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THE EVOLUTION OF CORPORATE CASH

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ABSTRACT

We put the recent increase in corporate cash in historic perspective by studying nearly 100 years of average and aggregate cash holdings. Corporate cash more than doubled in the first 25 years of our sample before returning to 1920 levels by 1970. Since then, average and aggregate patterns diverge. To understand these patterns, we examine both time-series and cross-sectional variation in cash policies and draw several conclusions. First, the increase in average cash ratios since 1980 is driven entirely by a shift in the cash policies of new entrants, while within-firm changes have been negative or flat since WW II. Second, the cross-sectional relations documented on modern data are remarkably stable back to the 1920s. Third, despite the stability of these relations, firm characteristics explain little of the time series variation in aggregate cash holdings over the century. Macroeconomic conditions, corporate profitability and investment, and (since 2000) repatriation tax incentives help fill this gap.

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The large increase in corporate cash balances in recent years has garnered much attention in both the academic literature and popular press. Several explanations have been proposed to explain this apparent shift in corporate policies. For example, Bates et al. (2009) suggest the riskiness of corporate cash flows has increased over time; Falato et al. (2013) suggest the nature of firms' assets has changed; Boileau and Moyen (2016) and Azar et al. (2016) argue that the opportunity cost of holding cash has declined; Nikolov and Whited (2014) suggest that agency conflicts stemming from low managerial stock ownership are responsible, and Booth and Zhou (2013) and Begenau and Palazzo (2017) argue for a change in the nature of firms going public. While these studies provide helpful insights, to fully understand what is different about modern cash policies and what drives time-series changes in corporate cash, one needs to put the recent trends in historical perspective. We gather corporate data back to 1920 to provide this perspective.

There is substantial variation in cash holdings over the past century (see Figure 1). Today's high average cash balances were also experienced in the 1940s, sandwiched between decades when mean cash-to-assets was less than half what it is today. In contrast, aggregate cash holdings today are similar to their 1920's levels, though they also increased and fell dramatically in the middle of the century. This begs the question of whether these shifts in cash holdings are due to changing cash policies, changing characteristics of firms or sensitivity to these characteristics, or macroeconomic conditions.

To understand these changing patterns in cash holdings, we perform separate cross-sectional and aggregate time-series analyses, leading to several new insights: 1) The cross-sectional sensitivity of cash holdings to firm characteristics has been relatively stable over the past 90 years. 2) Even with stable cross-sectional sensitivities, changing sample composition led to changes in the distribution of cash holdings; in particular, small growth (newly public Nasdaq) firms entered the sample with large cash holdings (relative to assets or sales), increasing the equally-weighted average of cash ratios starting in

1980. 3) However, these recent changes in characteristics of publicly traded firms are *not* the primary force behind changes in aggregate cash holdings. Contrary to the average, aggregate cash has been relatively stable in recent decades. 4) Changes in aggregate corporate cash over the century are primarily driven by macroeconomic variables, corporate profitability and investment, and since 2000, repatriation taxes.

To explore in more detail these conclusions about why corporate cash holdings have fluctuated, we start by examining cross-sectional determinants of cash holdings over the past century. The development of financial markets over the century has arguably impacted the relative importance of financial frictions relevant for cash policies, such as transaction costs and informational frictions. One might expect that this would lead to a shift in the determinants of cash policies over time, which could also drive time-series variation in cash holdings. Perhaps surprisingly, controlling for sample composition (for example, by focusing on NYSE firms), we find that many of the cross-sectional relations that have been identified in modern data are quite stable over the century. Ours is the first paper to show this over an extended horizon.

When we allow changes in sample composition, in contrast, we find notable changes in both cash sensitivities and firm characteristics since 1980. Recent increases in mean cash balances are driven by the changing composition of publicly traded firms. In particular, post-1980 Nasdaq firms IPO with substantial cash holdings, especially when their profits, sales, current assets, and debt access are low. By contrast, pre-existing firms (including post-1980 entrants after their IPOs) did not increase cash until after 2000. Thus, while many of the factors that determined cash policies in the 1920s are still relevant today, changes in the composition of publicly traded firms has dramatically affected the cross-sectional distribution of cash holdings in recent decades. This supports the views that the nature of a firm's assets is an important driver of cash policies (e.g., Falato et al., 2013), and different types of firms have gone

public in recent decades (Booth and Zhou, 2013; Begenau and Palazzo, 2017). We also show these changes are not fully captured by standard proxies for firm characteristics.

