International Food and Agribusiness Management Review
Volume 18 Issue 4, 2015

Assessing Cash Holdings in Agribusiness

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Abstract

By using fixed-effects panel regression, we model cash holdings for agribusiness firms during the 1970-2012 period. The results suggest that agribusiness firms manage cash in a manner consistent with the precautionary theory of caution management. Specifically, agribusiness firms hold cash to quickly execute growth opportunities and limit transaction costs of acquiring capital for growth. Furthermore, a subset of cash-rich agribusiness firms, which concentrates 78.5% of the aggregate cash and 49% of total revenues, is analyzed with a logit model. Results of cash-rich agribusiness deviate from predictions by the precautionary theory. This finding has potential implications for structural changes in this sector.

Keywords: optimal cash, precautionary theory, agency theory, US agribusiness

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Introduction

Many agribusiness firms held large amounts of cash relative to total assets recently. These firms recorded strong operating performance during the profitable agricultural production years, and banked some additional cash in reserve. Given that cash holdings typically generate immediate returns below firms' weighted average costs of capital, one might assume that the firms would have quickly redeployed the cash into other assets or returned the earnings to shareholders.

For example, Deere & Co held cash at elevated levels relative to total assets from 2009 through 2012 as compared to historical cash holdings. As the US farm economy has slowed, Deere & Co cash levels are closer to historically normal benchmarks. One reason for holding cash is to preserve liquidity, which can expedite investment in growth and acquisition opportunities. Another reason to hold cash is to prepare for less robust operating periods. Alternatively, managers of the firm might choose to hold cash to insulate themselves from the demands of the capital markets. Finally, perhaps management of a firm is risk averse and chooses to hold cash to manage risk.

One particularly relevant consideration for agribusiness firms is the consolidation among certain parts of the food and agricultural value chain. Consolidation has led to a declining number of actors in the agrichemicals, seeds, and fertilizer industries. There are also only a few farm equipment manufacturers left. The slowdown in the US farm economy might accelerate a wave of consolidation among others parts of the value chain. Retail appears particularly ripe for such activity. Retail supply firms have begun to acquire neighboring locations to drive sales growth and profitability. Firms executing this strategy will require cash to do so. Management at many such firms may opt to hold cash at elevated levels to make acquisition faster and cheaper.

The goal of this paper is to assess the financial positions of agribusiness firms to understand the reasons for holding cash. The results suggest that agribusiness firms manage cash in a manner consistent with the precautionary theory of caution management. Specifically, agribusiness firms hold cash to quickly execute growth opportunities and limit transaction costs of acquiring capital for growth. The results also suggest a deviation from the predictions by the precautionary theory when a subset of cash-rich agribusiness is analyzed.

Determinants of Cash and Literature Review

Harford (1999) and Opler et al. (1999) revive the cash literature, which currently relies on the precautionary theory mainly. Previous to these studies, the "…literature of cash reserves [was] … either descriptive or concerned with corporate transaction demand of cash" (Harford 1999, p. 1969). The transaction demand of cash theory, by Keynes (1936) and Miller and Orr (1966), focuses on transaction costs incurred by firms when converting noncash assets into cash. Firm size is the proxy to test this theory since economies of scale existed in transaction costs; small firms held higher cash as a percentage of total assets.

According to the precautionary theory, firms accumulate cash to cope with adverse shocks when access to capital markets is foreseen as more uncertain and costly. Opler et al. (1999, p.10) state: "…cash shortfall will prevent a firm to undertake profitable investments if it does not have liquid

assets. Thus, a firm will find it profitable to hold cash in order to mitigate the cost of financial distress." Under this theory, firm size, growth opportunities, the magnitude of cash flows, and cash flow volatility are the main determinants of cash levels in firms' balance sheets. The theory predicts that the level of cash has an inverse relationship with firm size and cash flow, and a positive relationship with growth opportunities and cash flow volatility. Empirical models add control variables to explain optimal cash.

On firm size, small firms could find high cash holdings more valuable as the access to credit is more limited (Opler et al. 1999, Sanchez and Yurdagul 2013). Firms with higher growth opportunities would retain cash to internally fund investments partially or totally without the need to seek external financing, which may be costly or unavailable (Cole 2014). Market value to book value (MTB) is widely used to proxy growth options. High MTB firms have growth options embedded in their current values (Opler et al. 1999) and derive most of their values from growth opportunities and intangibles such as human capital and research opportunities (Smith and Watts 1992 and Bizjak et al. 1993, cited in Harford 1999). John (1993) first documented that firms with higher MTB tend to hold more cash to avoid an underinvestment problem.

Regarding the magnitude of cash flows, firms generating higher level of cash flows (before investments) would keep lower cash reserves as they can replenish their holdings more quickly (Pinkowitz et al. 2013) when investment opportunities arise. The volatility of cash flows is perhaps more important than the level of cash flows in the precautionary theory framework. Firms with more volatile cash flows would hold higher cash for the uncertain future. Harford (1999) and Bates et al. (2009) find the increase in industry cash flow risk to be the one of the main causes of the recent increase of cash holdings in the US.

Empirical optimal cash models use the precautionary framework as a baseline. The model by Bates et al. (2009) is an extension of Opler et al. (1999). The model is currently widely used because it explains most of the variation of cash across firms. These results held even in the middle of the secular increase of cash holdings for the aggregate US firms during the last two decades. However, Bates et al. (2009) recognize that substantial cross sectional variation across industries is not explained by the model. They also recognize that the literature has not made enough progress to provide a dominant model for cash holdings. In this study, we use a model similar in Bates et al. (2009) with a minor extension; we include firms with foreign taxes as control variable since most recent research has found that some firms may have cash trapped overseas for tax reasons (Foley et al. 2007, cited in Dittmar and Duchin 2012; Cole 2014).

While most empirical studies support the precaution theory, deviations from its predictions have opened alternative hypotheses to explain cash, especially *high* levels of cash. The free cash flow hypothesis by Jensen and Meckling (1976) and Jensen (1986), built on the agency problem between managers and stockholders, is one of them. Under this hypothesis, managers abuse the freedom that excess cash could provide, as cash may insulate them from the discipline of capital markets. The prediction by this hypothesis is that managers in firms with large free cash flows and low growth opportunities are likely to hoard cash for their personal benefit or to invest it in value destroying projects.

