in our specification to control for investment opportunities . Tobin's Q is typically defined as the market value of the firm over the replacement value of its capital stock. As most of the firms in our sample are not listed on the stock market, we are unable to assess their market value. Hence, we control for investment opportunities in two different ways. First, following Konings et al. (2003) and Bakucs et al. (2009), we use the firm's sales growth, instead of Q, as a proxy for the firm's future profitability. Second, we include time dummies interacted with industry dummies in all specifications. As discussed in Brown et al. (2009) and Brown and Petersen (2009), since these dummies account for all time-varying demand shocks at the industry level, their inclusion represents an indirect way to control for investment opportunities or more general demand factors.

The error term in Equation (11), ϵ_{it}, comprises a firm-specific time-invariant component, encompassing all time-invariant firm characteristics likely to influence investment, as well as the time-invariant component of the measurement error affecting any of the regression variables; a time-specific component accounting for possible business cycle effects; and an idiosyncratic component. We control for the firm-specific time-invariant component of the error term by estimating our equation in first-differences, and for the time-specific component by including time dummies (in addition to the time dummies interacted with industry dummies) in all our specifications.

When constraints on the availability of external finance bind – a very likely situation in transition economies (de Haas (2001)) – firms can only pursue profitable investment projects using internal funds. Costly external finance may thus retard investment spending if firms do not have adequate internal funds to undertake such spending. We therefore expect a positive and significant investment-cash flow sensitivity (i.e. a positive and significant α_2 coefficient in Equation 11). However, when we consider the sporadic nature of investment under fixed adjustment costs, as we have explained in section 3, the interpretation of such coefficient is dubious and thus it may no longer be the case that it signals the presence of CMI. As illustrated in section 3, cash flow may appear to be an important determinant of investment in such a regression simply because it helps with the fit of a mis-specified investment equation and may have nothing to do with costly external finance or CMI in general.

Guided by the simulation results reported in section 3, our second test of the capital market imperfections hypothesis focuses on the estimation of the following empirical model, which relates the firm's accumulation of cash (saving) to total assets ratio ($\Delta Cash_{it}/TotalAssets_{it-1}$) to its cash flow to assets ratio, Tobin's Q (proxied by sales growth), and size (measured by the logarithm of its total assets):

$$\frac{\Delta Cash_{it}}{TotalAssets_{it-1}} = \beta_0 + \beta_1 \frac{Q_{it}}{TotalAssets_{it-1}} + \beta_2 \frac{CashFlow_{it}}{TotalAssets_{it-1}} + \beta_3 SIZE_{it-1} + \epsilon_{it} \quad (12)$$

The model described in section 3 implies that firms facing costly external finance will accumulate cash in periods of inactivity and use the savings during periods of investment activity in order to avoid the cost associated with using external finance. Hence, as discussed in the simulation results of section 3, this regression should provide reliable evidence on the presence of CMI. A similar specification is also used by Almeida et al. (2004), who derive it from a model of corporate liquidity, and by Khurana et al. (2006), Pál and Ferrando (2010), and Riddick and Whited (2009), who use it to test for the presence of CMI. It should be noted that the regression specification above is identical to the regression specification used in section 3, since the $(k + b)$ in Equation (10) actually corresponds to $SIZE$ in Equation (12).

In addition to the baseline specification above and with reference to the model simulations provided in section 3, we next test whether, as predicted by the model, firms in the inactive investment regime tend to accumulate cash at a relatively faster pace compared to firms with robust investment spending. This is a key prediction of the model and we view this test as a stricter way to validate it. Therefore, to assess whether changes in cash flow have a differential impact on the cash accumulation of firms in different investment regimes, we interact our cash flow variable in Equation (12) with a dummy variable, which aims to capture which investment regime the firm is operating in. This consideration leads to the following equation:

$$\frac{\Delta Cash_{it}}{TotalAssets_{it-1}} = \beta_0 + \beta_1 \frac{Q_{it}}{TotalAssets_{it-1}} + \beta_2 \frac{CashFlow_{it}}{TotalAssets_{it-1}} * INAC_{it} + \beta_3 \frac{CashFlow_{it}}{TotalAssets_{it-1}} * (1 - INAC_{it}) + \beta_4 SIZE_{it-1} + \epsilon_{it} \quad (13)$$

where $INAC_{it}$ takes the value of one for firm-year observations with investment rates in the range [-2%,2%], i.e. in the inactive regime, and 0 otherwise (active regime).