We next turn to understanding time-series patterns in economy-wide cash holdings. Much of the recent concern over high cash balances has focused on the amount of capital sitting "idle" on corporate balance sheets. To the extent that corporate cash management decisions impact money demand and economic growth, it is important to understand the drivers of change in aggregate cash holdings of the corporate sector. This requires many years of data, to provide enough power to reliably estimate time-series relations. To our knowledge, ours is the first study to examine this issue over a nearly 90-year horizon.

We first explore whether the persistent cross-sectional firm characteristic patterns aggregate up to explain time-series patterns in economy-wide cash holdings – and find for the most part that they do not (see also Azar et al., 2016). While differences in cash holdings across firm types within a given cross-section are fairly stable, the entire distributions shift over time in a way that is largely unrelated to aggregate characteristics. As a result, firm characteristics don't explain much of the time-series.

If not firm characteristics, what drives the observed shifts in aggregate corporate cash? We look next to macroeconomic conditions, which may influence aggregate cash holdings by affecting the opportunity cost of holding cash (e.g. through interest rates and inflation) or by influencing investment opportunities and uncertainty in ways not captured by firm characteristics. We find that the cost of carry is statistically related to cash holdings in level regressions but the significance disappears in first different specifications, resulting in only minimal explanatory power. We find some evidence that firms hold more cash when aggregate investment opportunities (as proxied by output-to-capital and GDP

growth) are greater. Adding these macro variables to the model helps explain aggregate cash movements, but still leaves much of the time-series variation unexplained.

The factors that provide the most explanatory power for time-series changes in aggregate corporate cash are simply contemporaneous cash flows and investment expenditures. Thus, while we find some evidence that firms have cash targets, much of the year to year fluctuation in cash holdings stems from accumulation of profits, and the use of those profits to fund investment. These results are consistent with firms adhering only loosely to cash targets, or pursuing double-barrier cash policies (Miller and Orr, 1966; Bolton, Chen and Wang, 2011).

Finally, we explore in more depth two periods of increasing aggregate cash holdings: the decade leading up to World War II and the decade that started in 2000, the latter following several decades of relatively constant aggregate cash. Despite a large increase in transactions volume in the late 1930s and early 1940s, we find no evidence that this drove the increase in cash. Rather, our evidence suggests the run-up in cash over this time was associated with increased precautionary savings demand in the pre-war and war years. After 2000, we find a strong correlation between proxies for the tax incentive to keep cash in overseas subsidiaries (Foley et al., 2007) and the increase in aggregate cash holdings over the most recent 15 years. While none of firm characteristics, macro factors, or contemporaneous cash flow and investment by themselves explain a great deal of time-series variation, the combination of these factors captures the broad trends in aggregate corporate cash over the past century.

While there is a large literature that studies the determinants of cash holdings, we are the first to comprehensively study how cash policies have evolved over nearly a century. For example, Bates et al. (2009) argue that cross-sectional coefficients did not change much between the 1980s and 1990s. We show that this is not just a recent phenomenon, but extends back many decades despite substantial

changes in financial markets over time. While Bates et al. attribute the recent cash run-up to changing firm characteristics, we show that this is not due to changes in cash and characteristics within firms but rather is driven purely by changing sample composition. We show that within-firm changes in cash have been negative since World War II.

Booth and Zhou (2013) and contemporaneous work by Begenau and Palazzo (2017) study modern data and, like us, argue that the modern run-up in cash is related to the type of firms going public. We broaden our understanding of this finding in several ways. First, we use our expanded cross-section to show that this is only a recent phenomenon. For at least 60 years prior to 1980, non-NYSE and NYSE firms had similar cash ratios, as did new entrants and existing firms, small and large firms, and firms in tech and non-tech sectors. Thus, it is not the addition of more small firms or new entrants per se, but rather the changing nature of these new entrants that has impacted the distribution of cash ratios. Second, we show that a shift in the relative sensitivities to firm characteristics accompanies the increase in cash levels. Thus, the higher cash holdings among IPO firms post-1980 reflects not only a difference in firm characteristics, but differences in how these firms manage their cash policies.