Harford's (1999) findings support the free cash flow hypothesis for American firms. The author models optimal cash holdings under the precautionary framework, estimate deviations from expected cash levels, and analyze spending behavior of cash-rich firms, those with the highest deviations from the model. Cash-rich firms, the author concludes, are more likely to make acquisitions, and those acquisitions are value decreasing because they are mainly diversifying acquisitions and because the acquired firms are less likely to attract other bidders. The results on the free cash flow hypothesis, however, are inconclusive due probably to the following reasons.

First, the methodology is sensitive to the optimal model of cash holdings employed. By the time the study by Harford (1999) was published, no consensus on a robust cash model existed; in fact, the model in Harford (1999) did not control for variables that have been shown to explain cash holdings.[1] Second, the study covers a period (i.e., 1972 to 1994) when cash holdings had not experienced dramatic increases in the US. Finally, other studies have documented results inconsistent with the free cash flow hypothesis. For instance, Opler et al. (1999), using additional control variables, find little evidence that being a cash-rich firm has impact on acquisitions and capital expenditures. In particular, firms with high cash spend only slightly more on new projects and acquisitions than the rest of firms. They find that some firms accumulate cash for precautionary motives to cover operating losses, not for the personal benefit of managers. Bates et al. (2009, p. 1998) conclude that: "…overall, the evidence is inconsistent with the notion that the increase in cash holdings over time can be systematically ascribed to agency problems in firms." Furthermore, Harford et al. (2008) show that poorly-governed firms tend to have lower cash ratios, and Dittmar and Duchin (2012) test several empirical proxies of corporate governance and confirm that agency problems do not explain why a firm is cash-rich.

Another hypothesis to explain cash-rich firms is a behavioral explanation provided by Dittmar and Duchin (2012). After showing that cash-rich firms have less incentive to hold cash for precautionary reasons, and finding no support for the free cash flow hypothesis, they claim that managers in cash-rich firms are overly conservative and have a propensity to hold more cash than needed, thus decreasing the market value of cash, as perceived by investors.

As is standard in the current literature, we follow the precautionary theory framework to model cash for agribusiness. Consistent with previous studies for the US market, we find overall support for this theory in agribusiness firms. Some empirical deviations from the precautionary theory and implications of the results are discussed. We provide the models in the next section and describe the sample.

In addition to the precautionary theory framework, one might also consider the strategic management literature to contextualize the findings of this study. This literature indicates that coordination governance or integration decision is driven by a) internal considerations of cost, technology, risk and *financial* management resources, and b) external competitive considerations (Boehlje et al. 2011). Cash holdings, according to a) is potentially a key driver in times of structural changes on industries. Indeed, evidence has shown that the possibility of acquiring

[1] In addition, the model uses cash divided by sales as proxy for cash holdings. The current literature widely uses cash divided to total assets and the logarithm of cash divided by assets net of cash. Cash to sales has been shown to contain excessive outliers in the US stock markets.

other firms or the threat to be acquired more likely increases when cash holdings deviate from normal levels (Harford 1999, Erel et al. 2012, Basmah and Rahatullah 2014) and when new growth opportunities arise in a sector as it seems to be the case of agribusiness. Furthermore, growth opportunities are expected to continue increasing in the near future (Kruchkin 2013). In their discussion on future agribusiness challenges, Boehlje et al. (2011) caution that the impact and consequences of the structural change taking place in agriculture (an influencing almost all participants in the food production and distribution industries) are dramatic and profound. The structural change involves consolidation, vertical integration, and changes in the vertical and horizontal boundaries of firms. Assessing cash holdings might assist in understanding and predicting structural realignments.

Methodology

Models

To model optimal cash holdings we use the panel regression

$$(1)\ Y_{i,t} = \sum_1^k \beta_k X_{itk} + u_i + v_t + \varepsilon_{i,t},$$

where the dependent variable is cash of the i^{th} firm in year t; explained by k firm characteristics supported by the precautionary savings theory, and control variables. Model (1) is a fixed effects model, which assumes that firm cash levels are affected by both the cross-section and time-series. Standard errors are corrected for heteroscedasticity and within cross-section serial correlation.

We use two proxies for cash in accordance to the literature: cash to assets and the logarithm of cash to net assets (assets net of cash). As explanatory variables we use two subsets. First, market to book value (*MTB*), firm size (*Size*), cash flow to assets (*CFtoA*), and firm's cash flow risk (*CFVol*) as the core variables of the precautionary theory. As control variables, we use net working capital (*NWC*), capital expenditures (*Capex*), dividends (*DIV*), and foreign income taxes (*Foreign*). μ_i represents cross-section effects that are constant over time, ν_t represents time effects that are common to all firms, and ε_{it} is the residual error. With the exception of *Foreign*, variables are constructed as in Bates et al. (2009);[2] *Foreign* is a proxy we propose. For replication purposes and/or research transparency, the appendix provides variable definitions, including COMPUSTAT codes.

Ex ante expectations- As elaborated in the previous section, the theory predicts that the level of cash has a negative relation with size and cash flow, and a positive relation with growth opportunities and cash flow volatility. On control variables, as *NWC* is a substitute for cash, a negative relationship is expected. The prediction for *Capex* is unclear; the coefficient would be negative if acquired assets are used as collateral to increase leverage, and in turn to decrease the

[2] *CFVol* is constructed slightly different than in Bates et al. (2009). In this study, cash flow volatility of each firm is used instead of the average across the two-digit SIC codes. The industry average was used only when we had missing data (as explained in the Appendix). Using the firm's cash flow volatility has the advantage in our (sectorial) study that it increases variability within the series.

demand for cash as a precautionary motive. On the other hand, if *Capex* serves as proxy for investment opportunities, the relationship would be positive. For *DIV*, theory predicts a negative sign since stable dividend payers are expected to have greater access to capital markets, and do not need to build up cash for precautionary motives. Finally, as recent studies suggest that cash held by firms in foreign countries affect cash ratios (Cole 2014; Foley et al. 2007, Dittmar and Duchin 2012), *Foreign* controls for this effect. American firms with cash accumulated in foreign jurisdictions may have limitations on cash accessibility associated with repatriation, since firms would face US taxes on repatriated income. Thus, even cash rich firms may have to borrow for operating if the use of internally generated cash would be too costly due to the high repatriation tax burden (Cole 2014). Thus, a positive sign is expected.