5.1.2 Estimation methodology

All equations are estimated in first-differences, to control for firm-specific, time-invariant effects. Given the possible endogeneity of our regressors, we use a system Generalized Method of Moments (GMM) approach (Arellano and Bover (1995); Blundell and Bond (1998)). This estimator combines in a system the relevant equation in first differences and in levels. It makes use of values of the regressors lagged twice or more as instruments in the differenced equation, and of differences of the regressors lagged once in the levels equation. The system GMM estimator is preferred to the simple first-difference GMM estimator when instruments are likely to be weak (Blundell and Bond (1998)).

To evaluate whether our instruments are legitimate and our model is correctly specified, we use the Sargan test (also known as J test), which is a test for overidentifying restrictions, and the test for second-order serial correlation of the residuals in the differenced equation ($m2$). Under the null of instrument validity, the former test is asymptotically distributed as a chi-square with degrees of freedom equal to the number of instruments less the number of parameters. The $m2$ test is asymptotically distributed as a standard normal under the null of no second-order serial correlation of the differenced residuals, and provides a check on the specification of the model and legitimacy of variables dated t-2 as instruments in the differenced equation.[9]

[9] If the un-differenced error terms are i.i.d., then the differenced residuals should display first-order, but not second-order serial correlation. Note that neither the Sargan nor the $m2$ tests allow to discriminate between bad instruments and model specification.

6 Empirical results

6.1 Main specifications

Table 6 presents estimates of Equation (11). The cash flow coefficients are positive and statistically significant for all countries. In terms of magnitudes, these coefficients range from 0.36 for Romania to 0.96 for Bulgaria and are statistically significant at the one percent level. These coefficients suggest that the elasticity of investment to cash flow, evaluated at sample means, is 0.73 for Bulgaria and 0.71 for Romania. In other words, a 10% increase in cash flow implies a 7.3% and 7.1% increase in investment for Bulgarian and Romanian firms respectively. The elasticities for the Czech Republic and Poland are respectively 0.47 and 0.53. At first sight these results signal significant evidence of capital market imperfections in all four transition countries.[10] However, viewed from the lens of our model and the simulation results in section 3, these sensitivities should be interpreted with caution since it is quite likely that the positive cash flow coefficients simply proxy for mis-specification bias due to the non-linear nature of investment. In fact, this interpretation is especially relevant, in the light of the evidence of significant fixed adjustment costs identified in our sample in section 4.

Table 7 presents the estimates of our baseline cash accumulation model. First, all four countries exhibit positive sensitivities of cash accumulation to cash flow. These results confirm the prediction of our model according to which firms that face costly external finance will exhibit positive sensitivities. The cash flow sensitivities of cash for the four transition economies are higher in magnitude compared to the sensitivities obtained by Almeida et al. (2004) for the US. Considering the relatively low level of financial development characterizing transition economies in comparison with the US (de Haas (2001) and Arellano et al. (2009)),

[10]Konings et al. (2003) reached a similar conclusion for Poland and the Czech Republic, but did not find evidence of financing constraints for Bulgaria and Romania. The difference between our results and theirs may be due to the fact that their sample covers a much earlier time period (1994-1999).

and considering that financial development reduces the costs of external funds and eases firms' financing constraints, this result is consistent with Khurana et al. (2006)'s finding that the cash flow sensitivity of cash is higher for countries characterized by lower financial development. In both Tables 6 and 7, the Sargan test statistics are insignificant at the conventional 5% level, and in most cases the $m2$ test does not indicate problems with our instruments.

6.2 Differentiating firms according to the investment regime

Given the inability of the investment cash flow regression to reliably detect the presence of capital market imperfections in the presence of fixed capital adjustment costs, we now focus on the savings regression that allows us to test the predictions of our model more precisely. Recall that a main prediction of our model is that the rate of cash accumulation will differ according to the investment regime. In particular, the sensitivity of savings to cash flow should be higher for those firm-year observations that fall in the investment inactivity regime compared to firms in the activity regime.

In order to capture this in our sample, we use the concepts of investment inactivity and investment spikes introduced in section 4, and classify firms accordingly. Table 8 presents estimates of Equation (13) for our four transition economies. In accordance with the prediction of the model, we observe that the cash flow sensitivity of savings varies with the investment regime. In particular, the coefficients on cash flow interacted with the inactivity dummy (Cash Flow/A*INAC) are always positive and statistically significant. They range from values of approximately 0.06 for Poland to 0.23 for Bulgaria. In contrast, the interaction terms between cash flow and the investment-active firms (Cash Flow/A*(1-INAC)) are insignificant and quantitatively unimportant. In addition, as indicated by the test of equality at the foot of the Table, the interactions between cash flow and the inactivity dummy are always significantly different from each other, at the 10% significance level or better.

