Financial Development, Macro Uncertainty and Saving-Cash Flow Sensitivity

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Abstract

This paper shows that (1) the sensitivity of corporate saving to cash flow does *not* systematically decrease with a country's financial development, and (2) the sensitivity systematically increases with macro uncertainty. The first result occurs because income variability matters more for saving than external finance constraints and because income variability is strongly positively correlated with financial development. The second result occurs because macro uncertainty magnifies the effect of external finance constraints on corporate saving, raises the variability of income flows, and reduces the attractiveness of investment opportunities. Therefore, contrary to previous evidence, saving-cash flow sensitivity cannot be directly used to test for the benefits of financial (and institutional) development, but it can be used to assess the impact of uncertainty on firms' demand for internal liquidity.

JEL Classification Number: G15, G31.

Keywords: saving-cash flow sensitivity; finance constraints; income variability; financial development; macro uncertainty.

1. Introduction

An important—and still debatable issue—concerns how to measure unobservable finance constraints. To address this issue, extant research focuses on corporate demand for internal liquidity as measured by either the level of cash holdings or the *sensitivity of cash saving to cash flow*.[1] Almeida et al. (2004) show that because of their restricted access to external finance, financially constrained firms save from their cash flows to fund future investment, while unconstrained firms generally do not. The sensitivity of saving to cash flow is therefore *positive* for constrained firms. In contrast, Riddick and Whited (2009) argue that income (cash flow) variability is as important as the cost of external finance in determining corporate saving, and conclude that the sensitivity cannot serve as a good measure of finance constraints. They further suggest that, controlling for measurement error in Tobin's *q*, saving and cash flow are often *negatively* correlated. Given only the argument of Almeida et al. (2004), the natural extension is to test the relation between a country's financial development and firms' propensity to save.[2] Since financial development can mitigate finance constraints, firms in countries with more developed capital markets and stronger protection of investors do not need to save as much out of cash flow; they are in essence less constrained (Khurana et al., 2006 and Kusnadi and Wei, 2011).

This study has three purposes. First, I affirm the conclusion that finance frictions and income variability are both important in determining saving. Saving sensitivities are stronger (less negative) in samples of firms with high cost of external finance. Also, saving sensitivities

[1] The extensive body of literature on the level of cash holdings surveyed in Faulkender and Wang (2006), Foley et al. (2007), Bates et al. (2009), McLean (2011), and Pinkowitz et al. (2012).
[2] I refer to "the sensitivity of saving to cash flow" and "the propensity to save out of cash flow" interchangeably.

are stronger (less negative) in samples of firms with high variability of income. These patterns exist because the firm's propensity to save (dissave) increases (decreases) with the cost of external finance and the variability of income.[3] Importantly, the effect of income uncertainty on saving dwarfs the effect of finance constraints. While the *gross* effect of being constrained and having high income variability is economically strong and significant, the *net* effect of being constrained and having low income variability is not. The main message here is that both forces affect the cash flow coefficient and that whatever its sign, this coefficient cannot be used as a standalone measure of finance constraints.

Second, I revise the argument that a country's financial development attenuates the sensitivity of saving to cash flow. On the one hand, firms from developed economies are supposedly less constrained than their counterparts from developing economies (Rajan and Zingales, 1998, Love, 2003). On the other hand, firms from developed economies operate with more innovative capital and in more competitive "new economy" environment, which is associated with higher uncertainty, and thus have more volatile and unpredictable income (Hansen et al., 2005, Moshirian et al., 2017). Because income variability affects firm saving at least as much as do finance constraints and because income variability is strongly positively correlated with financial development, saving sensitivities should *not* systematically decrease with financial development.

[3] The flip in the sign of the cash flow coefficient (more positive vs. less negative) is due to measurement bias in Tobin's *q*. Since the marginal *q* cannot be observed, most studies use Tobin's empirical *q* as a proxy for investment opportunities. The measurement error in the empirical *q* affects the cash flow coefficient in a regression if the regressors are correlated with each other. In this case, the regressors are correlated because the information about growth opportunities contained in cash flow leads to a positive correlation between *q* and cash flow. Therefore, when estimating saving-cash flow sensitivity using OLS, the sensitivity is *positive*. When mismeasured *q* is controlled for, the sensitivity is often *negative*.

The regression results conclude no differential sensitivities between financially developed and developing economies. If finance constraints, not income process, were a dominant force explaining variations in saving, one would document a smaller (more negative) cash flow coefficient in the saving regression with a higher level of financial or institutional development. In fact, however, a climate of financial development and fostered legal protection of investor rights do not attenuate the response of saving to cash flow in a statistically significant or economically meaningful way. Even supposedly exogenous event such as a stock market liberalization seems to have no impact on the sensitivity patterns.

Third, I test the conjecture that corporate cash saving change in response to events affecting *both* the firm's ability to raise costly external finance and to generate stable and predictable income. Such events should be exogenous to the firm policy set and preferably economy-wide, simultaneously affecting all firms at a given point of time. Examining the patterns of corporate saving in the presence of macro uncertainty allows for a test of the idea that finance constraints and income variability conjointly drive significant differences in the demand for internal liquidity. Because macro uncertainty is typically characterized by an impaired access to costly external capital (*finance constraint channel*) (Brunnermeier, 2009, Gorton, 2010, Gilchrist et al., 2014, Alfaro et al., 2017), a decline in corporate profits and increase in their variability (*income uncertainty channel*) (Mian and Sufi, 2010, Kahle and Stulz, 2013), and also the marginal attractiveness of future, as opposed to current investment opportunities (*real options channel*) (McDonald and Siegel, 1986, Bernanke and Blinder,

1988, Bloom, 2009), the response of saving to uncertainty should be significant in either direction (sign) of the cash flow coefficient.[4]

The findings support the notion that firms are exposed to higher costs of external finance and income variability in periods of rising and high uncertainty. As firms' costs of debt and equity, as well as firms' income variability increase, the sensitivity of saving to cash flow appears to be positively associated with uncertainty. It is on average 40% stronger (less negative). Under uncertainty, firms find it optimal to save a greater proportion of their cash inflows or, equivalently, reduce cash outflows. This pattern is consistent with the idea of precautionary saving. It also confirms the conjecture that the sensitivity is useful to measure dynamics of corporate liquidity responses to time-varying macro conditions.

Following Almeida et al. (2004), I estimate a model of the change in cash holdings (saving) as a function of cash flow, Tobin's *q*, and several sources and uses of cash. However, this model specification omits the asymmetric nature of saving-cash flow relation: firms have different levels of responses to their cash holdings when facing positive and negative income (Bao et al., 2012). Hence, the use of an augmented model that includes asymmetric effects of positive and negative income innovations is warranted.

To test how saving sensitivities vary across countries with different levels of financial development, I introduce novel and arguably accurate measures of a country's financial development and the quality of its institutional environment. I define them later in the study. To test how saving sensitivities respond to macro uncertainty, I use the yearly indicators of

[4] As discussed below, macro uncertainty refers to aggregate economic, financial market, or economic policy uncertainty.

U.S. recessions, an index of economic policy uncertainty from Baker et al. (2016), and two measures of aggregate and financial market uncertainty from Jurado et al. (2015).[5] Although the proposed uncertainty measures have different topical scope (and are not perfect), they are all highly correlated with macroeconomic shocks and with each other. They should be considered reliable measures, respectively, of the overall level of aggregate, financial market, and policy-related uncertainty present in the economy.

To measure the firm's investment opportunity set, this study employs Tobin's *q*. Roughly speaking, this variable capitalizes the value of cash holdings to the firm. Still, it is likely to contain a substantial measurement error. To address this widespread econometric problem, I use a method for obtaining consistent estimates in the presence of measurement bias. In particular, I follow the recent work by Erickson et al. (2014) who developed a remedy that is asymptotically equivalent to the moment estimators in Erickson and Whited (2000, 2002). This method runs a linear errors-in-variables regression with identification from the high-order cumulant estimators. Thus, in addition to OLS, all regressions are run using the cumulant estimators.

This study contributes to two strands of literature. First, it is related to Khurana et al. (2006), and Kusnadi and Wei (2011) whose findings suggest the importance of financial development and investor protection in easing the effect of finance constraints on the firms' propensity to save. I document that financial and institutional development has little or no easing effect on the propensity to save. This new result occurs because, along with the cost of external finance, the degree of income variability, which is substantially higher in financially

[5] The economic policy uncertainty index is available for the U.S. and a broad range of non-U.S. economies, while the measures of aggregate and financial market uncertainty are available for the U.S. economy only.

developed economies, predicts the correlation between saving and cash flow. Second, the study contributes to the growing literature on macro-level uncertainty and its role in corporate policies (literature review is contained in survey paper Bloom, 2014). Higher costs of raising external capital and higher variability of internal income, as well as poorer investment opportunities are all characteristics (if not consequences) of uncertainty. I show that, under these adverse conditions, firms to finance future incremental investment choose to allocate additional cash inflow to cash holdings or, equivalently, to dissave less out of cash inflow today.

The net result of this study suggests that the sensitivity of saving to cash flow is not a problem-free measure of finance constraints to directly gauge the benefits of financial development. Although a country's financial development and the quality of its institutional environment do ease the severity of firms' finance frictions, they are unlikely to exert a strong influence on firms' saving sensitivities. Still, the sensitivity is useful as a time-varying indicator of macro uncertainty. It is theoretically justified and empirically implementable to study dynamics of corporate liquidity responses to uncertainty shocks to business activity.

The paper proceeds as follows. Section 2 develops the hypotheses. Section 3 describes the data and main variables, and provides a brief overview of the methodology. Section 4 presents the results. Section 5 concludes.

2. Hypotheses development

Almeida et al. (2004) develop a model of a firm's demand for internal liquidity and propose a new measure, namely the *sensitivity of cash saving to cash flow*, that they argue better reflects, compared to other measures, the effect of finance constraints. Their model

predicts that saving can be sensitive to cash inflow in the presence of finance frictions. Firms anticipating finance constraints in the future should respond to those potential constraints by saving more cash today. Their empirical results support this prediction.

Riddick and Whited (2009) examine a firm's liquidity demand with a stochastic, dynamic model and measurement-error consistent estimators. Their model predicts that, controlling for Tobin's *q*, the firm counteracts movements in cash flow with opposite movements in saving. This negative propensity to save occurs because a positive productivity shock causes both cash flow and the marginal product of capital to increase. A substitution effect then induces the firm to use some of its cash stock to acquire more productive assets, that is, to dissave and invest. Their conclusion contradicts the results of Almeida et al. (2004) in two main aspects. First, the Riddick–Whited model is more realistic since it allows for changing capital productivity, liquid forms of physical investment, and a variety of capital depreciation rates. Second, the authors note that when a regressor (*q*) has a measuring error, the signs of the other perfectly measured regressors (cash flow) may change. The saving sensitivity is therefore *positive* if there is no correction for a measuring error in *q*, while *negative* after correcting for the bias. Although the results of these studies are noticeably different, they share a common conclusion with respect to firms' constraints in financing: the cash flow coefficient for the constrained firms, whatever its sign, *exceeds* that for the unconstrained firms. In particular, the OLS coefficient on cash flow is larger for the constrained firms, whereas the error-corrected coefficient is less negative for the constrained firms. This conclusion further suggests that the sensitivity rises with the cost of external finance because the firm's propensity to save (dissave) increases (decreases) with the cost of external finance.

Income variability is another determinant of saving. The sensitivity rises with the variability of income because the firm's marginal propensity to save (dissave) increases (decreases) with the variability of income flow. The first rationale is precautionary savings (Han and Qiu, 2007, Bates et al., 2009). Firms with more variable income save more (dissave less) to maintain cash buffer against future adverse income shocks. The second rationale is information about productivity contained in income process (Riddick and Whited, 2009). Firms with more variable income save more (dissave less) because they do not react to the small amount of information in high variance income innovations. Empirically, the OLS coefficient on cash flow is larger for firms with high income variability, whereas the error-corrected coefficient is less negative for these firms.

Further, Riddick and Whited (2009) point out the confounding role of income variability on the size of the cash flow coefficient. In their model, constrained firms are predicted to have larger negative coefficients. However, as discussed above, in the presence of highly variable income, the cash flow coefficient becomes less negative in the error-corrected regression. Because constrained firms *also* have more variable income, their cash flow coefficients are less negative. Put differently, the effect of income uncertainty on saving dwarfs the effect of finance constrainedness. This conclusion suggests that, although the sensitivity contains information about finance constraints, income variability strongly influences this one correlation for it to be used as a measure of finance constraints.[6] I summarise the confounding effects of these forces as follows:

[6] Other confounding forces, in addition to the cost of external finance and income dispersion, include the returns to scale, discount factor, rate of capital depreciation, fixed and quadratic adjustment costs. However, these forces are difficult to measure and estimate.