Opler et al. (1999) and Azar et al. (2016) also document decreasing cash ratios since 1950. We confirm this after correcting for the back-fill bias in Compustat and also show that this was a reversal of an equally large increase in cash holdings from 1920 through WWII. Azar et al. (2016), Curtis et al. (2017), and Boileau and Moyen (2016) show evidence that the time-series of corporate cash is related to the cost of carry. Using a longer time series, we show that while cost of carry is statistically related to aggregate cash in levels, the relation is insignificant in first differences and cost of carry has little explanatory power for aggregate cash over the whole century.

The longer perspective we take has several advantages. First, we are able to describe how cash policies of today are similar to, and depart from, those in the past. This provides a deeper understanding of the nature of the modern cash "puzzle." Second, having nearly a century of data uniquely positions us to study the determinants of changes in aggregate corporate cash holdings through time. We document an important contrast: firm characteristics are robustly related to cross-sectional differences in cash holdings, but have little explanatory power for aggregate cash. Macroeconomic conditions and contemporaneous cash flow and investment capture much of this time-series variation. These findings highlight the importance of business cycle fluctuations on money supply and corporate asset allocation. Finally, we provide a rich set of empirical facts to guide development of cash theories. For example, our evidence suggests the frictions relevant for determining cash targets, at least among NYSE firms, are similar throughout the century. At the same time, our evidence suggests firms are unconcerned about modest deviations from cash targets. Dynamic theories of cash should allow for this passive behavior in the short run. Lastly, explanations for the increase in average cash in recent decades should be consistent with declining within-firm cash balances and increasing cash ratios among new, primarily Nasdaq firms in the tech and health sectors.

The next two sections describe our data sources and extensively describe cash holdings since 1920. These sections identify dominant patterns that cash research should try to explain. Section 3 explores firm-specific, cross-sectional cash policies; Section 4 investigates aggregate cash. Section 5 concludes and offers some thoughts for future research.

1. Sample selection and summary statistics

To form our sample, we begin with all firms in the Center for Research in Security Prices (CRSP) monthly stock files. This includes New York Stock Exchange (NYSE) firms since December

1925, firms listed on the American Stock Exchange (Amex) since 1962, and firms listed on Nasdaq since 1972. For these firms, stock market data are from CRSP. Accounting data are obtained from two sources: Standard and Poor's (S&P) Compustat, and, for CRSP firms not on Compustat, data hand-collected from Moody's Industrial Manuals.[2] The end result is an unbalanced firm-year panel beginning in 1920 and ending in 2014.[3] In a few cases, we replace missing Compustat data with Moody's data. In the analyses below, we refer to this sample as the "CRSP sample."

Because of differing institutional environments, we exclude regulated (utilities, railroads, and telecommunications) and financial firms and focus our attention on unregulated industrial firms (all other industries). These exclusions allow us to avoid the effects of industry-specific regulatory environments affecting our analyses, and of course align us with the vast majority of empirical corporate finance research. Our sample includes years affected by WWII (1940s). In Appendix B we show that part of the increase in the mid-1940s cash holdings consists of war bond holdings (Treasury securities). As we describe in the appendix, filtering out the effect of war bonds, or altogether excluding Treasuries from the definition of cash, does not affect our main results.

Once per decade (in years ending in "8"), we also gather company-specific stock market and financial statement data for every public, unregulated nonfinancial firm covered in the Moody's Industrial Manual. This "extended sample" includes data from regional exchanges, which to some extent played the role of Amex and Nasdaq in the early part of the 20th century. These data allow us to examine very small firms throughout the century and, as shown in Appendix C, allow for relatively

[2] All firm-specific data before 1950 are from Moody's. In the 1950s, Compustat suffers from a back-fill problem (Opler et al., 1999), namely that Compustat initially started with a list of public companies that existed in the early 1960s, and data from the 1950s were back-filled for these firms. We address this issue by collecting data from Moody's for CRSP firms that existed in the 1950s that are excluded by Compustat. Our data entry process also adds data to supplement the Compustat sample in the 1960s and later, though the number of added observations gradually declines.

[3] For all firms in CRSP as of December 1925, we gather data for 1920-1924 and include these years in some of the graphs that follow. However, due to lack of market value data and potential back-fill bias, we exclude these observations from our regression analyses.

homogenous across-decade comparisons with respect to firm size. In addition, we gather data from Statistics of Income (SOI), which reports aggregated domestic tax return data for US-domiciled firms, including private and regulated companies.

Table 1 presents summary statistics for the main CRSP sample (unregulated, non-financial CRSP firms).[4] Panel A presents statistics for the firm-year panel. Panel B presents average firm characteristics by decade for the main (CRSP) sample, and Panel C does the same for the extended sample. In addition to their descriptive value, these results provide a context for subsequent analyses.