Both the Sargan and $m2$ tests do not indicate significant problems with the choice of our instruments and the specification of our model.[11] Our data provide therefore strong support to the predictions of the model.

7 Conclusions

A large body of empirical work has established the significance of financial variables in influencing firm level investment, even after controlling for investment opportunities. Within this literature, high investment-cash flow sensitivities have been taken as evidence of capital market imperfections. However, in the presence of fixed capital adjustment costs, this conclusion may no longer be applicable, as investment-Q regressions are incapable of detecting CMI. Nevertheless in a world characterized by fixed capital adjustment costs, there is an alternative, more robust way to test for the presence of CMI, that is using the saving- cash flow sensitivity in a savings regression. A higher sensitivity can be seen as evidence of high CMI. We construct a model characterized by fixed capital adjustment costs, and simulate it to illustrate the usefulness of the savings regression in detecting CMI. We then test the predictions of our model in a sample of four transition economies, where both capital market imperfections and fixed adjustment costs are prevalent. The data provide strong support to our model, and confirm that saving-cash flow sensitivities are better indicators of the presence of CMI than investment-cash flow sensitivities.

Our findings have two implications. First, researchers who aim at testing the presence of CMI should carefully try to assess the likely impact of non-convex capital adjustment costs before making any inferences based on investment-cash flow sensitivities. Second, policies

[11] It is interesting to note that Riddick and Whited (2009), who focus on the role of measurement error in Q, find a negative sensitivity of savings to cash flow in a panel of firms from developed economies. There are two important differences in our data set and empirical design compared to theirs. First, in our sample we document a strong presence of fixed costs, and second we crucially differentiate firms by investment regimes, in order to test for a key prediction of our model.

that aim to stimulate investment through the relaxation of financing constraints may not be successful in achieving the desired effect. Specifically, tax incentives or other policies aimed at increasing available internal resources for investment may have limited success for firms with non-convex adjustment costs.

A Appendix A

A.1 Numerical solution and calibration

We apply value function iteration to solve the model. To this end, the state variables have to be discretized over a certain interval. The size of the intervals is chosen in such a way that the variables remain in the state space during the simulations. The number of grid points per interval guarantees that the results are insensitive to using a finer grid. We discretize the state space of k_t into 150 grid points, that of b_t into 20 points, and that of s_t into 10 points. The process for the productivity shock is approximated as a first order Markov process, using the method by Tauchen (1986). We form a guess for the value function, and based on this guess we find policy functions that maximize the value function. We use the maximized value function thus obtained and repeat the procedure until convergence is achieved. We do not use a specific country as the basis for the calibration. Rather, we select parameter values that can be thought of as targeting the average of all four countries. The results are robust to reasonable perturbations of the parameters. We set the risk-free rate equal to 10%. We set the discount factor, β=0.9, which implies $\beta(1+r) < 1$, a necessary assumption in order for cash to be dominated in the case without costly finance. This can be thought of as a higher discount rate of firm owners relative to the market's discount rate. We set the capital share in production, α at 0.5. Since we did not have any information from the sample, in order to be able to estimate or calibrate this parameter, we chose a value that implies decreasing returns to capital in production. We have experimented with varying this between 0.4 and 0.6 with no noticeable change in the results. Our chosen value is close to the one used by Cooper and Haltiwanger (2006). The depreciation rate is set at 0.15, in line with the ratio of total depreciation to capital in our sample. The capital adjustment cost parameters are set to the values reported in Cooper and Haltiwanger (2006), i.e we set the variable cost parameter γ at 0.049 and the fixed cost parameter, F at 0.039. The parameter that determines the external finance cost, $fincoct$ is set equal to 0.08. This value implies a premium for using external funds equal to 8%. This choice is guided (though it is only an imprecise mapping) by the interest burden (i.e. the ratio of total interest expense to total debt) observed in our sample, which varies between 15% for Bulgaria to 33% for Romania. Finally, the persistence and standard deviation of the idiosyncratic productivity shock are chosen in order to come as close as possible to the persistence and volatility of investment rates in our sample as reported in Table 5 (last row) and Table 3 (first row, standard deviation reported in parenthesis). Specifically, we set $\rho = 0.75$ and $\sigma = 0.025$. This gives a persistence in investment rates in our simulated sample (in the industry with costly external finance with 25,000 firm year observations) equal to 0.11 and a standard deviation equal to 0.42, which are within the range of values observed in our sample (see Tables 3 and 5). [12]

A.2 Variable construction

This section provides the definition of variables used in the empirical section of the paper.