H_1: The gross effect of being financially constrained and having high income (cash flow) variability on corporate saving is significant, whereas the net effect of being financially constrained and having low income variability is not.

Khurana et al. (2006) test the connection between financial development and saving-cash flow sensitivity to document the negative relation between the two. Kusnadi and Wei (2011) examine the importance of investor legal protection in mitigating the effects of finance constraints on saving sensitivities. Baum et al. (2011) demonstrate that a country's financial system, in both its structure and level of development, influences saving sensitivities of constrained firms. All these studies take the position that the sensitivity is a good measure of finance constraints. This is an important point because the connection to financial development and investor protection makes sense only if the sensitivity is *mostly* driven by the severity of finance frictions. The question being tested here is whether financial development alleviates firms' finance frictions. Nevertheless, none of these studies considers the information contained in the variability of income process. Also, they do not control for measurement error in Tobin's *q*, which contains information about the attractiveness of firm growth opportunities and thus about the capitalized value of holding cash to the firm.

I revise the argument that a country's financial (and institutional) development attenuates the sensitivity of saving to cash flow. The motivation is as follows. On the one hand, firms from developed economies are supposedly less constrained than their counterparts from developing economies (Rajan and Zingales, 1998, Love, 2003). On the other hand, firms from developed economies, as opposed to firms from developing economies, operate with more intangible capital and in more competitive "new economy" environment, which is associated

with higher uncertainty, and thus have more volatile and unpredictable income (Hansen et al., 2005, Moshirian et al., 2017).[7]

Intangible and tangible capital are conceived as inputs in total production and contribute to the income of the firm. The uncertainty associated with intangible capital in the "new economy" is higher than that of tangible capital in traditional industries. Given that intangible capital is more important component of production in financially developed economies, their income is less persistent (more variable). In contrast, more tangible asset structures support the persistence of income in developing economies. Because income variability is as important for corporate saving as finance constraints and because income variability is strongly positively correlated with financial development, the relation between firms' saving and cash flow should *not* systematically decrease with financial development. The second hypothesis is thus expressed as follows:

H_2: The sensitivity of saving to cash flow does not systematically respond to (decrease with) a country's financial development and institutional quality.

Further, I hypothesize that macro uncertainty affects saving-cash flow sensitivity through three channels: (1) the cost of external finance, (2) the variability of income flows, and (3) the attractiveness of investment opportunities. In the presence of macro uncertainty, the cost of external finance and the variability of income flows should strongly correlate with each other. While this correlation is evident across all states of the economy (because constrained firms also have more variable income), it should strengthen with the level of

[7] "New economy" mostly refers to high-tech and service-oriented industries, which are characterized by a relatively low fraction of tangible productive capital and high fraction of innovative research-intensive capital. Even in traditional manufacturing industries, the production does not rely on tangible capital as much as it did in the past.

uncertainty. Also, the cost of external finance and the variability of income flows should negatively correlate with the attractiveness of current investment opportunities because the attractiveness fades with uncertainty. I discuss each of the channels below.

Theories of impaired access to external capital (Brunnermeier, 2009, Gorton, 2010, Shleifer and Vishny, 2010) hold that a macro (common) shock leads to a pervasive shock to the supply of bank loans, or credit more generally.[8] In that case, firms find it more difficult to raise credit capital and have to rely on internal resources (cash reserves and cash flow). In times of macro disturbances, however, firms are also concerned about uncertainty over the future financing. If the credit supply shock is expected to continue, firms would expect to face even greater financing difficulties. They would be less willing to use cash reserves now as they would need them in the future. As a result, under uncertainty, firms, which are constrained or likely to be constrained in the future, rationally prefer to save out of their cash inflows to hedge against future financing shocks.

Finance constraints could also come in the form of credit rationing (Fazzari et al., 1988). Under the credit rationing, even when the apparent costs of debt and equity are low, firms can still be constrained if they cannot borrow or issue equity. This kind of difficulty in external financing is reflected in lower borrowing and new issue activity. Rationing in capital markets is a likely consequence of uncertainty because lenders and investors are less willing to provide capital in uncertain environment.[9] Cash accumulation (saving) is therefore a way to counteract part of the negative effects of uncertainty on firms' access to external financing.

[8] The empirical evidence supporting the theories of loan supply and credit supply shocks can be found in Duchin et al. (2010), Ivashina and Scharfstein (2010), Santos (2011), Almeida et al. (2012), and Becker and Ivashina (2014).
[9] Buti and Padoan (2013) notes that "uncertainty is even more damaging for growth as it magnifies the effect of credit constraints, forcing banks to restrain credit further".

Greater macro uncertainty further leads to an increase in the risk premium (Christiano et al., 2014). This raises the cost of finance and the probability of defaults, by expanding the size of the default outcomes, raising the default premium and the deadweight cost of bankruptcy. This role of uncertainty in raising borrowing and bankruptcy costs amplifies the effect of finance constraints and fortifies the importance of internally generated cash flow as a source of precautionary saving.

The interaction between uncertainty and finance constraints has been studied in the recent literature (Gilchrist et al., 2014 and Alfaro et al., 2017). The former study focuses on the importance of credit constraints in channeling the impact of uncertainty shocks, while the latter – on the multiplicative effect of finance constraints and uncertainty. This interaction is subject to reverse causality, however. Both channels likely operate – finance constraints propagate with uncertainty and finance constraints amplify uncertainty. In any scenario, endogenous interactions between the two induce firms to save more (or dissave less) out of cash flow.

The theory of demand (income) shock states that a common shock to the demand for firms' products resulting from the loss of household income and wealth leads to a decline in firms' profitability (Mian and Sufi, 2010, Kahle and Stulz, 2013). Uncertainty also appears to harm demand because it reduces the willingness of consumers to spend. Consumers usually delay non-essential and some essential purchases relatively easily when income uncertainty is high (Eberly, 1994). Uncertainty also makes consumers less sensitive to demand incentives and price signals (Foote et al., 2000). In turn, this drop in consumer spending causes a negative shock to firms' total productivity and net worth. The dispersion of sales growth rises dramatically (Bloom et al., 2012). Losses and income variability also surge. Hence, greater

macro uncertainty almost surely translates into lower sales revenue and higher variability of income for firms. As discussed, the latter is a strong predictor of firm saving.

Finally, according to the *real options theory*, uncertainty triggered by an economy-wide shock reduces the marginal attractiveness of firms' current investment opportunities (when compared to future ones) as some of them are no longer as valuable or not available at all (Bernanke, 1983, McDonald and Siegel, 1986, Bernanke and Blinder, 1988, Bloom, 2009). Uncertainty makes firms cautious about investment because they deem the macro environment too uncertain to determine the investment's rate of return and because investment adjustment costs are too high to reverse (Cooper and Haltiwanger, 2006). Until the economic situation is clearer, firms delay their investment decisions to conform to changes in the economy and in their circumstances. All else being equal, an increase in macro uncertainty triggers a decline in investment and increase in cash flow allocation to cash holdings (equivalently, a decrease in cash outflows).

In sum, under uncertainty, finance irregularities and capital rationing are common, income fluctuations are wide, and investment is low. The prediction therefore states that the response of saving to macro uncertainty should be evident in either direction (sign) of cash flow. The last hypothesis is as follows:

H_3: *The sensitivity of saving to cash flow systematically responds to (increases with) macro uncertainty.*

3. Research design and data

3.1. Data, model and variables

Firm-level data are from the Worldscope files. The data constitute an unbalanced panel that covers the years 1991 to 2013. Firms operating in the financial and utilities sectors are excluded. To mitigate outliers and data errors, the sample does not include observations for which there are no data on cash holdings, nor for which the cash value exceeds total assets. The observations for years in which net income exceeds total assets, in which total assets are non-positive are also removed. To alleviate backfilling bias, firms must have at least three non-missing observations during the sample period. Appendix 1 reports the number of firms in the sample by country and year.

The empirical approach builds on saving regressions as in Almeida et al. (2004) and Bao et al. (2012). The baseline model is estimated as follows.

$$\Delta Cash_{i,t} = \alpha_c + \alpha_n + \alpha_t + \beta_0 + \beta_1 CF_{i,t} + \beta_2 \left(CF_{i,t} * Neg_{i,t}\right) + \beta_3 Neg_{i,t} + \\ + \beta_4 q_{i,t} + \beta_5 Controls_{i,t} + \varepsilon_{i,t}, \quad (1)$$

where $\Delta Cash$ is the change in cash holdings (saving) (ΔWC02001) scaled by total assets (WC02999). *CF* (cash flow) is calculated as net income before extraordinary items (WC01551) plus depreciation and amortization (WC01151), scaled by total assets. Tobin's q, which is a proxy for a firm's investment opportunities, is the ratio of the market value of assets (WC08001 minus WC03501 plus WC02999) to the book value of assets.

The model in Eq. (1) includes country (α_c), industry (α_n), and time (α_t) fixed effects to account for unobserved heterogeneity.[10] The choice of control variables accounts for a firm's characteristics that can influence its cash position. In particular, *Controls* includes natural log of total assets (*Size*, WC02999), capital expenditures (*CapEx*, WC04601), acquisition spending (*Acquisition*, WC04355), changes in non-cash working capital (ΔNWC or Δ(WC02051 plus WC02101 minus WC03101 plus WC03051)), and changes in short-term debt (ΔSD or ΔWC03051), where all the control variables are scaled by total assets. *Neg* is an indicator variable that is equal to unity if cash flow is negative, and zero otherwise. Its cross-product term with cash flow (*CF * Neg*) determines how saving varies with the sign of cash flow. Dividends and stock repurchases are excluded from Eq. (1) because, as discussed below, both uses of cash are used to differentiate financially constrained from unconstrained firms. The regression variables are trimmed at the 1% level.

To test the effect of finance constraints on a firm's cash holding behavior, I use two schemes to sorting firms into constrained and unconstrained categories: firm size and cash payout. Firm size is often used as an indicator of the cost of raising external finance. Large and mature firms are generally considered to have better access to external finance than small, young, and lesser-known firms (Gilchrist and Himmelberg, 1995, Hennessy and Whited, 2007). Consequently, firms with their asset size in the top (bottom) three deciles of the size distribution for country *j* in year *t* are considered financially unconstrained (constrained). Also, Fazzari et al. (1998) posit that finance frictions are more binding on firms not paying cash dividends. Consequently, non-dividend-paying and non-stock-repurchasing firms are treated

[10] Alternatively, the model includes firm fixed effects along with country-year and industry-year effects. Introducing this alternative set of fixed and time-varying effects yields no significant changes in the main findings.

as financially constrained. Dividend-paying and stock-repurchasing firms are treated as unconstrained. The rankings are performed on an annual basis.[11]

To test the effect of income variability on a firm's cash holding behavior, I estimate the standard deviation of the residuals from a first-order panel autoregression of *CF* and the standard deviation of *CF* firm-by-firm. Firms with their respective volatilities in the top (bottom) three deciles of the distribution for country *j* are considered as having high (low) income variability.

3.2. Financial development measures

To differentiate economies according to their levels of financial development (H_2), this study employs a number of classification schemes. First, I introduce the indicator variable, which is equal to unity if an economy (market) is classified as financially developed by major market data providers, namely the Dow Jones, the Financial Times and London Stock Exchange Group, Morgan Stanley, Russell Investments, and Standard and Poor's, and zero otherwise (*DEV*). Other economies in the sample are classified as developing markets. Developed markets must meet criteria under several categories, namely high-income economies, regulatory environment, openness to foreign ownership, ease of capital movement, and efficiency of market institutions (Table 1).

Second, I use the World Economic Forum Financial Development Index. Particularly, I use the average of the country-specific index over the years 2008 to 2012 and rank each country in the sample according to its average. Based on this ranking, I then construct a

[11] I omit the Kaplan–Zingales (1997) index because this measure is endogenously determined with firm saving. I also do not consider bond and commercial paper ratings because too few firms in the international sample have them.

categorical variable with four possible values: 0, 0.33, 0.67, and 1 (*WEFI*). Each country is allocated into one of the four categories. Countries with a value of 0.67 or 1 are classified as financially developed, whereas countries with a value of 0 or 0.33 – as underdeveloped. There are seven pillars of financial market development used to measure the index, namely institutional and business environment, financial stability, development of banking and non-banking intermediation, development of capital markets, and capital availability (Appendix 2).