In addition, we investigate the effect that cash holding determinants, according to the precautionary theory, have on the probability that an agribusiness is cash rich using the logit regression,

$$(2)\ P_i = \frac{1}{1+e^{-(\sum_1^k \beta_k X_{ik})}},$$

where the dependent variable is an indicator variable set to 1 if the agribusiness is cash-rich or to 0 otherwise; P_i is the probability of being a cash-rich agribusiness firm. The explanatory variables are *MTB*, *Size*, *CFtoA*, and *CFVol*, the core variables from model (1). Model (2) tests the importance of the precautionary theory variables on agribusinesses becoming cash-rich firms. In turn, cash-rich firms are defined as those agribusinesses in the top deciles when the sample is ranked every year in terms of total cash adjusted at 2012 US values; and non-cash-rich agribusiness are those in other deciles. This method follows Dittmar and Duchin (2012).

Data

Financial data from Standard & Poor's COMPUSTAT for the 1970-2012 fiscal years are used.[3] The sample contains agribusinesses listed on US stock exchanges as available in this database. Data are obtained from COMPUSTAT at the 3-, 4-, 5- and 6-digits level of the 2012 North American Classification System (NAICS).[4] We categorize six agribusiness subsectors: 1) agricultural input suppliers (AIS, hereafter); 2) agricultural producers (APD); 3) food processors (FPR); 4) beverage and tobacco product processors (BTP); 5) food and beverage stores (and wholesalers) (FBS); and 6) food service providers (FSP).

Industry Classification

While recent studies across fields of business and economics are still based on the Standard Industrial Classification (SIC), NAICS is used in this study due to the advantages this classification system has compared to SIC (Ambler and Kristoff 1998, Murphy 1998).

[3] Firms with fiscal year end month ending between January and May have a prior year "Fiscal Year." Thus, the sample also contains agribusinesses that "closed" their fiscal years in January thought May 2013.

[4] In NAICS, 3 digits represent subsector; 4 digits, industry group; 5 digits, international (Mexico, USA, and Canada) industry; and 6 digits, US industry. The list of NAICS codes selected for this study is available upon request.

Introduced in 1998 to replace SIC, NAICS is based on a consistent "production-oriented" economic concept on which firms that use the same or similar processes to produce goods and services are grouped together. In contrast, under SIC, some industries were demand-oriented and others production-oriented. The reclassification of industries according to NAICS reflects the structure of the current economy in the US as a response to criticism by analysts regarding SIC as outmoded and not reflective of the economy.[5]

Table 1 provides a breakdown of the sample, which contains a total of 995 agribusiness and 13,686 firm-years, with NAICS codes indicated in parenthesis. Agricultural input suppliers (AIS), which represents around 11% of the sample, is mainly formed by seed, pesticide, and fertilizer providers, and by machinery equipment firms. Agricultural producers (APD), 9% observations, is mainly comprised by crop, animal, and forestry production. Food and beverage manufactures, are broken down in two subsectors, food processors (FPR), with around 35% of the sample, and beverage tobacco product processors (BTP), with 13%. Food and beverage stores (and wholesalers) (FBS), with 19%, represents food and beverage retailers mainly. Finally, food service providers (FSP) (13%) has food services and drinking places.

Our agribusiness sector sample is comprehensive as in Sonka and Hudson's (1989) depiction of agribusiness, which conceives the sector as a sequence of interrelated activities made up of genetics and seedstock firms, input suppliers, agricultural producers, merchandisers or first handlers, processors, wholesalers, food retailers, and food service providers.[6]

Table 2 provides descriptive statistics for the sample. Panel A presents the complete period, 1970 to 2012, and Panel B 2000 to 2012. The means and medians of cash ratios are similar in both periods, no statistical difference exists between the series. Cash in agribusiness has not experienced the dramatic increase that the whole US market has in the last decade.

Figure 1 compares means and medians of cash to assets for agribusiness and the complete US market. The statistics in Figure 1 for the whole market are similar/comparable to those estimated

[5] Comparing industry grouping accuracies under different classification systems is out of the scope of this study. Some studies have shown that NAICS might be superior to SIC. Kelton et al. (2008) document that the model by Feser and Bergman (2000) to identify US national-level clusters works better when firms are grouped by NAICS instead of SIC. The classification of firms using NAICS produces mixed-sectors clusters that better capture the relationships among industries in the US economy. In financial accounting, field of this study, Krishan and Press (2003) compare the dispersion of financial ratios using COMPUSTAT data within SIC and NAICS and find that NAICS generates more homogenous industries, particularly for manufacturing, transportation, and services. While those studies have documented NAICS as a superior classification system over SIC, results could not be generalized as research results depend on specific research design and sample properties (Krishan and Press 2003). Some studies related to stock returns and market anomalies use either the Global Industrial Classification Standard (GICS) or the Fama and French industry classification (Fama and French 1997). These classifications are broad, however, for our purposes to study intra-sector variations on cash holdings for agribusinesses.

[6] COMPUSTAT contains agribusinesses that would allow the categorization of additional subsectors. For instance, there were 538 observations of food and beverage wholesalers (F&B wholesalers, in Table 1). However, as these observations represent only 3.9% of the sample, we decided to include them in the "food and beverage stores (and wholesalers)" subsector, FBS, as wholesalers provide services to these retailers in this subsector. Similarly, "farm supplies wholesalers" were added to AIS since they only represented 0.3% of the sample. Finally, "farm product raw material wholesalers," 1.1%, were included in APD.

in Bates et al. (2009) for 1980-2006. Figure 2 depicts the relationship between cash to assets and the core variables by the precautionary theory over time for agribusiness. Growth opportunities and size for agribusiness firms have consistently grown over time even when cash decreased. Interestingly, the levels of *Size* and *MTB* grew faster in the last decade, in tandem with cash. The positive relationship of growth opportunities and cash is consistent with the precautionary theory. Cash flow volatility has also increased over time but it has been stable during the last decade. Finally, cash flow has been more erratic during the period analyzed.