- *Total assets*: sum of the firm's fixed and current assets, where fixed assets include tangible fixed assets, intangible fixed assets, and other fixed assets; and current assets include inventories, accounts receivable, and other current assets.
- *Cash flow*: net income plus depreciation.
- *Cash*: cash and equivalents.
- *Fixed investment*: difference between the book value of tangible fixed assets (which include land and buildings; fixtures and fittings; and plant and vehicles) of end of year t and end of year t-1, plus depreciation of year t.
- *Capital stock*: tangible fixed assets.

[12]Since we are only interested in simulating panels of firms, and not in matching, for example, industry dynamics, for simplicity, we ignore any common component in the productivity process across firms.

- Q: Tobin's Q proxied by the firm's sales growth.
- $Sales$: firm's total sales (including domestic and overseas sales).
- $Deflators$: all variables are deflated using the GDP deflator for the relevant country.

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Figure 1: Investment rates by country

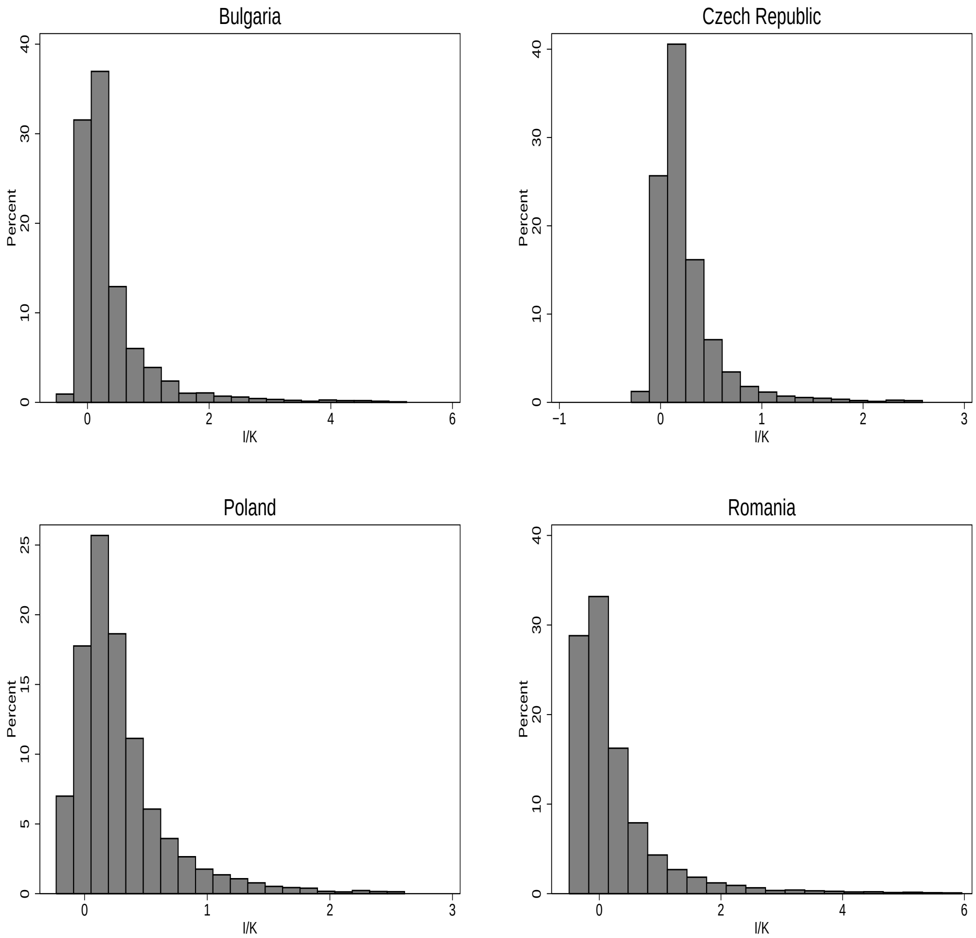

Table 1: Simulated investment equations

	Panel with costly external finance	Panel with costless external finance
	(1)	(2)
$\frac{CashFlow}{k}$	5.904***	5.858***
	(0.038)	(0.039)
$\frac{Q}{k}$	1.802***	1.740***
	(0.022)	(0.022)
$Observations$	25,000	25,000
$R-squared$	0.55	0.55