Third, I include the legal origin variable from La Porta et al. (1998) and Kusnadi and Wei (2011) (*Law*). An indicator variable is equal to unity for English common-law countries and zero for French, German or Scandinavian civil-law countries. The differences in the legal systems explain the development of domestic capital markets. Generally, the common-law countries offer stronger legal protection to investors than do countries with other legal traditions (Table 1).

Fourth, I borrow the aggregate measure of financial development from Love (2003) and Khurana et al. (2006), which is the standardized sum of the value of shares traded over the GDP and the credit going to the private sector over the GDP (*FD*). The ratio is standardized to have mean zero and a standard deviation of one. The measure reflects the stock market and financial intermediary development. Firms from countries with the ratio above (below) its sample median in year *t* are classified as financially developed (underdeveloped) (Table 1).[12]

Lastly, I follow Gupta and Yuan (2009) who investigate the effect of a stock market liberalization on industry growth in developing economies. Using liberalization as an

[12] In unreported results, I also consider a *capital market governance index*, which captures the degree of earnings opacity, the enforcement of insider trading laws, and the effect of removing short-selling restrictions featured in Bhattacharya and Daouk (2002).

exogenous shock to the development of local finance, it is possible to get a firmer grasp on whether firms' saving propensities actually reflect a country's financial development. Gupta and Yuan's sample consists of 27 economies which liberalized their stock markets between 1986 and 1995. Through matching, I end up with 14 liberalizing and 6 non-liberalizing economies in my sample. The liberalization spans the period from 1987 to 1992. The estimation period for this classification scheme is from 1991 to 2001 (nearly a decade after liberalization). The details are provided in Appendix 3.[13]

3.3. Macro uncertainty measures

The empirical literature on macro-level uncertainty is still at an early stage. The measures of uncertainty are far from perfect and are best described as proxies. Given the broad definition and numerous sources of uncertainty, it should not be surprising that there is no perfect measure yet. First, I use the economic recession data from U.S. National Bureau of Economic Research business cycles (http://www.nber.org/cycles.html). Macro uncertainty appears to move endogenously with the business cycle. Uncertainty rises sharply in recessions, as low economic growth induces greater uncertainty, and falls in booms (Bloom, 2014).[14] It is noteworthy that recessions are usually accompanied by jumps in uncertainty but not all uncertainty shocks occur in recessions. For the purpose of this study, the year *t* is a recession year if at least one quarter falls within the contraction. The year immediately preceding and the year immediately following the contraction are also considered as recession years (*Recession*). This classification is consistent with the notion that uncertainty can affect

[13] Liberalization is a regulatory change after which foreign investors have the right to invest in domestic securities.
[14] Uncertainty itself can damage growth, by reducing output, consumption, and investment. It can lead the initial slowdown to be propagated and amplified over time. Also, uncertainty can stall aggregate productivity growth by damaging the productivity-enhancing reallocation of resources across firms (Bloom et al., 2012).

corporate policies several quarters before the beginning and several quarters after the end of the contraction. Generally, firms should demonstrate a stronger propensity to save (lower propensity to dissave) in the presence of high or rising uncertainty and in anticipation of uncertainty resolution. Recovering from the effects of uncertainty can take a significant amount of time, however. The U.S. business cycle contractions and expansions are in Appendix 4.

Second, I use an index of economic policy uncertainty (*EPU*) from Baker et al. (2016). The index is comprised of three underlying components. The first and most heavily weighted component is derived from a count of newspaper articles containing key terms related to policy uncertainty. This component reflects the frequency of articles in ten U.S. newspapers that contain the following triple: the term "uncertain" or "uncertainty"; the term "economic" or "economy"; and one or more of the terms "congress", "deficit", "the Fed", "legislation", "regulation" or "White House". An article must contain terms in all three categories pertaining to uncertainty, the economy, and policy. The first component constitutes the *news-based EPU index*. The second component estimates the present value of provisions in the U.S. tax code set to expire in the near future (data is from the Congressional Budget Office). The pending expiration of tax provisions create uncertainty for the majority of firms. The third component uses the disagreement among professional forecasters over the future government purchases and consumer prices (data is from the Survey of Professional Forecasters). Periods when forecasters hold more diverse opinions are likely to reflect greater uncertainty. The weighted average of the three components constitutes the *overall EPU index*. Since the news-based index is available for a broad range of countries, I use it as a baseline measure of policy-related

uncertainty. The overall index is constructed for U.S. only. The indices are highly correlated (correlation of 0.9). Both indices are plotted in Figure 1.[15]

In general, government policies (spending and fiscal stimulus, job creation programs, subsidies, and other policy-related decisions) have a great impact on all firms operating in the economy because they alter the environment in which firms operate. No doubt that the uncertainty induced by the political system is one of the disturbances equally affecting corporates, capital markets, and the economy. At the aggregate level, large increases in the EPU index tend to be associated with declines in GDP and business investment, and market crashes. When the economy turns down or experiences a shock, politicians are tempted to experiment with current policies, elevating policy uncertainty. It is also possible that indecision of politicians (lack of policy responses to macro shocks) can lead to greater uncertainty about future business conditions. At the micro level, there is substantial evidence that economic policy uncertainty adversely affects the cost of external finance and harm the persistence of income flows (Pastor and Veronesi, 2012, 2013, Kelly et al. 2016, Colak et al., 2017, and Jens, 2017).

Third, I borrow two comprehensive measures of aggregate economic (*AEU*) and financial market uncertainty (*AFU*) from Jurado et al. (2015). The authors use data on a large number of economic data series in a system of forecasting equations and look at the implied forecast errors. The uncertainty measures are based on the comovement in the forecast errors. Forecasts are formed from two datasets. The first dataset includes 132 monthly macroeconomic

[15] The news-based index is available for Australia, Brazil, Canada, Chile, China, France, Germany, India, Ireland, Italy, Japan, Korea, Netherlands, Russia, Singapore, Spain, Sweden, U.K., and U.S. The index data have different starting dates: the data series for Sweden starts in Jan 1976; the data series for U.S., Canada, and Ireland start in Jan 1985; other country-specific indices run from later dates.

data series: real output and income, employment, manufacturing and trade sales, consumer spending, housing starts, inventories, orders, labor costs, capacity utilization, bond and stock market indices, among many others. The second dataset includes 147 monthly financial data series: dividend-price and earnings-price ratios, growth rates of aggregate dividends, default and term spreads, yields on corporate bonds and Treasuries, yield spreads, and a broad cross-section of industry, size, book-market, and momentum portfolio equity returns. The two series are used separately because the financial series, which are far more volatile than the macroeconomic series, can easily dominate the aggregate measure. The uncertainty estimates are available for three forecast horizons: 1, 3, and 12 months. This study uses 3-month horizon. The estimates are available for U.S. only and plotted in Figure 2. By their calculations, forecast errors rise dramatically in large recessions and macroeconomic disturbances. Again, these macro measures of uncertainty appear to be countercyclical.

The EPU, AEU, and AFU measures are calculated as yearly averages from their respective monthly values. For the purpose of H_3, the recession years and the years in which the uncertainty measures exceed (or come close to exceeding) 0.5 standard deviation above their respective sample means are classified as high uncertainty periods. Low uncertainty periods include all remaining years in the sample.

3.4. Methodology

Tobin's *q* is an empirical proxy for a firm's investment opportunity set. Given the coefficient bias that *q* measurement error can cause, it may be difficult to draw a meaningful conclusion solely based on the cash flow coefficient in OLS. Finding instruments for the mismeasured regressor is also problematic, particularly given Erickson and Whited's (2012)

evidence that using irrelevant or other mismeasured regressors as instruments can lead to misleading inferences (see robustness tests in Section 4.4). To address this econometric issue, I refer to Erickson et al. (2014) who developed a measurement-error remedy that is asymptotically equivalent to the moment estimators in Erickson and Whited (2000, 2002). Erickson et al. (2014) consider estimation of a linear errors-in-variables model as follows:

$$Y_i = X_i\beta + Z_i\alpha + \mu_i \tag{2}$$

$$x_i = X_i + \varepsilon_i, \tag{3}$$

in which Y_i is the dependent variable, X_i is a vector of unobservable regressors, Z_i is a vector of perfectly measured regressors, and μ_i is the regression disturbance. x_i is the proxy for X_i, and ε_i is the measurement error. In this case, X_i is the unobservable marginal q and x_i is the empirical average q. By substituting (3) into (2), we have $Y_i = x_i\beta + Z_i\alpha + v_i$, where $v_i = \mu_i - \beta\varepsilon_i$. The correlation between x_i and v_i causes the estimate of β to be biased downward. Since there is a positive correlation between the mismeasured average q and cash flow, the q error also causes the coefficient of cash flow to be biased upward.

To control for poorly measured q and inflated cash flow estimates, the errors-in-variables regression can implement the cumulant or moment estimators. The cumulant estimators are an advance beyond the moment estimators. Over-identified moment estimators require a numerical minimization and starting values for this minimization, but cumulant estimators are linear and have a closed-form solution; that is, they do not require any information beyond that contained in the observable regressors. This feature of cumulants eliminates the selection of starting values for the estimated parameters, which is important, given the sensitivity of moments to starting values. Hence, all regressions are run using OLS

and the higher-order cumulant estimators. The number of order is an empirical choice. Order of five is a reasonable starting value. The minimum value is three, which corresponds to an exactly identified Geary (1942) estimator. Values above eight are not recommended because of the computational cost. The R^2 of measurement equation, which is an index of measurement quality (τ^2), is reported. The *tau* index ranges between 0 and 1, with zero indicating a worthless proxy and one indicating a perfect proxy. Low quality of *q* (below 0.5) is expected in saving regressions, where measurement error typically stems from a large conceptual gap between *q* and the true investment opportunities.

To ensure that the results are not driven by a few countries with the highest number of observations, all cross-country regressions are based on weighted data. The weights are equal to a value of 1 divided by the number of firm-years in each country. This approach weighs each country equally so that firm-years receive more (less) weight in countries with fewer (more) observations. Comfortingly, the results remain largely the same if cross-country regressions are based on unweighted data.

Lastly, the OLS standard errors are clustered at the country level. The standard errors returned from two-way clustering (country and year) are generally lower than those returned from one-way clustering (country).

3.5. Summary statistics

Table 1 reports the summary statistics. Panel A contains firm characteristics and financial development metrics across 43 economies. Firms from financially developed economies (23 economies classified by the *DEV* scheme) hold more cash than do their counterparts from developing economies (20 economies). The average cash ratios are 0.15 and

0.11, respectively. Firms from developed economies are larger, higher valued, and less profitable. Compared to developing economy firms, they have lower (0.07 and 0.04, respectively) and more variable income flows (0.07 and 0.09, respectively). This firm characteristic is of particular interest because it indicates that developed economy firms operate in less profitable and more volatile environment, and thus should not exhibit lower (more negative) saving sensitivities.

Panel B contains a number of U.S. firms' characteristics in periods of high and low uncertainty (classified by the *Recession* scheme). High uncertainty is associated with larger cash holdings and higher income variability, but lower profitability, capital investment, and market value. The changes in cash holdings are negatively related to uncertainty. Overall, uncertainty generates a temporary slowdown as many firms tend to preserve liquidity and postpone investment, cope with negative income shocks, and wait for uncertainty to resolve.

4. Empirical results

4.1. What drives saving–cash flow sensitivity: finance constraints or income variability?

Table 2 reports the results obtained from the regression model in Eq. (1). Panel A contains the results for firms classified as financially constrained and unconstrained. I tabulate the main variables of interest only. A brief overview of the unreported results for the control variables is as follows. The estimated coefficients for *CapEx*, *Acquisition*, and *ΔNWC* are negative, while the coefficient for *ΔSD* is positive and all significant at better than the 1% level. The results are expected, as the first three controls constitute the uses of cash and new borrowings are an important source of cash.

The main focus of this section—in relation to the testable hypotheses—is the sensitivity of saving to cash flow (β_1 in Eq. (1)). The set of constrained firms displays a stronger response of saving to cash flow than does the set of unconstrained counterparts. The OLS estimate of the cash flow coefficient varies between 0.22 (t = 9.28) and 0.25 (t = 12.9) for constrained firms, while it varies between 0.11 (t = 3.81) and 0.17 (t = 5.66) for unconstrained firms. The difference in saving sensitivities is significant at better than the 1% level. The fact that *q*-sensitivity of saving is not economically meaningful (around 0.02) is not surprising given that *q* is downward biased in OLS.