Table 1. Agribusiness and Subsectors

Agribusiness Subsectors	**Firms**	**Firm-Years**
Agricultural Input Suppliers (AIS)	**109**	**1,396**
Ag. Input Suppliers	105	1,351
Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing (3253 up to 6 digits)	58	674
Seeds (111, 111150, and 111920)	17	162
Agricultural Implement Manufacturing (33311)	30	515
Farm Supplies Wholesalers	4	45
Farm Supplies Merchant Wholesalers (42491 up to 6 digits)	3	23
Farm and Garden Machinery and Equipment Merchant Wholesalers (42382)	1	22
Agricultural Producers (APD)	**100**	**1,164**
Ag. Producers	93	1,015
Crop Production (111 up to 6 digits, except 111,111150, and 111920)	39	523
Animal Production and Aquaculture (112 up to 6 digits)	22	168
Forestry and Logging (113 up to 6 digits)	17	205
Fishing, Hunting and Trapping (114 up to 6 digits)	2	40
Support Activities for Agriculture and Forestry (115 up to 6 digits)	13	79
Farm Product Raw Material Wholesalers	7	149
Farm Product Raw Material Merchant Wholesalers (4245 up to 6 digits)	7	149
Food Processors (FPR)	**345**	**4,768**
Food Manufacturing (311 up to 6-digits)	342	4,739
Food Product Machinery Manufacturing (333241)	3	29
Beverage and Tobacco Product Processors (BTP)	**134**	**1,666**
Beverage and Tobacco Product Manufacturing (312 up to 6 digits)	134	1,666
Food and beverage stores (and wholesalers) (FBS)	**178**	**2,786**
F&B Stores	139	2,248
Food and Beverage Stores (445 up to 6 digits)	139	2,248
F&B Wholesalers	39	538
Grocery and Related Product Merchant Wholesalers (4244 up to 6 digits)	34	449
Tobacco and Tobacco Product Merchant Wholesalers (42494)	3	67
Beer, Wine, and Distilled Alcoholic Beverage Merchant Wholesalers (4248 up to 6 digits)	2	22
Food service providers (FSP)	**129**	**1,906**
Food Services and Drinking Places (722 up to 6 digits)	129	1,906
Agribusiness (AGB)	**995**	**13,686**

Notes. The sample contains agribusinesses traded in US stock exchanges with data available in Standard and Poor's COMPUSTAT from 1970 to 2012 fiscal years. Both, active and inactive firms are considered in this study. Canadian agribusinesses, 2,205 firm-years, considered domestic firms in COMPUSTAT, are included in the sample. Firm-years with zero, negative, or missing revenues in COMPUSTAT were excluded from the sample (179 observations). NAICS codes in parenthesis.

Table 2. Descriptive Statistics

	Mean	Median	Std. Dev.	N
Panel A: 1970-2012				
CtoA	0.098	0.050	0.134	13,686
CtoNA	0.307	0.053	8.006	13,684
MTB	2.171	1.304	11.321	11,522
Size	5.861	5.902	-0.226	13,686
CFtoA	-0.019	0.067	1.281	13,658
CFVol	0.069	0.028	0.250	13,664
NWC	-0.043	0.051	2.381	13,513
Capex	0.078	0.059	0.075	13,243
DIV	0.522	1.000	0.500	13,686
Foreign	0.283	0.000	0.451	10,315
Panel B: 2000-2012				
CtoA	0.101	0.052	0.136	4,670
CtoNA	0.218	0.055	1.439	4,668
MTB	3.062	1.449	18.515	4,155
Size	6.093	6.219	2.623	4,670
CFtoA	-0.102	0.066	2.148	4,665
CFVol	0.098	0.032	0.394	4,653
NWC	-0.220	0.003	4.001	4,631
Capex	0.061	0.042	0.065	4,498
DIV	0.452	0.000	0.498	4,670
Foreign	0.404	0.000	0.491	3,319

Notes. Sample description in Table 1. *CtoA* is cash to assets; *CtoNA* is cash to net assets; *MTB* is market to book value; *Size* is firm size, the logarithm of assets in 2012 USD values; *CFtoA* is cash flow to assets; *CFVol* is volatility of cash flows; *NWC* is net working capital to assets; *Capex* is capital expenditures divided by assets; *DIV* is a dividend payout dummy variable, set to 1 in years in which firms pay common dividends; and *Foreign* is a dummy variable set to 1 when a firm report foreign income taxes. Definition of variables in the Appendix.