Notes: Dependent variable is $\frac{I_{it}}{k_{it}}$. All specifications were estimated using OLS. The figures reported in parentheses are robust asymptotic standard errors. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

Table 2: Simulated savings regressions

	Panel with costly external finance		Panel with costless external finance	
	(1)	(2)	(3)	(4)
$\frac{CashFlow}{b+k}$	0.083**	0.356***	0	0
	(0.034)	(0.053)		
$k+b$		0.103***		0
		(0.001)		
$\frac{Q}{b+k}$	2.351***	2.192***	0	0
	(0.018)	(0.027)		
$Observations$	25,000	25,000	25,000	25,000
$R-squared$	0.52	0.69		
Controlling for investment regime				
Panel with costly external finance				
$\frac{CashFlow}{b+k}*INAC$	0.686***	0.686***		
	(0.067)	(0.066)		
$\frac{CashFlow}{b+k}*(1\text{-}INAC)$	-0.243***	-0.238***		
	(0.067)	(0.065)		
$k+b$		0.002**		
		(0.001)		
$\frac{Q}{b+k}$	1.576***	1.579***		
	(0.033)	(0.033)		
$Observations$	25,000	25,000		
$R-squared$	0.954	0.954		
Test of equality (p-value): Cash Flow	0.00	0.00		

Notes: Dependent variable is $\frac{\Delta b_{it+1}}{b_{it}+k_{it}}$. All specifications were estimated using OLS. $INAC$ is a dummy variable that takes the value 1 for firm i if firm i's investment rate is equal to zero, and zero otherwise. The figures reported in parentheses are robust asymptotic standard errors. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

Table 3: Summary statistics: baseline investment model

	Bulgaria	Czech Republic	Poland	Romania
I/K	0.318	0.223	0.263	0.172
	(0.540)	(0.278)	(0.346)	(0.648)
Q/K	0.446	0.357	0.467	0.033
	(1.391)	(1.039)	(1.501)	(1.385)
$CashFlow/K$	0.243	0.271	0.352	0.346
	(0.290)	(0.321)	(0.441)	(0.571)
K	34.801	73.565	60.825	19.917
	(64.075)	(127.977)	(98.248)	(41.448)
Observations	2314	7757	5629	4656

Notes: I represents the firm's real investment; K, its real capital stock (expressed in thousands of euros); and Q, Tobin's Q, proxied by the firm's sales growth. The numbers in this Table are means, with standard deviations in parentheses. See the Appendix for precise definitions of all variables.

Table 4: Summary statistics: baseline cash model

	Bulgaria	Czech Republic	Poland	Romania
$Cash/A$	0.065	0.071	0.063	0.059
	(0.098)	(0.087)	(0.087)	(0.085)
$\Delta Cash/A$	0.009	0.006	0.008	0.0008
	(0.068)	(0.052)	(0.052)	(0.061)
Q/A	0.181	0.130	0.163	0.019
	(0.533)	(0.328)	(0.482)	(0.491)
$CashFlow/A$	0.107	0.105	0.129	0.132
	(0.107)	(0.090)	(0.122)	(0.174)
$Cash$	2.855	8.124	7.177	1.936
	(8.188)	(23.241)	(19.855)	(5.938)
A	69.664	145.795	130.862	43.107
	(114.922)	(222.750)	(192.222)	(82.657)
Observations	2310	7747	5600	4651

Notes: A represents the firm's real total real assets (expressed in thousands of euros); and Q, Tobin's Q, proxied by the firm's sales growth. $Cash$ represents real cash holdings, expressed in thousands of euros. The numbers in this Table are means, with standard deviations in parentheses. See the Appendix for precise definitions of all variables.

Table 5: Investment spikes and inaction regimes

	Bulgaria	Czech Republic	Poland	Romania
Investment rates within 2%	11.4%	6.8%	4.7%	5.1%
Investment rates > 80%	14.78%	6.53%	10.73%	14.50%
Investment rates < -80%	0.48%	0.11%	0.09%	0.11%
Investment rates > 50%	23.0%	13.8%	19.2%	21.4%
Investment rates < -50%	1.0%	0.4%	0.2%	0.9%
Investment rates > 30%	34.8%	26.8%	35.2%	29.3%
Investment rates <- 30%	1.49%	0.94%	0.58%	14.81%
Investment rates < 0	14.9%	11.0%	18.4%	46.9%
Investment rates: 2.5 times above firm median	18.2%	11.5%	8.4%	36.6%
Investment rates: 3 times above firm median	16.9%	9.3%	7.0%	36.4%
Correlation $(\frac{I}{K}, (\frac{I}{K})_{-1})$	0.13	0.09	0.14	0.01

Notes: Firm level medians are computed for each country separately.