When I apply the cumulant estimators, the coefficient on cash flow is negative and significant at better than the 1% level. The coefficient estimate for constrained firms is less negative than that for unconstrained firms. This result is similar to that in OLS inasmuch as the cash flow coefficient for the constrained firms *exceeds* that for the unconstrained firms. The coefficient is simply shifted down from the inflated positive coefficient in OLS. The effect of treating measurement error can also be seen in the estimated coefficient on *q*, which is up to 15 times as high as its OLS counterpart. This effect can be explained by the bias in the OLS regression, which in this case is large because of the low estimates for τ^2 (around 0.2). Also, correcting for measurement error substantially increases the regression R^2.

It is noteworthy that the cash flow coefficient is positive in a negative cash flow environment (β_2 in Eq. (1)), and that the coefficient for unconstrained firms is somewhat stronger (more positive) than that for constrained firms. This result indicates that, facing negative income shock, unconstrained firms are more likely to continue to exploit attractive investment opportunities and decumulate cash because they find it easier to obtain external

finance. Conversely, constrained firms are more likely to postpone their investments and thus spend less cash.

Panel B contains the results for firms classified as having high and low income variability. The high variability group has a cash flow coefficient that is statistically different both from zero and from the coefficient in the low variability group. Particularly, the OLS coefficient on cash flow varies between 0.21 (t = 11.3) and 0.23 (t = 13.7) in the former group, whereas it varies between 0.07 (t = 2.03) and 0.08 (t = 2.59) in the latter group.

The error-corrected coefficient estimate on cash flow is negative. The coefficient estimate is significantly less negative for firms in the high variability group. Further, the coefficient is positive in a negative cash flow environment, and this coefficient for the firms in the low variability group is stronger (more positive) than that for the firms in the high variability group. This result is quite intuitive because firms that do not face a great deal of income uncertainty can make larger changes in their cash holdings in response to negative income shock.

At this point, I affirm the notion that income variability matters at least as much as finance constraints by testing a modified regression model in Eq. (1) with a constraint dummy, a low variability dummy, the cross-product term of each of these dummies with cash flow, the cross-product term of the two dummies with each other, and the triple cross-product term of both of these dummies with cash flow. The results are in Table 3. I find a positive OLS coefficient on cash flow (column [1]) and positive coefficient on its combination with the constraint dummy (column [2]). I find a negative error-corrected coefficient on cash flow (column [1]) and positive coefficient on its combination with the constraint dummy (column

[2]). The combination of cash flow and the low variability dummy returns a negative coefficient in all tests performed (column [3]).

One piece of evidence is of particular importance. It concerns the sum of the coefficients on the three cross-product terms (column [5]). It measures the *net* effect of being constrained and having low income variability. The OLS summary coefficient is mostly indistinguishable from zero. The error-corrected summary coefficient is insignificant or negative and significant. Stripping away firms with high income variability from the constrained group leaves almost no differential sensitivity between this smaller constrained group and the rest of the sample. The main punchline here is that both forces affect the cash flow coefficient and that whatever its sign, this coefficient cannot be used as a standalone measure of finance imperfections.

Finally, I run a modified regression model in Eq. (1) with a constraint dummy, a high variability dummy, and a set of the cross-product terms, similar to that used in the previous regression test. The results are in Table 4. The coefficients on the combination of cash flow and the constraint dummy (column [2]), the combination of cash flow and the high variability dummy (column [3]), and the sum of the coefficients on the three cross-product terms (column [5]) are all positive and significant at better than the 1% level. The sum of the coefficients (column [5]) measures the *gross* effect of being constrained and having high income variability. Its consistent (positive) sign and strong significance in both OLS and error-corrected regressions suggest that the cash flow coefficient in the saving regression is a summary measure of external finance constraints and income variability. Overall, the results support H_1.

4.2. Saving–cash flow sensitivity and financial development

I provide evidence in favor of the hypothesis that saving propensities do not systematically respond to (decrease with) the benefits of financial development. First, I estimate the standard deviation of cash flow autoregressive residuals for financially constrained and unconstrained firms from both developed and underdeveloped economies. Table 5 reports the univariate results. Panel A reports the results for five different industry groups, while Panel B – for two non-overlapping periods (1991-2002 and 2003-2013). The degree of income variability is greater for firms categorized as financially constrained. More importantly, the degree of income variability is significantly greater for the constrained firms from developed economies. The standard deviations for small and non-dividend-paying firms from developed economies are 0.14 and 0.15, respectively, while from underdeveloped economies – only 0.09 and 0.10, respectively. This result clearly indicates that income uncertainty, which increases firms' saving propensities, is strongly and positively associated with a country's level of financial (institutional) development.

To mitigate the concern that the variability of income is driven by heterogeneity of sample composition over time, I form the industry group of manufacturing firms only (SIC codes from 2000 to 3990) and estimate the standard deviation of cash flow autoregressive residuals for this group. Manufacturing firms constitute 51% of the sample. The standard deviation for the constrained firms from developed economies ranges from 0.12 to 0.14, whereas from underdeveloped economies – from 0.08 to 0.09. Similarly, I construct the group of high-tech firms (SIC codes 28, 35, 36, 37, 38, and 73), which are known to have more unpredictable income. The standard deviation for the constrained firms from developed economies ranges from 0.15 to 0.16, whereas from underdeveloped economies – from 0.09 to

0.10. The results obtained from the durable and nondurable goods industries are similar. Further, the variability of income process increases (remains flat) in the group of developed (underdeveloped) economy firms over time. The upward trend is more evident among the constrained firms (+20%) than among the unconstrained firms (+10%). Lastly, I construct a balanced panel of firms that existed through the entire sample period and find similar differences in income volatilities (unreported). As such, a strong association between firms' income uncertainty and a county's financial development holds across industries and over time.

Second, using the model in Eq. (1), I estimate cash flow and *q* sensitivities for each country in the sample. Figure 3 plots the OLS and measurement error-consistent coefficient estimates on cash flow, Tobin's *q*, and R^2. Although the coefficient on cash flow varies substantially across countries, it is *not* consistently lower in financially advanced countries. The same conclusion applies to the estimated coefficient on *q*. The *q* coefficient is driven by the correction for measurement bias, rather than by a country's financial development. Countries with larger *q* coefficients, including financially underdeveloped, return more negative cash flow coefficients and higher R^2. Specifically, countries with the ten largest negative cash-flow coefficients (with the average of -1.0) return an average *q* coefficient of 0.17 and R^2 of 22%. In contrast, economies with the ten smallest negative coefficients (with the average of -0.1), return an average *q* coefficient of 0.09 and R^2 of 13%. Moreover, three financially underdeveloped and three financially developed economies, respectively, are among those with the largest and smallest negative coefficients. In sum, the figure does not provide a conclusive evidence for a differential effect of a cross-country financial development on cash flow and *q* sensitivities.

Third, using financial development metrics, I formally test whether sensitivities are different for economies with different levels of financial development and legal investor protection. Table 6 reports the results obtained from the model in Eq. (1). Except for one classification (*DEV*), the OLS coefficient estimate on cash flow does not demonstrate economically meaningful and empirically significant differences between financially developed and underdeveloped economies. Similarly, except for one classification (*Law*), the cash flow coefficient returned from the cumulant estimators is almost indistinguishable between the two groups of economies. The findings indicate that financial environment and institutional quality do *not* attenuate firms' saving propensities.[16]

Fourth, I control for the possibility that changes in savings are driven by financial distress. This test considers firms with strictly positive income; that is, financially solvent firms (*Neg* variable and its combination with cash flow are dropped from the model in Eq. (1)). In unreported results, economies with greater financial (and institutional) development do *not* yield smaller OLS or larger negative measurement error-consistent cash flow coefficients. Instead, in some regressions, the OLS and error-consistent coefficients are larger and less negative, respectively, in more developed economies.

Overall, the evidence presented in this section is consistent with H_2.

4.3. Saving–cash flow sensitivity and macro uncertainty

I now explore how saving propensities respond to macro uncertainty. Because uncertainty adversely affects firms' access to external finance and ability to generate stable

[16] When I use the the cross-product terms of financial development measures with cash flow (instead of splitting the sample), the estimated coefficients on the cross-product terms are statistically insignificant in 8 out of 10 (OLS and measurement-error consistent) regressions.

income, firms inevitably alter their liquidity preferences (towards saving and holding more cash) in response to uncertainty. I test the prediction that, responding to uncertainty-associated irregularities, firms save a greater proportion of the cash flows they generate or dissave less out of their cash flows.

First, I divide the entire sample period into high-uncertainty and low-uncertainty periods (the details are in Section 3.3) and estimate the regression model in Eq. (1) for each period.[17] Table 7 reports the estimation results. One noticeable feature of saving–cash flow sensitivity is its sharp increase in high-uncertainty periods. Specifically, saving sensitivities are from 30% to 60% stronger (less negative) across all estimations. These jumps are statistically significant at better than the 5% or 1% levels.[18] As such, the effect of uncertainty on the propensity for a firm to save cash out of incremental cash flows is empirically strong and economically important. The results support H_3.

To ensure the results are not driven by the sign of cash flow, I restrict the sample to firms with positive income (*Neg* variable and its combination with cash flow are dropped from the model in Eq. (1)). Because loss-incurring firms are possibly more exposed to credit constraints and income disturbances, they are likely to be more exposed to the effects of uncertainty. In untabulated results, however, the documented patterns of firms' saving behavior continue to hold. When profitable firms operate under common uncertainty, their saving propensities are from 30% to 50% stronger (less negative). The jumps are highly

[17] In the U.S.-only regressions, the model in Eq. (1) is modified to replace country (α_c) and industry (α_n) fixed effects by firm fixed effects (α_i).

[18] When I use the cross-product terms of uncertainty measures with cash flow (instead of splitting the sample), the estimated coefficients on the cross-product terms are consistently positive and statistically significant in all (OLS and measurement-error consistent) regressions.

significant. Thus, the impact of economy-wide uncertainty on the process of cash accumulation is of equally high importance to all firms operating in the economy.

In addition to the U.S. EPU index, Baker et al. (2016) construct the policy-related uncertainty indices for major global economies (the details are in Section 3.3). Their methodology follows the same approach as with the news-based U.S. EPU index. The availability of country-specific indices allows us to explore the impact of economic policy uncertainty on firms' liquidity choices in an international setting. To this end, I modify the model in Eq. (1) by including the EPU index and its combination with cash flow, and then estimate regressions of this form in the full sample and subsample of firms with positive income. The U.S. index is omitted in this test. The results are in Table 8. The coefficient estimate on the cross-product term (*CF * EPU*), which reflects additional cash saving with rising policy uncertainty, is positive and distinguishable from zero in all regressions. Saving propensities strengthen almost synchronously across eighteen non-U.S. major economies, suggesting that they are systematically related to the information contained in the level of policy uncertainty, or macro uncertainty more generally.

4.4. Saving–cash flow sensitivity and macro uncertainty: robustness checks

The following tests aim to ensure that the documented interactions between saving propensities and macro uncertainty are robust to model specification, sample selection, and estimation techniques. The first robustness test is performed to address issues relating to omitted variable bias. Specifically, the model in Eq. (1) is now extended to include lagged cash-to-assets ratio (*L.Cash*) and its first difference (*L.ΔCash*) as additional control variables. The model in Eq. (1) is also modified to include uncertainty measure and its cross-product

term with cash flow. These modified regressions are run in the full sample and subsample of firms with positive income. Table 9 presents the results. For brevity, I tabulate the results obtained from the full sample. The introduction of the additional control variables yields no changes in the main findings. The coefficient estimate on the combination of uncertainty metrics and cash flow remains significantly positive in all tests performed. The negative coefficient estimates on the new control variables (their estimates range from -0.28 to -0.37 and from -0.07 to -0.10, respectively) suggest that firms with large cash reserves have less incentives to save. This finding echoes that in Duchin et al. (2010), who document that corporate investment following the onset of the recent financial crisis is stronger for *ex-ante* cash-rich firms.

The second robustness test controls for alternative source of financing (unreported). Cash flow is one source of savings. Firms also save from share issues and debt issues. I therefore modify the model specification in Eq. (1) to include share issues in addition to cash inflow and the change in short-term debt. The introduction of the alternative source of financing does not significantly alter the coefficient estimates of the main variables of interest. The estimated coefficient on share issues is expectedly positive and significant. The robustness checks confirm that alternative model specifications do not alter inferences drawn from this study.