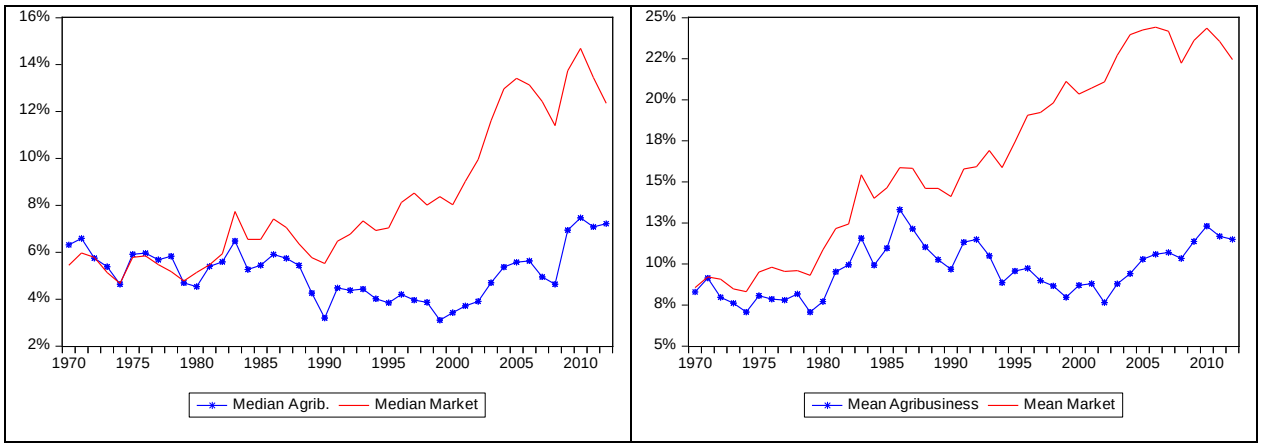

Figure 1. Cash to Assets for Agribusiness and the Complete US Market, 1970-2012

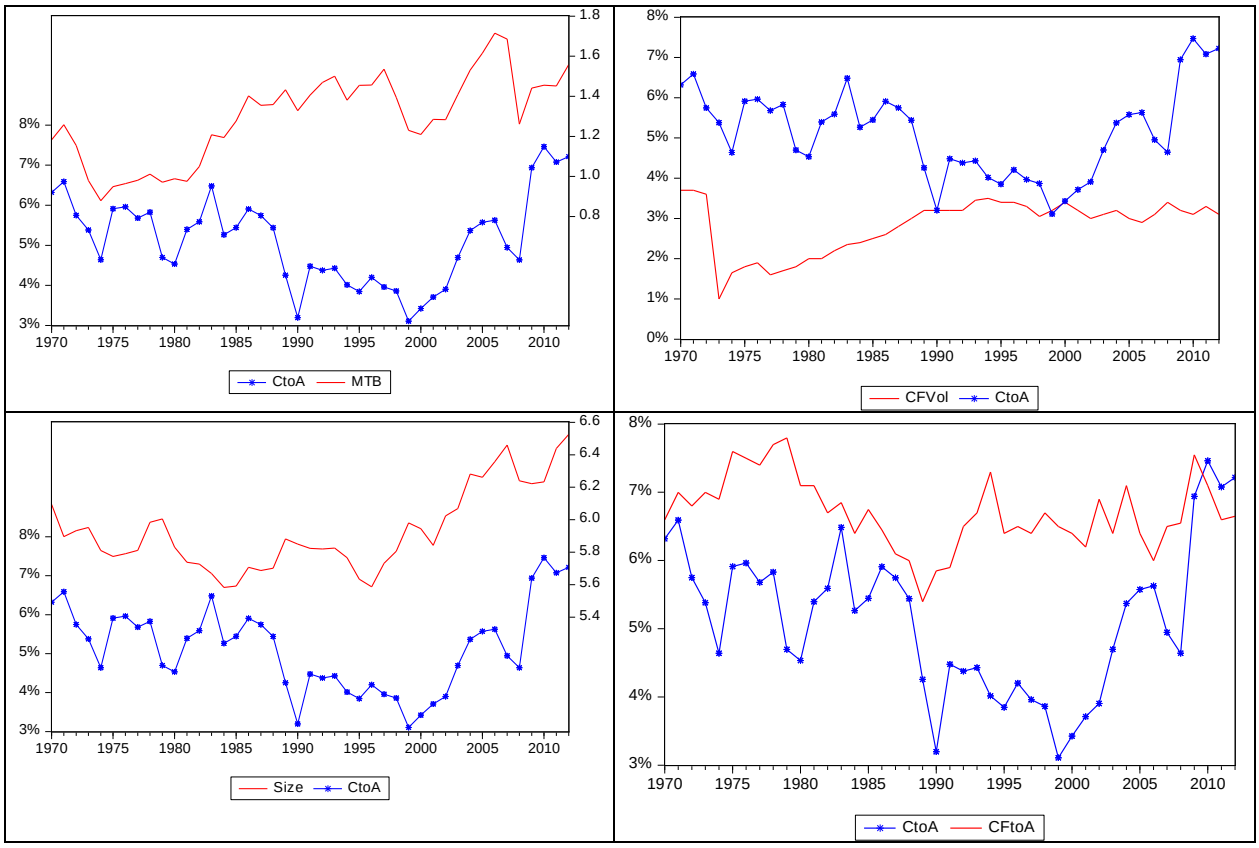

Figure 2. Cash to Assets and Selected Firm Characteristics for Agribusiness, 1970-2012

Notes. *CtoA* is cash to assets; *MTB* is market to book value; *Size* is firm size, the logarithm of assets in 2012 USD values; *CFtoA* is cash flow to assets; and *CFVol* is volatility of cash flows. *MTB* and *Size* scales in the right axis. Median values plotted.

Results

Optimal Cash Holding Model for Agribusiness

Table 3 provides results of model (1). Panel A uses cash to assets as dependent variable, and Panel B uses the natural logarithm of cash to net assets. Models 1a and 1b use as explanatory the core variables of the precautionary theory: growth opportunities (*MTB*), firm size (*Size*), cash flow level (*CFtoA*), and volatility of cash flows (*CFVol*). Models 2a and 2b add control variables net working capital (*NWC*), capital expenditures (*Capex*), and dividends (*DIV*). Models 3a and 3b include foreign income taxes (*Foreign*). Standard errors, in Table 3, are heteroscedastic and within cross-section serial correlation robust.[7]

We discuss results on models 1a, 2a, 1b, and 2b together first. With a few exceptions, estimates are statistically significant. *MTB*, the proxy for the likelihood of a firm having positive NPV projects in the future, or for growth opportunities embedded in current values of agribusiness

[7] We implement White Period (cluster by cross-section) error estimates, which are heteroskedastic and cluster robust so that they allow for $E(u_{i,t}u_i)$ to be non-zero for $t <> s$ and to differ across periods.

firms, is positive. Agribusinesses hold cash levels in direct relation to *MTB* in order to be able to fund those foreseeing investment opportunities. *Size* estimates are negative. Small agribusiness firms need higher cash ratios relative to large firms, as it is more costly for them to raise funds in case of cash shortfall. With the exception of 1b, *CFtoA* is not statistically significant.[8] A negative *CFVol* estimate for agribusiness firms is inconsistent with the precautionary theory, which predicts that firms will increase cash on their balance sheets when cash flows become more volatile.[9]

On the control variables, *NWC* and *Capex* are expected to be negative because *NWC* is a substitute of cash and *Capex* could serve as collateral to raise capital in cash shortfall situations. The *NWC* estimates are not statistically significant. *Capex* is negative and statistically significant. Finally, *DIV* is positive, and statistically significant in 2a. Theory predicts a negative sign since dividend payers are stable firms expected to have greater access to capital markets – compared to non-dividend payers, and not in need to build up cash for precautionary motives. Overall, results of models 1 and 2 are consistent with the cash holdings precautionary savings theory. The relevant exceptions are the signs of cash flow volatility and dividends. We try to explain this later in this article.