Table 6: Baseline investment model

	Bulgaria	Czech Republic	Poland	Romania
Q/K	0.236**	0.002	-0.010	0.193***
	(0.10)	(0.03)	(0.03)	(0.06)
$Cashflow/K$	0.960***	0.391***	0.400***	0.356***
	(0.35)	(0.09)	(0.09)	(0.12)
$Observations$	2314	7757	5629	4656
$Firms$	462	1539	1208	1014
$m2$	0.534	0.341	0.701	0.644
$Sargan$	0.188	0.129	0.123	0.316

Notes: All specifications were estimated using a GMM system estimator. The figures reported in parentheses are asymptotic standard errors. Time dummies and time dummies interacted with industry dummies were included in all specifications. Standard errors and test statistics are asymptotically robust to heteroskedasticity. Instruments in all columns are Q/K and $Cashflow/K$ lagged twice or more. Time dummies and time dummies interacted with industry dummies were always included in the instrument set. The J statistic is a test of the overidentifying restrictions, distributed as chi-square under the null of instrument validity. m2 is a test for second-order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. Also see the Appendix for precise definitions of all variables. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

Table 7: Baseline cash model

	Bulgaria	Czech Republic	Poland	Romania
Q/A	0.008	0.003	0.001	-0.005
	(0.02)	(0.01)	(0.00)	(0.01)
$Size$	0.016	-0.006	0.002	0.008
	(0.01)	(0.01)	(0.00)	(0.01)
$Cashflow/A$	0.096*	0.118***	0.085***	0.097**
	(0.05)	(0.03)	(0.02)	(0.05)
$Observations$	2250	7,479	5,428	4,513
$Firms$	459	1,515	1,201	1,006
$m2$	0.426	0.320	0.560	0.00
$Sargan$	0.620	0.05	0.283	0.05

Notes: All specifications were estimated using a GMM system estimator. The figures reported in parentheses are asymptotic standard errors. Time dummies and time dummies interacted with industry dummies were included in all specifications. Standard errors and test statistics are asymptotically robust to heteroskedasticity. Instruments in all columns are Q/A, $Size$ (measured as the log of the firm's real assets), and $Cashflow/A$ lagged twice or more. Time dummies and time dummies interacted with industry dummies were always included in the instrument set. The J statistic is a test of the overidentifying restrictions, distributed as chi-square under the null of instrument validity. m2 is a test for second-order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. Also see the Appendix for precise definitions of all variables. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

Table 8: Cash models controlling for investment inactivity regime

	Bulgaria	Czech Republic	Poland	Romania
Q/A	0.033**	0.004	0.008	0.013
	(0.01)	(0.02)	(0.009)	(0.01)
$Size$	0.002	0.001	0.003	0.005
	(0.007)	(0.005)	(0.005)	(0.007)
$CashFlow/A * INAC$	0.101*	0.061*	0.053**	0.091**
	(0.06)	(0.03)	(0.02)	(0.04)
$CashFlow/A * (1 - INAC)$	-0.195*	-0.256*	-0.100*	-0.134*
	(0.11)	(0.13)	(0.06)	(0.07)
$Observations$	2250	7,479	5,428	4,513
$Firms$	459	1,515	1,201	1,006
$m2$	0.354	0.290	0.423	0.004
$Sargan$	0.226	0.752	0.050	0.456
Test of equality (p-value): Cash Flow	0.00	0.00	0.00	0.00

Notes: All specifications were estimated using a GMM system estimator. The figures reported in parentheses are asymptotic standard errors. Time dummies and time dummies interacted with industry dummies were included in all specifications. Standard errors and test statistics are asymptotically robust to heteroskedasticity. Instruments in all columns are Q/A, $Size$ (measured as the log of the firm's real assets), and $Cashflow/A * INAC$ and $Cashflow/A * (1 - INAC)$ lagged twice or more. $INAC$ is a dummy which takes the value 1 for firm i if firm i's investment rate is greater than -2% and smaller than 2%, and zero if firm i's investment rate is greater than 80%. Time dummies and time dummies interacted with industry dummies were always included in the instrument set. The J statistic is a test of the overidentifying restrictions, distributed as chi-square under the null of instrument validity. m2 is a test for second-order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. Also see the Appendix for precise definitions of all variables. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.