The results are remarkably robust to different subsamples and estimation techniques. The results remain qualitatively the same in the following settings: (1) when I include manufacturing firms only (SIC codes from 2000 to 3990); (2) hi-tech firms only (SIC codes 28, 35, 36, 37, 38, and 73); (3) durable and nondurable goods firms; (4) firms that existed

through the entire sample period; and (5) when cross-country regressions are based on unweighted panel data.

Finally, I run additional robustness tests to ensure the evidence is not biased by q measurement error. For brevity, the estimation results are not tabulated. First, following Almeida et al. (2004), I reestimate the model in Eq. (1) replacing Tobin's q with the ratio of future to current fixed investment. Although the investment ratio is potentially subject to endogeneity concern, it sidesteps the issue of distinguishing between market evaluation of growth opportunities and a firm's ability to exploit these opportunities.[19] Second, I replace q with the past growth rate in sales. La Porta et al. (2000) point out that the growth rate in sales has the advantage of being independent of cross-country differences in accounting standards. Third, I adopt an approach from Cummins et al. (2006), who use analysts' forecasts of earnings, namely the forecast of the one-year and two-year-ahead earnings, and a forecast of long-term earnings growth from I/B/E/S, as instruments for q. This approach is built on the idea that q is the discounted profits from using productive capital. I therefore use the median forecast of the two-year-ahead earnings scaled by total assets as an instrument for q in the generalized method of moments estimation. In short, the main findings documented in this study are robust to the substitution for and instrumentalization of q in the saving regression.

5. Conclusion

Financially constrained firms tend to save more from their cash flows to meet future investment needs. To this extent, the sensitivity of saving to cash flow should decrease with the level of financial (institutional) development. The underlying intuition is that financial

[19] Tobin's q may reflect not only availability of growth opportunities, but also the market's perception of a firm's ability to exploit them.

development and legal protection of investors improve firms' access to lower cost external finance.

An alternative view suggests that the sensitivity is a biased measure of firm finance frictions. The degree of income variability is at least as important for saving as the degree of finance constraints. I therefore argue that, because finance constraints are not the dominant force explaining variations in saving and because income variability is strongly positively correlated with a country's financial development, the sensitivity should *not* systematically decrease with financial development. Also, empirical problem arises from mismeasured Tobin's *q*. After correcting the bias induced by *q* measurement error, statistical inferences in the application related to saving process change.

This study affirms the conclusion that, in a large international panel of firms, income process matters more for saving than finance constraints. Controlling for *q* and the sign of internally generated cash flow, the sensitivity of saving to cash flow does *not* respond to the development of financial intermediation and capital markets. Established access to credit and equity, which are efficient mechanisms to mitigate firms' finance frictions, do not translate into a lower propensity to save.

Further, the study documents the sensitivity patterns in the presence of macro uncertainty. Constraints in financing and income variability drive significant differences in corporate saving during periods of heightened aggregate, economic policy, and financial market uncertainty. Because finance constraints and income irregularities are much greater, and current investment opportunities are poorer in the face of economy-wide uncertainty, saving sensitivities systematically increase with uncertainty.

The net result of this study suggests that, contrary to previous evidence, the relation between the changes in cash holdings and cash flow cannot be directly used to test for the benefits of financial (and institutional) development. Still, this relation can be used to study the impact of uncertainty on firms' demand for internal liquidity.

Table 1. Summary statistics

The table reports the summary statistics for variables used in the model in Eq. (1). Panel A contains country-level means of firm characteristics and country-level financial (institutional) development metrics. Panel B contains U.S. firms' characteristics in high-uncertainty and low-uncertainty periods (classified by *Recession*). *Cash* is the ratio of cash and cash equivalents to total assets. *ΔCash* is the change in cash holdings scaled by total asset. *CF* is cash flow (net income before extraordinary items plus depreciation and amortization) scaled by total assets. *Neg* is an indicator variable that is equal to unity if cash flow is negative, and zero otherwise. *CFVol* is the standard deviation of the firm's cash flow. Tobin's *q* is the ratio of the market value of assets to the book value of assets. *Size* is natural log of total assets. *CapEx* is capital expenditures scaled by total assets. *FD* is the standardized sum of the value of shares traded over the GDP and the credit going to the private sector over the GDP. *DEV* is equal to unity [1] if a country is classified as financially developed by the Dow Jones, FTSE, MSCI, Russell Investments, and S&P, and zero [0] otherwise. *WEFI* is the categorical variable constructed from the World Economic Forum Financial Development Index. *Law* is equal to unity for English common-law countries and zero for French, German or Scandinavian civil-law countries. *Recession* is equal to unity [1] for the year in which at least one quarter falls within the contraction, the year immediately preceding and the year immediately following the contraction. *Recession* is equal to zero [0] for all remaining sample years. The recession data are from U.S. National Bureau of Economic Research.

Panel A. Firm characteristics and financial development metrics

	Firm characteristics							**Development metrics**			
	Cash	*ΔCash*	*CF*	*Neg*	*CFVol*	*q*	*Size*	*FD*	*DEV*	*WEFI*	*Law*
Australia	0.22	0.00	-0.06	0.50	0.15	1.79	10.7	0.91	1	1	Common
Austria	0.13	0.00	0.07	0.10	0.06	1.33	12.7	-0.34	1	0.67	Civil
Belgium	0.13	0.00	0.07	0.13	0.07	1.51	12.6	-0.79	1	0.67	Civil
Canada	0.20	0.01	-0.07	0.51	0.14	1.89	10.8	1.36	1	1	Common
Denmark	0.15	0.00	0.06	0.15	0.08	1.55	11.9	0.28	1	0.67	Civil
Finland	0.13	0.00	0.08	0.10	0.07	1.52	12.5	0.11	1	0.67	Civil
France	0.15	0.01	0.06	0.13	0.06	1.50	12.5	0.04	1	1	Civil
Germany	0.15	0.00	0.05	0.18	0.09	1.55	12.3	0.36	1	1	Civil
Hong Kong	0.21	0.02	0.03	0.25	0.11	1.35	12.3	6.32	1	1	Common
Ireland	0.18	0.01	0.02	0.27	0.10	1.92	12.6	-0.12	1	0.67	Common
Israel	0.24	0.00	0.02	0.26	0.10	1.50	11.6	-0.52	1	0.33	Civil
Italy	0.12	0.00	0.05	0.16	0.06	1.33	13.3	-0.35	1	0.33	Civil
Japan	0.18	0.00	0.04	0.11	0.04	1.16	12.9	2.31	1	1	Civil
Netherlands	0.12	0.01	0.08	0.11	0.07	1.69	13.2	0.81	1	1	Civil
New Zealand	0.09	0.00	0.05	0.19	0.09	1.64	11.5	0.13	1	-	Common
Norway	0.17	0.01	0.04	0.21	0.10	1.56	12.4	0.05	1	0.67	Civil
Portugal	0.06	0.00	0.06	0.11	0.05	1.19	12.7	0.18	1	0.33	Civil
Singapore	0.18	0.01	0.05	0.17	0.09	1.30	11.7	1.09	1	1	Common
Spain	0.09	0.01	0.07	0.12	0.06	1.46	13.3	1.17	1	0.67	Civil
Sweden	0.16	0.00	0.02	0.25	0.11	1.83	11.6	1.06	1	0.67	Civil
Switzerland	0.16	0.00	0.07	0.11	0.07	1.65	13.2	2.51	1	1	Civil
UK	0.15	0.01	0.03	0.25	0.11	1.79	11.7	1.39	1	1	Common
US	0.20	0.00	0.00	0.30	0.12	2.04	12.1	3.43	1	1	Common

Table 1 (continued)

Argentina	0.08	0.01	0.08	0.16	0.09	1.16	12.4	-2.00	0	0	Civil
Brazil	0.13	0.02	0.06	0.18	0.08	1.32	13.4	-1.17	0	0.33	Civil
Chile	0.08	0.01	0.08	0.10	0.06	1.29	12.5	-0.58	0	0.33	Civil
China	0.21	0.03	0.06	0.10	0.06	2.09	12.6	1.11	0	0.67	Civil
Egypt	0.15	0.01	0.11	0.07	0.05	1.52	11.7	-1.19	0	0	Civil
Greece	0.08	0.00	0.03	0.27	0.07	1.19	12.1	-0.32	0	0	Civil
India	0.07	0.01	0.07	0.12	0.06	1.41	11.3	-0.76	0	0.33	Common
Indonesia	0.12	0.01	0.06	0.17	0.09	1.43	11.6	-1.61	0	0	Civil
Korea	0.15	0.01	0.04	0.20	0.09	1.14	12.1	1.75	0	0.67	Civil
Malaysia	0.13	0.01	0.05	0.18	0.07	1.23	11.4	0.51	0	0.67	Common
Mexico	0.08	0.01	0.07	0.13	0.06	1.34	13.9	-1.86	0	0	Civil
Pakistan	0.08	0.01	0.08	0.16	0.07	1.28	10.8	-1.45	0	0	Common
Peru	0.08	0.01	0.11	0.08	0.07	1.38	11.8	-1.86	0	0	Civil
Philippines	0.12	0.01	0.05	0.23	0.09	1.44	11.5	-1.55	0	0	Civil
Poland	0.11	0.01	0.06	0.15	0.09	1.49	11.1	-1.34	0	0.33	Civil
Russia	0.10	0.01	0.10	0.12	0.07	1.31	13.2	-1.02	0	0.33	Civil
South Africa	0.13	0.01	0.09	0.13	0.09	1.52	12.0	0.89	0	0.33	Common
Taiwan	0.19	0.02	0.07	0.15	0.07	1.39	11.8	n/a	0	n/a	Civil
Thailand	0.10	0.01	0.08	0.13	0.08	1.31	11.4	0.58	0	0.33	Civil
Turkey	0.10	0.02	0.07	0.19	0.09	1.55	11.9	-1.12	0	0.00	Civil
Mean	0.14	0.01	0.05	0.18	0.08	1.49	12.2	0.20			
Median	0.08	0.00	0.07	0.00	0.06	1.17	12.0	-0.05			
S.D.	0.16	0.11	0.14	0.38	0.07	1.03	2.02	1.79			
DEV [1]	0.15	0.01	0.04	0.20	0.087	1.57	12.3	0.93			
DEV [0]	0.11	0.01	0.07	0.15	0.075	1.39	12.0	-0.68			
[1]-[0]	0.04	-0.01	-0.03	0.05	0.012	0.18	0.24	1.61			
(t-stat.)	(52.0)	(-8.84)	(-41.7)	(25.1)	(33.0)	(32.7)	(21.0)	(231.4)			

Table 1 (continued)

Panel B. Firm characteristics and periods of uncertainty (classified by *Recession*)

	Firm characteristics					
	Cash	Δ*Cash*	*CF*	*Neg*	*q*	*CapEx*
Recession [1]	0.20	-0.01	-0.02	0.34	1.88	0.05
Recession [0]	0.19	0.01	0.01	0.27	2.14	0.06
[1]-[0]	0.01	-0.02	-0.04	0.08	-0.25	-0.01
(t-stat.)	(5.90)	(-14.7)	(-23.7)	(24.1)	(-24.3)	(-13.2)

Table 2. Saving model: the effects of finance constraints and income variability

The table reports the OLS and measurement-error consistent regression coefficients estimated from the model in Eq. (1). The regression variables are defined in Table 1. In Panel A, firm size and cash payout are the indicators of finance constraints. Firms with their asset size in the top (bottom) three deciles of the size distribution for country *j* in year *t* are considered financially unconstrained (constrained). Dividend-paying (non-dividend-paying) and stock-repurchasing (non-stock-repurchasing) firms are treated as financially unconstrained (constrained). In Panel B, the standard deviation of the residuals from a first-order panel autoregression of cash flow and the standard deviation of cash flow are the indicators of income variability. Firms with their respective volatilities in the top (bottom) three deciles of the distribution for country *j* are considered as having high (low) income variability. The t-statistics (OLS) and z-statistics (cumulants) are reported in parentheses.