2. Trends in cash holdings

Panel A of Figure 1 presents the aggregate (dashed line) and average (solid line) cash-to-assets ratios from 1920 to 2014. The rise in average cash that started around 1980 and has garnered much recent attention is evident in the figure, as are several other important trends. First, average cash holdings were as high in the 1940s as they are in modern times – about 25% of assets (see also Graham, Leary, and Roberts, 2015). Average cash ratios increased by as much from 1920 to the mid-1940s as they have in recent decades, and fell by a similar magnitude in the two decades after WWII. In this sense, the recent experience is not unique by historical standards.

Second, the recent growth in aggregate cash is much less pronounced than in the average, indicating that the recent growth in the average is driven by large cash balances (relative to book assets) in small firms (see also Bates et al., 2009). The increase in average cash holdings peaked in 2000, while larger firms accumulated moderately more cash but not starting until about 2000. In contrast to these differing recent trends, aggregate and average cash holdings were very similar (both in level and trend) prior to

[4] See Appendix A for variable definitions.

1980. This implies that while the magnitude of the change in cash holdings seen in recent years is not unprecedented, the nature of modern cash trends is somewhat different.

Panels B and C explore the extent to which the trends documented in Panel A are influenced by the changing composition of the CRSP universe, which included only NYSE firms prior to 1962 but added Amex firms in 1962 and Nasdaq firms in 1972. Panel B shows similar trends using our extended once-per-decade sample, which adds to the CRSP sample many small non-NYSE firms (note: the extended sample shows a more modest increase in cash in the 1940s because by jumping from 1938 to 1948, the extended sample misses the early-to-mid 1940s). In Panel C we control for sample composition by including only those firms with at least 80 years of data. The average and aggregate cash ratios in this constant-firm sample show a very similar pattern to the aggregate ratio from Panel A. While there is substantial variation in the average cash ratio over the first fifty years of our sample, cash holdings for these long-lived firms have been stable since 1970, again with a slight increase only after 2000. In the Appendix D, we present time series plots of cash-to-assets for each of the 66 long-lived firms in Panel C. The implications from Panel C also apply to many of the individual long-lived firms: There is substantial with-firm variation in cash holdings, especially in the first half of the sample. The cash ratios of the majority of the long-lived firms approach historic lows in the late-1990s, and post-2000 increases return cash ratios to near their long-term averages. Overall, Figure 1 highlights substantial variation in cash that is fairly homogeneous up to 1980, with significant divergence across firm types since.

Figure 2 highlights the broadening of the cross-sectional distribution of cash holdings in recent decades. Panel A plots the cross-sectional standard deviation of the cash/assets ratio by year. The standard deviation was fairly stable at about 10% for the first sixty years of our sample period, but more than doubled between 1980 and 2000. In Panel B we observe a very similar pattern for the extended sample. Thus, the Panel A jump is not merely an artifact of the expansion of the CRSP universe to

include Amex and Nasdaq firms, which occurred in 1962 and 1972, respectively, but rather due to changes in the distribution of cash policies starting around 1980. This is also reflected in Panel C, which plots the quartile breakpoints of the distribution of cash ratios each year. While earlier time-series changes represent "parallel" shifts in the entire distribution, since 1980 there is a dramatic widening of the distribution of cash holdings. Panel D shows that this widening is also associated with a growing frequency of very high cash ratios in excess of 80 percent of book assets.

In sum, there appear to be four eras in cash holdings over the past century. Cash-to-assets 1) increased dramatically from the 1920s until the mid-1940s, then 2) gradually declined through 1970. 3) From 1980 to 2000, average cash holdings increased dramatically but aggregate cash was flat. Finally, 4) average cash plateaued starting in about 2000 while aggregate cash increased between 2000 and 2010.

2.1 Cross-sectional heterogeneity in cash trends

We now explore how the cross-section of cash holdings has evolved for firms of differing characteristics, such as size, stock exchange, industry, and IPO status. The contrast between average and aggregate cash ratios in Figure 1 suggests that the post-1980 increase in average cash is concentrated among small firms. We first investigate whether this is due to the sample being composed of proportionally more small firms that enter the sample with high cash balances or whether small firms begin to hold more cash within-firm. To the extent that the change in average cash reflects changing sample composition (which our results below support), we also ask whether it is firm size per se that matters, or whether there is something else about the nature of new entrants that is different. That is, is it the case that small firms typically hold much more cash than large firms so adding many small firms to the modern sample naturally raises average cash holdings? Or are the new small firms of today different from the small firms of earlier decades?