As recent studies suggest that cash held by firms in foreign countries affect cash ratios (Cole 2014; Foley et al. 2007, Dittmar and Duchin 2012), in models 3a and 3b we include the dummy variable *Foreign* for firms reporting foreign income taxes. The explanatory power of the models marginally increase with this variable, and the estimates of models 3a and 3b are similar to 2a and 2b. However, while the sign of *Foreign* tends to be positive, we do not find statistically significance in the agribusiness sample.

Subsectors

We also run model (1) for the six agribusiness subsectors. Results are in Table 4, with cash to assets as dependent variable in Panel A and the logarithm of cash to net assets in Panel B. In general, results are consistent with the predictions by the precautionary theory for the FPR, FBS, FSP, and APD subsectors. The exceptions are those noted previously for the complete agribusiness sample, and differences that might be related to the nature of the specific subsector, which we discuss below. The results for AIS and BTP, however, are difficult to explain with this model.

The FSP subsector has a statistically significant negative *NWC* estimate, inconsistent with the theory for the average firm, but consistent with the nature of restaurants, with negative working capital, defined as current assets net of cash minus current liabilities. FPR, which comprises

[8] We define cash flow as in Bates et al. (2009), namely cash flow after deducting dividends paid but before working capital and capital expenditures. We used alternative proxies for cash flow, namely, cash flow before dividends (as in Dittmar and Duchin 2012), and cash flow from operations taken directly from the statement of cash flow (the problem with the later approach is that the sample is significantly reduced). Results, untabulated, are similar.

[9] Since this is a significant deviation from the theory, we also run the regression using the standard deviations of cash flow to assets in the same way as in model (1) but without inputting the industry cash flow volatility in case of missing values. The results, untabulated, are similar; the sample is reduced from around 8,500 observations (in column 3a) to about 7,200.

financially strong firms such as ADM or Kraft Foods, has a positive, statistically significant *CFtoA* estimate in both panels in Table 4, implying that firms with high levels of cash flow also hold high cash in their balance sheets. This is inconsistent with the precautionary theory, and in line with the idea that cash-rich firms could accumulate cash even when they do not need it. Finally, in both panels, the signs of *DIV* are positive and statistically significant for BTP, a mature with low growth opportunities segment, which could be another characteristic of cash-rich firms. Cash-richness is analyzed in the following section.

Table 3. Fixed Effects Regressions for Agribusiness

Panel A: Dependent Variable is Cash to Assets						
	[1a]		[2a]		[3a]	
	Estimate	p	Estimate	p	Estimate	p
Intercept	0.148***	0.000	0.181***	0.000	0.197***	0.000
MTB	0.001***	0.000	0.002*	0.087	0.002	0.110
Size	-0.008*	0.076	-0.013***	0.006	-0.015***	0.008
CFtoA	-0.005	0.328	0.020	0.184	0.023	0.119
CFVol	-0.035*	0.077	-0.067**	0.038	-0.095***	0.002
NWC			-0.011	0.345	-0.016	0.156
Capex			-0.131***	0.000	-0.151***	0.000
Div			0.011**	0.023	0.013**	0.025
Foreign					0.000	0.963
Adj R. Squared	0.514		0.527		0.531	
Panel B: Dependent Variable is Log(Cash to Net Assets)						
	[1b]		[2b]		[3b]	
	Estimate	p	Estimate	p	Estimate	p
Intercept	-1.895***	0.000	-1.584***	0.000	-1.359***	0.000
MTB	0.007***	0.000	0.016*	0.068	0.015*	0.084
Size	-0.170***	0.001	-0.223***	0.000	-0.256***	0.000
CFtoA	0.057*	0.072	0.154	0.197	0.174	0.114
CFVol	-0.356**	0.028	-0.587**	0.029	-0.881***	0.000
NWC			-0.015	0.859	-0.059	0.453
Capex			-0.780***	0.009	-0.948***	0.004
DIV			0.103	0.115	0.133*	0.061
Foreign					0.024	0.837
Adj R. Squared	0.496		0.508		0.521	
N	11,484		11,007		8,496	
Firms (Years)	867 (43)		859 (43)		730 (43)	

Notes. Regression results of model (1), 1970-2012. *MTB* is market to book value; *Size* is firm size, the logarithm of assets in 2012 USD values; *CFtoA* is cash flow to assets; *CFVol* is volatility of cash flows; *NWC* is net working capital to assets; *Capex* is capital expenditures divided by assets; *DIV* is a dividend payout dummy variable, set to 1 in years in which firms pay common dividends; and *Foreign* is a dummy variable set to 1 when a firm report foreign income taxes. Dependent variables indicated in the top of panels. Definition of variables in the Appendix. ***1%, **5%, and *10% statistical significance level.