Panel A. The effect of finance constraints

Dependent variable: $\Delta Cash$	*N*	*CF*	*CF*Neg*	*q*	R^2	*CF*	*CF*Neg*	*q*	R^2
Scheme #1: Firm size			OLS				Cumulants		
Unconstrained	123,049	0.11	0.04	0.01	10.1%	-0.67	0.91	0.11	20.4%
		(3.81)	(1.32)	(6.32)		(-27.1)	(30.0)	(47.3)	
Constrained	123,027	0.22	0.01	0.02	11.1%	-0.37	0.90	0.14	25.0%
		(9.28)	(0.45)	(12.1)		(-16.0)	(31.9)	(64.8)	
Scheme #2: Payout									
Unconstrained	253,588	0.17	0.06	0.01	12.3%	-0.90	1.43	0.15	24.5%
		(5.66)	(1.58)	(6.78)		(-46.0)	(56.4)	(98.4)	
Constrained	155,029	0.25	0.01	0.03	12.2%	-0.24	0.74	0.14	26.9%
		(12.9)	(0.50)	(13.4)		(-14.5)	(36.4)	(78.4)	

Panel B. The effect of income variability

Scheme #1: σ of residuals			OLS				Cumulants		
Low variability	122,408	0.07	0.02	0.01	9.4%	-1.02	1.67	0.14	24.5%
		(2.03)	(0.41)	(5.46)		(-30.4)	(27.9)	(53.2)	
High variability	122,406	0.23	0.05	0.02	12.9%	-0.25	0.73	0.14	25.9%
		(13.7)	(1.85)	(11.3)		(-12.6)	(30.9)	(66.6)	
Scheme #2: σ of cash flow									
Low variability	122,910	0.08	-0.11	0.01	9.6%	-0.94	1.50	0.14	25.4%
		(2.59)	(-2.45)	(5.66)		(-29.6)	(24.5)	(54.5)	
High variability	122,911	0.21	0.06	0.02	12.7%	-0.34	0.82	0.14	26.0%
		(11.3)	(2.23)	(12.0)		(-15.6)	(31.7)	(67.3)	

Note: The estimation results for control variables are not tabulated.

Table 3. Saving model: the *net* effect of finance constraints and low income variability

The table reports the OLS and measurement-error consistent regression coefficients estimated from the modified model in Eq. (1). D_C is a dummy variable that takes a value of unity if a firm is classified as constrained, and zero otherwise. D_L is a dummy variable that takes a value of unity if a firm is classified as having low income variability, and zero otherwise. *Sum* refers to the sum of the coefficients in columns (2) to (4). The regression variables are defined in Table 1. Firm size and cash payout are the indicators of finance constraints. Firms with their asset size in the top (bottom) three deciles of the size distribution for country *j* in year *t* are considered financially unconstrained (constrained). Dividend-paying (non-dividend-paying) and stock-repurchasing (non-stock repurchasing) firms are treated as financially unconstrained (constrained). The standard deviation of the residuals from a first-order panel autoregression of cash flow and the standard deviation of cash flow are the indicators of income variability. Firms with their respective volatilities in the top (bottom) three deciles of the distribution for country *j* are considered as having high (low) income variability. The t-statistics (OLS) and z-statistics (cumulants) are reported in parentheses.

Dependent variable: Δ*Cash*	*N*	*CF*	*CF*D*$_C$	*CF*D*$_L$	*CF*D*$_C$ **D*$_L$	*Sum*	R^2	*CF*	*CF*D*$_C$	*CF*D*$_L$	*CF*D*$_C$ **D*$_L$	*Sum*	R^2
		(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
		OLS						Cumulants					
Size (D_C) / σ of residuals (D_L)	151,315	0.19	0.07	-0.24	0.14	-0.03	11.8%	-0.60	0.18	-0.92	0.49	-0.25	29.5%
		(7.39)	(2.17)	(-9.32)	(3.18)	(-0.91)		(-12.6)	(3.19)	(-13.6)	(4.36)	(-2.48)	
Size (D_C) / σ of cash flow (D_L)	152,510	0.14	0.12	-0.18	0.07	0.02	11.5%	-0.85	0.40	-0.49	0.19	0.10	29.5%
		(5.93)	(4.87)	(-5.73)	(2.46)	(0.71)		(-16.5)	(6.80)	(-7.42)	(1.92)	(1.22)	
Payout (D_C) / σ of residuals (D_L)	244,818	0.19	0.11	-0.21	0.11	0.02	12.2%	-0.66	0.41	-0.62	-0.09	-0.30	30.2%
		(8.04)	(5.36)	(-5.28)	(4.77)	(0.56)		(-21.8)	(11.4)	(-13.6)	(-1.31)	(-4.71)	
Payout (D_C) / σ of cash flow (D_L)	245,825	0.15	0.15	-0.16	0.06	0.06	12.0%	-0.82	0.54	-0.34	-0.26	-0.06	30.7%
		(5.69)	(7.51)	(-4.68)	(3.34)	(1.99)		(-25.2)	(13.8)	(-7.51)	(-3.74)	(-0.99)	

Note: The estimation results for control variables are not tabulated.

Table 4. Saving model: the *gross* effect of finance constraints and high income variability

The table reports the OLS and measurement-error consistent regression coefficients estimated from the modified model in Eq. (1). D_C is a dummy variable that takes a value of unity if a firm is classified as constrained, and zero otherwise. D_H is a dummy variable that takes a value of unity if a firm is classified as having high income variability, and zero otherwise. *Sum* refers to the sum of the coefficients in columns (2) to (4). The regression variables are defined in Table 1. Firm size and cash payout are the indicators of finance constraints. Firms with their asset size in the top (bottom) three deciles of the size distribution for country *j* in year *t* are considered financially unconstrained (constrained). Dividend-paying (non-dividend-paying) and stock-repurchasing (non-stock repurchasing) firms are treated as financially unconstrained (constrained). The standard deviation of the residuals from a first-order panel autoregression of cash flow and the standard deviation of cash flow are the indicators of income variability. Firms with their respective volatilities in the top (bottom) three deciles of the distribution for country *j* are considered as having high (low) income variability. The t-statistics (OLS) and z-statistics (cumulants) are reported in parentheses.

Dependent variable: Δ*Cash*	*N*	*CF*	*CF*D*$_C$	*CF*D*$_H$	*CF*D*$_C$ **D*$_H$	*Sum*	R^2	*CF*	*CF*D*$_C$	*CF*D*$_H$	*CF*D*$_C$ **D*$_H$	*Sum*	R^2
		(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
		OLS						Cumulants					
Size (D_C) / σ of residuals (D_H)	151,315	-0.05	0.21	0.24	-0.14	0.31	11.8%	-1.51	0.67	0.92	-0.49	1.09	29.5%
		(-1.45)	(7.69)	(9.32)	(-3.17)	(6.36)		(-30.8)	(6.80)	(13.6)	(-4.36)	(19.2)	
Size (D_C) / σ of cash flow (D_H)	152,510	-0.04	0.19	0.18	-0.07	0.30	11.5%	-1.34	0.60	0.49	-0.19	0.89	29.5%
		(-1.15)	(6.01)	(5.72)	(-2.45)	(6.85)		(-31.4)	(7.48)	(7.41)	(-1.92)	(17.3)	
Payout (D_C) / σ of residuals (D_H)	244,818	-0.02	0.22	0.21	-0.11	0.32	12.2%	-1.28	0.32	0.62	0.09	1.04	30.2%
		(-0.35)	(8.71)	(5.28)	(-4.77)	(6.94)		(-36.3)	(5.26)	(13.6)	(1.31)	(24.9)	
Payout (D_C) / σ of cash flow (D_H)	245,825	0.00	0.21	0.16	-0.06	0.31	12.0%	-1.16	0.27	0.34	0.26	0.87	30.7%
		(-0.06)	(10.6)	(4.68)	(-3.34)	(7.62)		(-36.5)	(4.64)	(7.50)	(3.74)	(22.2)	

Note: The estimation results for control variables are not tabulated.

Table 5. Income variability across countries

The table reports the standard deviation of the residuals from a first-order panel autoregression of cash flow for firms classified as financially unconstrained (constrained) from countries classified as financially developed (underdeveloped). Panel A reports the results for five different industry groups. Panel (1) reports the standard deviations returned from the full sample; panel (2) – from the subsample of manufacturing firms (SIC codes from 2000 to 3990); panel (3) – from the subsample of high-tech firms (SIC codes 28, 35, 36, 37, 38, and 73); panel (4) – from the subsample of firms from the durables industries (SIC codes between 24 and 25, or between 32 and 38); and panel (5) – from the subsample of firms from the nondurables industries (SIC codes between 20 and 23, or between 26 and 31). Panel B reports the results for two non-overlapping periods. Firms with their asset size in the top (bottom) three deciles of the size distribution for country *j* in year *t* are considered financially unconstrained (constrained). Dividend-paying (non-dividend-paying) and stock-repurchasing (non-stock-repurchasing) firms are treated as financially unconstrained (constrained). *DEV* is equal to unity [1] if a country is classified as financially developed by the Dow Jones, FTSE, MSCI, Russell Investments, and S&P, and zero [0] otherwise.

Panel A. Income variability across groups of countries and industries

(1) Full sample	Unconstrained Large	Constrained Small	Unconstrained Payout	Constrained No Payout
DEV [1]	0.057	0.14	0.060	0.15
DEV [0]	0.052	0.09	0.054	0.10
(2) Manufacturing firms				
DEV [1]	0.051	0.12	0.056	0.14
DEV [0]	0.050	0.08	0.051	0.09
(3) Hi-tech firms				
DEV [1]	0.056	0.15	0.066	0.16
DEV [0]	0.053	0.09	0.053	0.10
(4) Durable goods firms				
DEV [1]	0.054	0.12	0.058	0.13
DEV [0]	0.051	0.08	0.052	0.09
(5) Nondurable goods firms				
DEV [1]	0.048	0.13	0.052	0.15
DEV [0]	0.049	0.08	0.051	0.09

Panel B. Income variability across groups of countries and over time

DEV [1] 1991-2002	0.048	0.12	0.053	0.13
DEV [1] 2003-2013	0.055	0.15	0.056	0.15
DEV [0] 1991-2002	0.053	0.08	0.053	0.10
DEV [0] 2003-2013	0.047	0.09	0.049	0.09

Table 6. Saving model: the effect of financial development

The table reports the OLS and measurement-error consistent regression coefficients estimated from the model in Eq. (1). The regression variables are defined in Table 1. *DEV* is equal to unity [1] if a country is classified as financially developed by the Dow Jones, FTSE, MSCI, Russell Investments, and S&P, and zero [0] otherwise. *WEFI* is the categorical variable constructed from the World Economic Forum Financial Development Index. Countries with a value of 0.67 or 1 are classified as financially developed, whereas countries with a value of 0 or 0.33 – as financially underdeveloped. *Law* is equal to unity [1] for English common-law countries and zero [0] for French, German or Scandinavian civil-law countries. *FD* is the standardized sum of the value of shares traded over the GDP and the credit going to the private sector over the GDP. Firms from countries with the ratio above (below) its sample median in year *t* are classified as financially developed [1] (underdeveloped [0]). *Liberalization* is equal to unity [1] if a country liberalized its stock market from 1987 to 1992, and zero [0] otherwise. Liberalization is a formal regulatory change after which foreign investors officially have the opportunity to invest in domestic securities. The t-statistics (OLS) and z-statistics (cumulants) are reported in parentheses.

Dependent variable: Δ*Cash*	*N*	*CF*	*q*	R^2	*CF*	*q*	R^2
		OLS			Cumulants		
DEV [1]	278,619	0.10	0.02	10.4%	-0.66	0.13	25.2%
		(4.52)	(8.57)		(-35.3)	(94.7)	
DEV [0]	129,998	0.19	0.01	9.6%	-0.62	0.17	26.6%
		(11.8)	(3.35)		(-17.0)	(35.8)	
[1]-[0]		-0.09			-0.05		
(p-value)		(0.00)			(0.21)		
WEFI [0.67, 1]	322,427	0.13	0.02	10.5%	-0.64	0.14	26.2%
		(5.21)	(8.28)		(-34.8)	(99.8)	
WEFI [0, 0.33]	66,722	0.17	0.01	8.9%	-0.62	0.14	16.6%
		(4.91)	(2.34)		(-20.0)	(45.4)	
[0.67, 1]-[0,		-0.04			-0.03		
(p-value)		(0.17)			(0.40)		
Law [1]	207,202	0.12	0.02	10.0%	-0.70	0.14	24.7%
		(4.91)	(5.58)		(-31.6)	(80.7)	
Law [0]	201,415	0.16	0.01	9.7%	-0.57	0.15	28.6%
		(8.53)	(6.07)		(-25.0)	(71.1)	
[1]-[0]		-0.03			-0.13		
(p-value)		(0.22)			(0.00)		
FD [1]	315,087	0.13	0.02	10.1%	-0.63	0.14	26.2%
		(5.49)	(7.64)		(-35.1)	(98.9)	
FD [0]	75,457	0.16	0.01	9.4%	-0.65	0.15	18.2%
		(7.98)	(3.54)		(-22.0)	(54.1)	
[1]-[0]		-0.03			0.01		
(p-value)		(0.24)			(0.68)		
Liberalization [1]	15,898	0.23	0.00	16.6%	-0.36	0.11	12.9%
		(5.96)	(2.18)		(-3.32)	(6.31)	
Liberalization [0]	5,375	0.11	0.01	10.5%	-0.38	0.12	22.4%
		(1.95)	(4.73)		(-2.91)	(6.17)	
[1]-[0]		0.13			0.02		
(p-value)		(0.07)			(0.89)		

Note: The estimation results for control variables are not tabulated.

Table 7. Saving model: the effect of macro uncertainty

The table reports the OLS and measurement-error consistent regression coefficients estimated from the model in Eq. (1). The regression variables are defined in Table 1. *Recession* is equal to unity [1] for the year in which at least one quarter falls within the contraction, the year immediately preceding and the year immediately following the contraction. *Recession* is equal to zero [0] for all remaining sample years. The recession data are from U.S. National Bureau of Economic Research. *EPU* is the U.S. economic policy uncertainty index from Baker et al. (2016). *AEU* and *AFU* are aggregate and financial market uncertainty measures, respectively, from Jurado et al. (2015). The policy, aggregate, and financial market uncertainty measures are calculated as yearly averages from their respective monthly values. The measures are equal to unity [1] for the years in which their values exceed 0.5 standard deviation above their respective sample means. The measures are equal to zero [0] for all remaining sample years. The t-statistics (OLS) and z-statistics (cumulants) are reported in parentheses.

Dependent variable: Δ*Cash*	*N*	*CF*	*q*	R^2	*CF*	*q*	R^2
			OLS			Cumulants	
Recession [1]	31,702	0.30	0.02	25.1%	-0.59	0.13	29.3%
		(9.52)	(11.6)		(-12.9)	(31.0)	
Recession [0]	52,492	0.19	0.02	21.6%	-0.83	0.13	27.8%
		(9.46)	(16.9)		(-20.8)	(43.2)	
[1]-[0]		0.10			0.25		
(p-value)		(0.00)			(0.00)		
EPU [1]	33,202	0.28	0.02	26.8%	-0.75	0.15	32.1%
		(9.50)	(10.9)		(-18.4)	(70.8)	
EPU [0]	50,518	0.22	0.02	21.5%	-1.05	0.16	33.1%
		(9.94)	(17.6)		(-26.4)	(88.5)	
[1]-[0]		0.06			0.30		
(p-value)		(0.04)			(0.00)		
AFU [1]	34,871	0.30	0.02	24.7%	-0.58	0.13	30.6%
		(10.1)	(14.0)		(-13.7)	(36.6)	
AFU [0]	48,849	0.20	0.02	21.8%	-0.84	0.14	27.0%
		(9.12)	(15.5)		(-19.4)	(38.3)	
[1]-[0]		0.10			0.26		
(p-value)		(0.00)			(0.00)		
AEU [1]	24,452	0.33	0.02	25.8%	-0.72	0.16	31.6%
		(8.86)	(9.65)		(-15.8)	(66.2)	
AEU [0]	59,268	0.20	0.02	22.2%	-0.94	0.15	31.4%
		(10.7)	(18.5)		(-28.4)	(94.9)	
[1]-[0]		0.13			0.22		
(p-value)		(0.00)			(0.00)		

Note: The estimation results for control variables are not tabulated.

Table 8. Saving model: the effect of economic policy uncertainty

The table reports the OLS and measurement-error consistent regression coefficients estimated from the (modified) model in Eq. (1). The model is modified to include the *EPU* index and its combination with cash flow. *EPU* is the economic policy uncertainty index from Baker et al. (2016). The index is available for Australia, Brazil, Canada, Chile, China, France, Germany, India, Ireland, Italy, Japan, Korea, Netherlands, Russia, Singapore, Spain, Sweden, and U.K. The U.S. index is omitted in this test. The regression variables are defined in Table 1. The test considers all sample firms and firms with strictly positive income (*CF*>0). The t-statistics (OLS) and z-statistics (cumulants) are reported in parentheses.

Dependent variable: Δ*Cash*	*N*	*CF*	*CF* EPU*	*q*	R^2	*CF*	*CF* EPU*	*q*	R^2
		OLS				Cumulants			
All firms	212,341	-0.17	0.08	0.02	10.6%	-1.75	0.26	0.15	25.4%
		(-2.46)	(6.22)	(5.95)		(-11.7)	(8.34)	(77.3)	
Firms with *CF*>0	165,875	-0.11	0.07	0.01	11.6%	-1.80	0.27	0.15	27.9%
		(-0.90)	(3.03)	(8.25)		(-11.8)	(8.43)	(62.7)	

Note: The estimation results for control variables are not tabulated.

Table 9. Augmented saving model: the effect of macro uncertainty

The table reports the OLS and measurement-error consistent regression coefficients estimated from the (modified) model in Eq. (1). The model is modified to include lagged cash-to-assets ratio (*L.Cash*) and its first difference (*L.ΔCash*), uncertainty measure (Ψ) and its combination with cash flow (*CF*Ψ*). *Recession* is equal to unity for the year in which at least one quarter falls within the official contraction, the year immediately preceding and the year immediately following the contraction. *Recession* is equal to zero for all remaining sample years. The recession data are from U.S. National Bureau of Economic Research. *EPU* is the U.S. economic policy uncertainty index from Baker et al. (2016). *AEU* and *AFU* are aggregate and financial market uncertainty measures, respectively, from Jurado et al. (2015). The policy, aggregate, and financial market uncertainty measures are calculated as yearly averages from their respective monthly values. Other regressors are defined in Table 1. The t-statistics (OLS) and z-statistics (cumulants) are reported in parentheses.

Dependent variable: Δ*Cash*	*N*	*CF*	*CF * Ψ*	*L.Cash*	*L.Δ Cash*	*q*	R^2	*CF*	*CF * Ψ*	*L.Cash*	*L.Δ Cash*	*q*	R^2
					OLS						Cumulants		
Recession	76,454	0.26	0.06	-0.37	-0.07	0.03	31.3%	-0.77	0.25	-0.28	-0.10	0.14	35.6%
		(27.9)	(6.09)	(-38.2)	(-9.46)	(25.8)		(-20.1)	(7.06)	(-37.8)	(-13.0)	(51.9)	
EPU	76,454	-0.21	0.11	-0.37	-0.07	0.03	31.3%	-1.83	0.24	-0.28	-0.10	0.14	36.4%
		(-2.37)	(5.72)	(-38.3)	(-9.57)	(25.8)		(-5.83)	(3.65)	(-38.0)	(-12.9)	(53.7)	
AFU	76,454	0.10	0.19	-0.37	-0.07	0.03	31.3%	-1.34	0.69	-0.28	-0.10	0.14	35.6%
		(2.60)	(5.46)	(-38.1)	(-9.49)	(25.8)		(-11.1)	(5.90)	(-37.9)	(-13.0)	(52.9)	
AEU	76,454	0.11	0.22	-0.37	-0.07	0.03	31.3%	-1.84	1.40	-0.29	-0.10	0.14	36.2%
		(2.20)	(3.90)	(-38.2)	(-9.41)	(25.8)		(-9.93)	(6.31)	(-37.9)	(-12.8)	(53.4)	

Note: The estimation results for control variables are not tabulated.

Figure 1. U.S. economic policy uncertainty indices

The figure plots the overall (solid line) and news-based (round dot line) indices of economic policy uncertainty. The indices are reported at a monthly frequency. The figure spans the period from Jan 1992 to Dec 2013. The horizontal lines correspond to 0.5 standard deviations above the respective mean of each series. Source: www.policyuncertainty.com.

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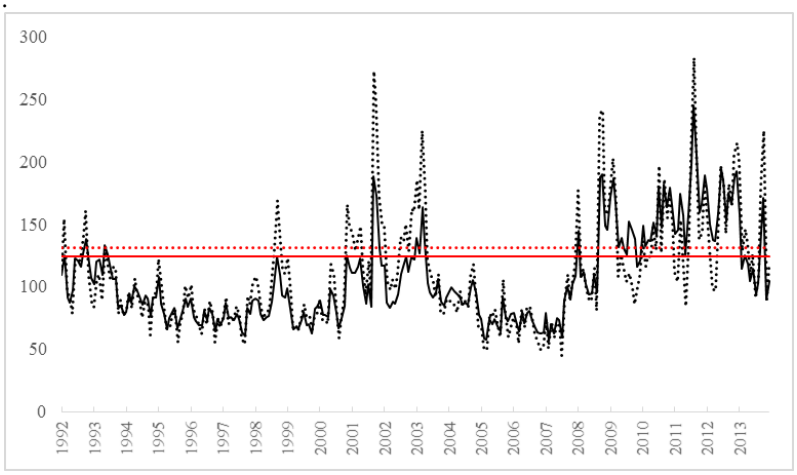


Figure 2. U.S. aggregate and financial market uncertainty measures

The figure plots aggregate (solid line) and financial market (round dot line) uncertainty measures. The measures are reported at a monthly frequency. The figure spans the period from Jan 1992 to Dec 2013. The horizontal lines correspond to 0.5 standard deviations above the respective mean of each series. Source: https://www.sydneyludvigson.com/data-and-appendixes.

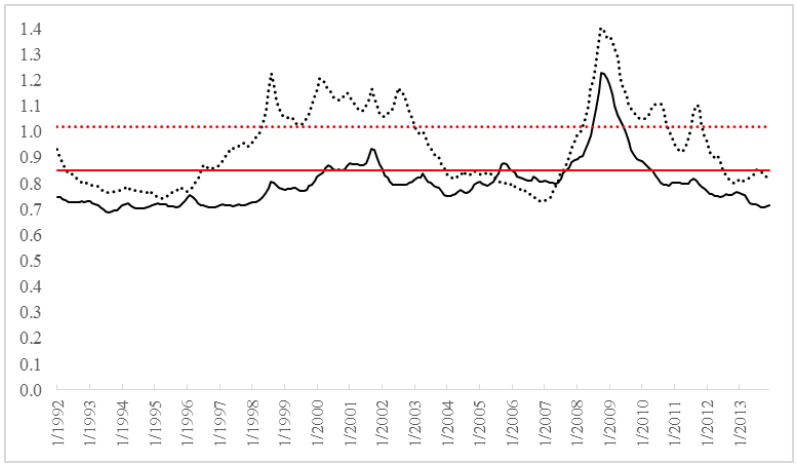
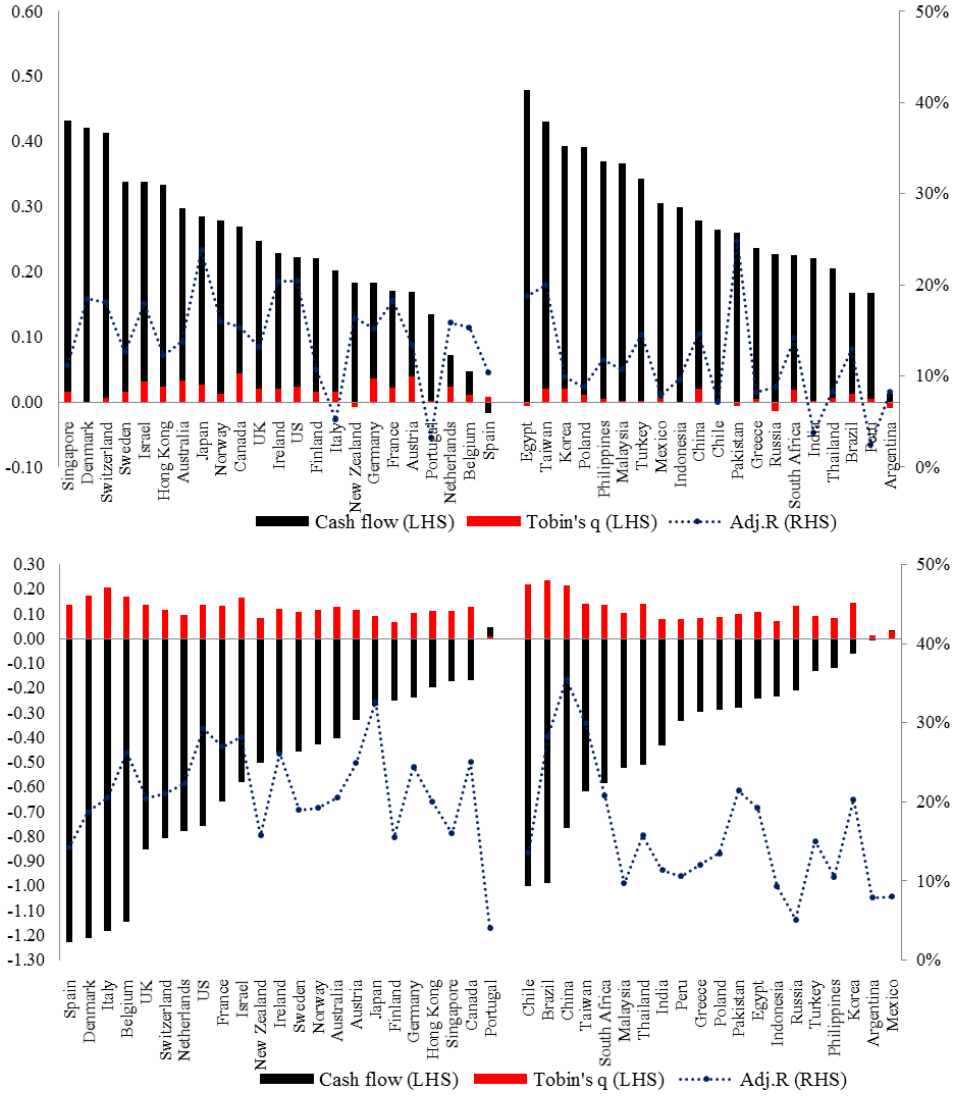