Table 4. Fixed Effects Regressions for Agribusiness Subsectors

	AIS	APD	FPR	BTP	FBS	FSP
Panel A: Dependent variable is Cash to Assets						
Intercept	0.150	-0.043	0.211***	0.133	0.221	0.273***
MTB	0.001	0.004*	0.009***	0.001	0.000	0.028***
Size	-0.002	0.030	-0.017**	-0.008	-0.019	-0.033***
CFtoA	0.033	0.022	0.120***	0.021	-0.037	-0.118**
CFVol	-0.077*	-0.183**	-0.053*	-0.145*	-0.006	-0.027
NWC	-0.030	-0.044	-0.035**	-0.012	-0.061**	0.150***
Capex	-0.248	-0.053	-0.278***	0.003	-0.290***	-0.159***
DIV	0.029*	0.032**	0.007	0.053***	0.017	-0.002
Foreign	-0.011	0.069	-0.005	-0.001	0.008	0.010
Adj R. Squared	0.614	0.604	0.556	0.546	0.502	0.418
Panel B: Dependent variable is Cash to Net Assets						
Intercept	-1.949*	-4.910***	-1.557***	-0.306	-0.677	-1.190**
MTB	0.007	0.041**	0.074***	0.009	0.000	0.272***
Size	-0.194	0.394**	-0.208**	-0.454**	-0.330***	-0.338***
CFtoA	0.233	-0.099	0.915***	0.113	-0.653*	-0.400
CFVol	-0.383	-0.800	-0.660**	-3.006***	-1.435*	1.273
NWC	-0.016	-0.442**	-0.175	-0.031	-0.644**	1.029**
Capex	-0.620	0.139	-1.898***	0.865	-3.323***	-1.545***
DIV	0.265	0.093	-0.025	0.531**	0.168	0.117
Foreign	0.250	0.472	-0.045	-0.017	0.238	-0.081
Adj R. Squared	0.556	0.636	0.530	0.525	0.541	0.460
N	845	655	3,049	883	1,776	1,288
Firms (Years)	86 (43)	74 (43)	248 (43)	94 (43)	127 (43)	101 (43)

Notes. Regression results of model (1), 1970-2012. AIS is Agricultural Input Suppliers subsector; APD, Agricultural Producers; FPR, Food Processors; BTP, Beverage and Tobacco Product Processors; FBS, Food and beverage stores (and wholesalers); and FSP, Food service providers. *MTB* is market to book value; *Size* is firm size, the logarithm of assets in 2012 USD values; *CFtoA* is cash flow to assets; *CFVol* is volatility of cash flows; *NWC* is net working capital to assets; *Capex* is capital expenditures divided by assets; *DIV* is a dividend payout dummy variable, set to 1 in years in which firms pay common dividends; and *Foreign* is a dummy variable set to 1 when a firm report foreign income taxes. Dependent variables indicated in the top of panels. Definition of variables in the Appendix. ***1%, **5%, and *10% statistical significance level.

Cash-Rich Agribusiness Firms

Following Dittmar and Duchin (2012), we define cash-rich agribusiness firms as those in the top deciles when the sample is ranked every year in terms of total cash adjusted by the consumer price index, and non-cash-rich agribusiness are those in other deciles. Panel A of Table 5 shows descriptive statistics by deciles for the complete period of study. Similar to the findings by Dittmar and Duchin (2012) for the entire US market, cash is highly concentrated in agribusiness. Decile 10, with the largest cash reserves, accounts for 78.5% of the aggregate cash by agribusiness firms (this compares to 77.6% reported by Dittmar and Duchin 2012, for the complete US market). Further, cash-rich agribusiness firms concentrate 68% of total net income,

49% of total revenues, and 59% of total assets. Panel B compares cash-rich and non cash-rich (those in deciles 1 to 9) in terms of cash ratios and variables in the precautionary theory.

Table 6 provides the results of logit model (2) for cash-rich agribusiness firms. An agribusiness firm is significantly more likely to become cash-rich if it is larger and has lower and less volatile cash flow to assets. *MTB*, proxy of growth opportunities, is not statistically significant. The logit regression results do not support the free cash flow hypothesis in cash-rich agribusiness firms. The free cash flow hypothesis predicts that managers in firms generating high cash flows and with low growth opportunities accumulate excessive cash for their own benefit. The flip side of this implication is that cash-rich agribusinesses, large firms with low cash flow volatility relative to the average agribusiness, could be ready to further consolidate the agribusiness sector; we elaborate on this in the following section.

Table 5. Concentration of Cash by Deciles and Selected Firm Characteristics for Agribusinesses

Panel A: All Deciles

Cash Decile	Fraction of Cash	Fraction of Income	Fraction of Revenue	Fraction of Assets	C toA mean	CtoA median
1	0.000	0.001	0.004	0.003	0.036	0.009
2	0.001	0.004	0.007	0.005	0.062	0.027
3	0.001	0.004	0.011	0.007	0.086	0.039
4	0.003	0.005	0.016	0.010	0.101	0.042
5	0.006	0.009	0.028	0.018	0.104	0.046
6	0.012	0.018	0.041	0.029	0.109	0.054
7	0.022	0.025	0.060	0.044	0.128	0.067
8	0.048	0.064	0.115	0.092	0.120	0.069
9	0.123	0.191	0.228	0.205	0.103	0.064
10	0.785	0.679	0.490	0.588	0.127	0.100

Panel B: Decile 10 and All other Deciles

	CtoA mean	CtoA median	MTB mean	Size mean	CFtoA mean	CFVol mean
Cash-rich	0.127	0.100	1.806	9.313	0.060	0.024
Non cash-rich	0.094	0.044	2.215	5.470	-0.027	0.074
t-statistic	8.524	23.570	-1.211	65.168	2.411	-6.980

Notes. Panel A provides firm characteristics of agribusiness by cash deciles. Agribusinesses were ranked every year in terms of total cash adjusted by the CPI in 2012 USD values. The second column shows the fraction of total cash by deciles during 1970-2012. The fractions of total income (Compustat item NI), of total revenue (SALE), and total assets (AT) by deciles are shown in the next columns. The last two columns of Panel A provide means and medians of cash to assets. Panel B compares cash-rich (decile 10) and non cash-rich agribusiness (deciles other than 10).