Figure 3. Saving-cash flow and saving-*q* sensitivities

The table reports the OLS (upper figure) and measurement-error consistent (lower figure) regression coefficients estimated from the model in Eq. (1). The left (right) bars correspond to financially developed (underdeveloped) countries (classified by the *DEV* scheme). *DEV* is equal to unity if a country is classified as financially developed by the Dow Jones, FTSE, MSCI, Russell Investments, and S&P, and zero otherwise The coefficient estimates on cash flow and Tobin's *q* are reported for each country in the sample. The regression variables are defined in Table 1. *Adj.R* corresponds to adjusted R^2.



Appendix 1. The number of firms in the sample

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Argentina	3	10	20	26	27	32	37	40	42	39	48	54	56	56	55	56	56	59	56	53	55	54	31
Australia	110	153	151	189	232	253	275	297	359	495	823	847	903	996	1,090	1,138	1,264	1,267	1,327	1,327	1,337	1,114	154
Austria	4	27	41	45	46	46	62	65	74	83	83	68	57	55	52	60	68	66	64	67	64	59	43
Belgium	4	60	63	66	65	62	70	85	89	88	91	88	86	84	91	90	96	94	92	89	87	80	72
Brazil	0	69	72	72	104	131	126	131	147	233	230	213	205	212	221	222	232	226	223	233	235	215	204
Canada	55	311	313	329	324	372	391	438	601	695	745	831	893	967	1,156	1,647	1,794	1,801	1,785	1,816	1,839	1,698	1,152
Chile	0	28	35	41	56	60	68	75	90	122	128	126	126	131	126	131	132	129	126	123	123	124	119
China	0	7	8	24	35	95	105	127	132	257	304	1,160	1,238	1,382	1,449	1,575	1,714	1,911	2,038	2,431	2,736	2,853	2,822
Denmark	20	102	102	108	109	116	140	140	130	122	117	117	107	102	100	102	116	113	106	109	106	99	85
Egypt	0	0	0	0	0	0	1	2	5	6	9	13	21	26	53	89	112	126	120	116	124	121	81
Finland	7	67	68	69	77	82	98	108	105	107	120	114	110	109	110	117	119	118	114	115	113	110	110
France	13	347	381	397	392	391	477	566	554	608	630	623	592	558	551	594	591	561	547	537	506	452	382
Germany	16	279	304	345	356	370	432	482	540	608	649	592	576	541	539	569	579	564	551	531	519	493	419
Greece	0	1	6	9	10	11	11	9	9	39	92	63	71	78	231	252	258	247	248	241	232	208	187
Hong Kong	29	84	91	110	165	265	307	326	334	393	602	666	700	738	773	792	845	830	846	897	912	894	604
India	17	122	149	170	239	258	255	262	267	296	293	356	413	493	558	1,528	1,723	1,800	1,859	1,914	1,923	1,860	71
Indonesia	2	60	65	74	80	112	123	132	135	166	218	237	237	234	239	230	251	275	271	287	305	322	343
Ireland	16	50	50	50	52	56	69	68	69	67	66	67	71	71	81	89	93	85	77	72	75	67	48
Israel	0	0	6	16	29	29	34	44	42	63	97	107	114	139	154	357	394	397	388	391	359	332	295
Italy	8	122	109	111	116	116	128	133	134	164	181	185	167	164	173	197	215	206	202	200	194	172	163
Japan	354	410	442	479	1,088	1,233	1,218	1,228	2,559	3,025	3,230	3,266	3,237	3,322	3,390	3,437	3,406	3,340	3,260	3,202	3,184	3,181	541
Korea	6	96	96	161	190	213	244	277	353	568	591	634	706	737	843	1,229	1,363	1,390	1,496	1,533	1,531	1,530	1,507
Malaysia	35	133	140	151	180	261	288	297	307	380	584	632	658	757	824	846	840	834	830	819	803	769	511
Mexico	0	40	54	61	96	99	103	118	133	134	130	127	115	112	110	110	111	114	109	112	110	106	94
Netherlands	7	131	133	145	158	163	185	205	193	197	180	175	163	154	149	153	157	135	127	130	130	116	112
New	21	23	24	29	36	43	52	52	50	50	66	71	73	83	81	82	92	95	95	92	92	76	17
Norway	0	70	70	80	88	90	148	158	137	118	112	104	101	115	123	139	155	150	144	151	146	136	121
Pakistan	1	19	42	60	69	69	69	71	69	75	84	87	88	88	141	159	174	172	186	193	189	159	41
Peru	0	3	14	20	17	18	26	28	34	45	57	59	56	52	53	83	83	89	85	81	78	71	61
Philippines	0	15	22	31	40	55	61	62	65	85	101	108	109	113	117	114	113	120	119	122	125	119	115
Poland	0	0	0	1	2	12	12	12	13	18	24	32	54	87	120	170	220	266	289	310	344	340	266
Portugal	0	13	36	32	43	50	59	56	60	57	61	51	52	48	48	45	47	49	47	46	44	43	39
Russia	0	0	0	0	0	0	5	12	17	16	26	32	37	44	70	185	246	314	236	269	266	238	201
Singapore	14	81	83	89	129	176	174	184	191	234	373	383	421	462	484	486	502	503	504	517	509	492	343
South	62	114	138	149	149	150	152	246	315	301	281	252	229	218	211	218	261	270	270	268	251	240	81
Spain	3	78	86	89	92	92	107	104	105	113	113	111	105	103	96	96	100	100	101	109	111	113	100
Sweden	3	95	104	113	133	139	186	217	211	219	220	214	215	222	229	286	312	332	341	359	354	322	281
Switzerland	11	88	94	106	121	122	145	158	159	163	189	186	180	181	177	185	188	183	187	190	179	176	162
Taiwan	2	19	25	43	102	190	205	213	207	339	447	909	1,057	1,277	1,288	1,321	1,390	1,403	1,426	1,503	1,571	1,598	1,538
Thailand	4	60	105	154	170	182	193	203	191	190	267	281	297	333	378	391	398	399	406	404	406	421	428
Turkey	0	13	18	20	24	28	38	48	60	81	108	131	160	169	174	212	218	223	222	236	250	250	224
UK	465	1,065	1,067	1,114	1,167	1,242	1,410	1,372	1,214	1,213	1,284	1,243	1,246	1,302	1,355	1,412	1,392	1,257	1,162	1,087	1,036	979	593
US	474	2,190	2,308	2,659	3,455	3,891	4,245	4,689	5,210	5,202	4,796	4,586	4,370	4,272	4,194	4,137	4,066	3,705	3,405	3,278	3,316	3,258	2,488
Total	1,766	6,655	7,135	8,037	10,063	11,375	12,534	13,540	15,711	17,474	18,850	20,201	20,472	21,387	22,457	25,331	26,486	26,318	26,087	26,560	26,869	26,060	17,249

Appendix 2. World Economic Forum Financial Development Index

WEFI is the categorical variable constructed from the World Economic Forum Financial Development Index (WEF). Countries with a value of 0.67 or 1 are classified as financially developed, whereas countries with a value of 0 or 0.33 – as financially underdeveloped.

	WEF 2008	WEF 2009	WEF 2010	WEF 2011	WEF 2012	WEF 2008-12 (average)	*WEFI*
Argentina	47	51	52	53	55	51.6	0
Australia	11	2	5	5	5	5.6	1
Austria	18	18	19	20	22	19.4	0.67
Belgium	17	13	10	13	16	13.8	0.67
Brazil	40	34	32	30	32	33.6	0.33
Canada	5	6	6	6	6	5.8	1
Chile	30	31	30	31	29	30.2	0.33
China	24	26	22	19	23	22.8	0.67
Denmark	-	10	16	15	12	13.25	0.67
Egypt	37	36	38	49	53	42.6	0
Finland	21	19	20	21	17	19.6	0.67
France	6	11	11	12	14	10.8	1
Germany	3	12	13	14	11	10.6	1
Greece	n/a	n/a	n/a	n/a	48	48	0
Hong Kong	8	5	3	1	1	3.6	1
India	31	38	37	36	40	36.4	0.33
Indonesia	38	48	51	51	50	47.6	0
Ireland	14	16	18	22	20	18	0.67
Israel	23	28	27	26	24	25.6	0.33
Italy	22	21	25	27	30	25	0.33
Japan	4	9	9	8	7	7.4	1
Korea	19	23	24	18	15	19.8	0.67
Malaysia	20	22	17	16	18	18.6	0.67
Mexico	43	43	43	41	43	42.6	0
Netherlands	9	8	7	7	9	8	1
New Zealand	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Norway	15	17	15	10	13	14	0.67
Pakistan	34	49	54	55	58	50	0
Peru	46	42	48	40	41	43.4	0
Philippines	48	50	50	44	49	48.2	0
Poland	41	39	35	33	37	37	0.33
Portugal	n/a	n/a	n/a	n/a	27	27	0.33
Russia	36	40	40	39	39	38.8	0.33
Singapore	10	4	4	4	4	5.2	1
South Africa	25	32	31	29	28	29	0.33
Spain	12	15	14	17	19	15.4	0.67
Sweden	13	14	12	11	10	12	0.67
Switzerland	7	7	8	9	8	7.8	1
Taiwan	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Thailand	29	35	34	35	34	33.4	0.33
Turkey	39	44	42	43	42	42	0
UK	2	1	2	3	3	2.2	1
US	1	3	1	2	2	1.8	1

Appendix 3. Stock Market Liberalization

Liberalization year refers to the year of a formal regulatory change after which foreign investors officially have the opportunity to invest in domestic equity securities.

Country	Liberalization year (1986-1992)
Argentina	1989
Brazil	1991
Chile	1992
Egypt	1992
Greece	1987
India	1992
Indonesia	1989
Korea	1992
Malaysia	1988
Mexico	1989
Pakistan	1991
Philippines	1991
Thailand	1987
Turkey	1989
Non-liberalizing countries (1986-2001)	
China	
Peru	
Poland	
Russia	
South Africa	
Taiwan	

Appendix 4. U.S. Business Cycles

The recession data are from U.S. National Bureau of Economic Research (NBER) business cycles (http://www.nber.org/cycles.html). *NBER recession* is equal to unity [1] for the year in which at least one quarter falls within the contraction (peak to trough). *Recession* is equal to unity [1] for the year in which at least one quarter falls within the official contraction, the year immediately preceding and the year immediately following the contraction. *Recession* is equal to zero [0] for all remaining sample years.

Year	Peak to trough period	*NBER recession*	*Recession*
1991	07/90-03/91	1	1
1992	-	0	1
1993	-	0	0
1994	-	0	0
1995	-	0	0
1996	-	0	0
1997	-	0	0
1998	-	0	0
1999	-	0	0
2000	-	0	1
2001	03/01-11/01	1	1
2002	-	0	1
2003	-	0	0
2004	-	0	0
2005	-	0	0
2006	-	0	0
2007	12/07-06/09	0	1
2008	12/07-06/09	1	1
2009	12/07-06/09	1	1
2010	-	0	1
2011	-	0	0
2012	-	0	0
2013	-	0	0

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