Conclusions and Implications

In this section, we summarize our findings and interpret them in the context of potential structural changes in this sector. Table 7, which summarizes the main results of this study, shows the predictions by the precautionary theory with respect to its core variables and the results of models (1) and (2). The fixed-effect regressions, based in model (1), reported that cash is positively, and statistically significant, related to growth opportunities, and negatively related to

firm size. Agribusinesses with higher opportunities would retain more cash to internally fund investments partially or totally without the need to seek external financing, which might be costly or unavailable. This reduces the likelihood of underinvestment on foreseen positive NPV projects. The negative relation between cash and firm size is consistent with the view that smaller (higher) agribusinesses could find high cash holdings more (less) valuable as the access to credit is more (less) limited for them. Somewhat puzzling is the negative relation of cash flow from operations volatility with cash holdings since according to the precautionary theory cash is expected to increase as uncertainty (e.g., cash flow volatility) heightens. Overall, our results for the agribusiness sector are similar to results in studies for the whole US market (Opler et al. 1999, Harford 1999, Bates et al. 2009).[10]

The focus on the subset of cash-rich agribusiness, defined as firms in the top decile when the sample is ranked every year in terms of total cash adjusted by the consumer price index, provides additional insights and relevant potential implications for management. The logit regression, model (2), confirmed that the larger the agribusiness firm and the lower the level of cash flow volatility the more likely to become cash-rich. These two deviations from the precautionary theory are consistent with the study by Dittmar and Duchin (2012) for the whole US market. Ditmar and Duchin, however, document that the precautionary theory fails to explain the signs of all four variables for the subset of cash-rich firms, and propose a behavioral explanation (e.g., managers in those firms are overly conservative). The main difference of our results, as they relate to the subset of cash-rich agribusiness firms, is that growth opportunities do not drive agribusiness firms in their cash accumulation behavior (model 2).

Thus, one might conclude that the precautionary theory explains optimal cash holdings for the average agribusiness firm but does not explain cash holdings for the subset of cash-rich agribusiness. Furthermore, these deviations are relevant from a managerial perspective because cash-rich agribusinesses are large firms, with stable cash flow of operations generation, and with no more growth opportunities compared to opportunities an average agribusiness has. One of the possible implications of this finding is that agribusiness are hoarding cash to take advantage of growth opportunities through acquisition and resulting consolidation of firms. This is particularly important for this industry due to the upward trend of growth opportunities for agribusiness in the last decade (Figure 2), and given that growth opportunities are expected to continue increasing in the near future according to scholars in this field.

[10] In addition, our cash flow to assets estimate is not statistically significant. Estimates for cash flow to assets have been inconsistent across studies in the literature. For instance, Harford's (1999) estimate is not statistically significant; and Bates et al. (2009) document statistical significance in six out of the nine model specifications, and inconsistent signs. Thus, the direction of the relationship between cash holdings and the magnitude of cash flow seems empirically unclear.

Table 6. Logit Regressions for Cash-Rich Agribusinesses

Intercept	-2.074***	-13.585***	-2.232***	-1.397***	-13.175***
MTB	-0.011				-0.002
Size		1.462***			1.430***
CFtoA			1.314***		-0.164***
CFVol				-23.384***	-2.161*
McFadden R-squared	0.000	0.510	0.006	0.060	0.504
N	11,502	13,686	13,658	13,664	11,484
Obs. with Dep.=0	10,241	12,294	12,266	12,272	10,223
Obs. with Dep.=1	1,261	1,392	1,392	1,392	1,261

Notes. Regression results of model (2), 1970-2012. The dependent variable is a binary variable, set to 1 if the agribusiness is ranked in decile 10 (e.g., cash-rich) or 0 otherwise. *MTB* is market to book value; *Size* is firm size, the logarithm of assets in 2012 USD values; *CFtoA* is cash flow to assets; *CFVol* is volatility of cash flows; and *DIV* is a dividend payout dummy variable, set to 1 in years in which firms pay common dividends.

Table 7. Predictions by the Precautionary Theory and Results for the Agribusiness Sample and for Cash-Rich Agribusiness

Variables	Predictions PT	All agb (model 1)	Cash-rich agb only (model 2)
MTB	Positive	Positive (as predicted)	No significant
Size	Negative	Negative **(**as predicted)	Positive (deviation)
CFtoA	Negative	No significant	Negative **(**as predicted)
CFVol	Positive	Negative (deviation)	Negative (deviation)

Acknowledgements

Carlos Trejo-Pech acknowledges that this article was completed while he was participating as a Visiting Scholar at Purdue University, West Lafayette, IN. He acknowledges CONACYT Mexico and Universidad Panamericana Guadalajara, Mexico for partial funding during this visit.

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Appendix. Variable Definitions

Compustat items are in brackets.

Dependent variables:

CtoA = Cash to Assets: Cash and short-term investment divided by assets (CHE / AT).
CtoNA = Cash to Net Assets: Cash and short-term investments divided by net assets [CHE / (AT – CHE)]. We use the logarithm of CtoNA as dependent variable.

Explanatory variables:

MTB = Market Value to Book Value: Total assets minus book value of equity plus the market value of equity (Price at fiscal year close times common shares outstanding), all divided by total assets [AT – CEQ + (PRCC_F * CSHO)] / AT.

Size = Firm size in 2012 USD values: The logarithm of assets in 2012 USD values; 2012 USD values adjusted by using the consumer price index available in the USA Department of Labor. Log(AT in 2012 USD Values).

CFtoA = Cash flow to assets: Earnings after interest, dividends, and taxes but before depreciation and amortization divided by total assets [(OIBDP – XINT – TXT – DVC) / AT].

NWC = Net working capital to assets: Working capital minus cash plus short-term investments all divided by assets minus cash and short term investments [(WCAP – CHE) / (AT – CHE)].

Capex = Capital expenditures to assets: Capex divided by assets (CAPX / AT).

CFVol = Cash flow risk: The standard deviation of cash flow to assets for the previous ten years (requiring at least 3 years for this computation) for each firm. For missing values, the average of the cash flow standard deviation from the industry was used.

DIV = Dividends: Dividend payout dummy variable, set to 1 in years in which firms pay common dividends (DVC), and to 0 otherwise.

Foreign = Foreign Taxes: Dummy variable, set to 1 in years in which firms report foreign income taxes (TAXFO), and to 0 otherwise.