To study this issue, we turn to the extended sample, which contains one observation per decade for every firm covered by the Moody's manuals and therefore includes many small, regional stock exchange firms. Appendix C shows that in the extended sample the average size of firms in the low end of the size distribution is fairly stable (in real dollar terms) over the century, and hence across-decade extended sample comparisons roughly hold size constant. Panel A of Figure 3 provides evidence that small firms held approximately the same amount of cash as large firms until about 1980, but after 1980 small firms began to hold much more cash. Therefore, the modern surge in average cash is due to the typical modern small firm holding more cash relative to assets than small firms did before 1980.

Panel B of Figure 3 presents trends in cash holdings by stock exchange, again using the extended sample. Interestingly, NYSE firms had higher average cash ratios than non-NYSE firms in the pre-WWII period and about the same amount after the war through the 1970s. The rapid increase in average cash since 1980, in contrast, is clearly attributable to non-NYSE (primarily Nasdaq) firms, with NYSE firms not exhibiting a rise until after 2000.

Panel C examines variation across industries, grouping tech and health care versus all other sectors, as defined by the Fama-French 12-industry categorization. Due to missing industry classification for many of our extended sample firms, this panel presents the CRSP sample. We see very similar levels and trends between health/tech and other sectors prior to 1980. In contrast, average cash-to-assets among health/tech firms (which in this panel combines both Nasdaq and NYSE firms) increases dramatically after 1980. Non-NYSE firms in sectors other than health and tech show a moderate increase after 1980 but it is concentrated after 2000. Non-health/tech NYSE average cash holdings do not increase until after 2000, and then relatively modestly.

Finally, while we have just shown that there is significant heterogeneity across unregulated industries, Panel D shows similar cash trends between regulated and unregulated sectors.[5] However, regulated firms hold substantially lower cash balances than unregulated firms throughout the century, consistent with a precautionary motive for cash holdings, as regulated firms like utilities likely face less uncertainty in their access to capital and more stable cash flows.

Figure 4 examines how cash policies differ between incumbent firms and new entrants to the sample. The solid line displays the average cash/assets ratio in each year *t* for all firms in the database (same solid line as in Figure 1). The long-dash line plots the average cash ratio for firms that entered the sample prior to 1980, while the short-dashed and dotted lines show the average cash/assets of NYSE and Nasdaq firms new to the sample in each year *t*. Between 1925 and 1980, new firms came into the sample with cash balances similar to existing firms, with the exception of the 1930s, when new firms had somewhat higher average cash balances. New NYSE and pre-1980-entrant firms continue to have similar cash balances between 1980 and 2008 – and there is little if any trend in average cash holdings in either group through 2000. By contrast, newly public[6] Nasdaq firms have dramatically higher average cash ratios than existing firms in the modern period.[7]

Table 2 uses a series of simple regressions to further explore the role of changing sample composition in cash trends. In the first four columns, we estimate panel regressions of cash-to-assets on a time trend, separately over each of four eras discussed above: 1920 – 1945, 1946 – 1980, 1981 – 2000,

[5] Panel D plots aggregate cash ratios using *Statistics of Income* data, which define cash exclusive of marketable securities.
[6] We define new entrants based on the first year they appear in the CRSP universe, which allows a consistent definition throughout our sample period. While this definition is likely to be somewhat broader than the set of IPO firms, we find very similar results for IPO firms in unreported analysis in which we link IPO dates from SDC's New Issues database to our sample from 1970 on.
[7] This finding is consistent with Bates et al. (2009), who show increasing cash balances among more recent IPO cohorts. See also McLean (2011), Bouwman and Lowry (2012), Booth and Zhou (2013) and Begenau and Palazzo (2017). While other papers also study IPO effects, we highlight that nearly the entire 1980-2000 increase in average cash is driven by the addition of new Nasdaq firms.

and 2001 – 2014. Consistent with Figure 1, the coefficients indicate a significantly positive trend over the first and third eras and a negative trend in the second period. Interestingly, despite the focus on increasing cash balances in recent years, the average 2000-2014 time trend in cash is negative, though not significantly so. In columns (5) through (8) we add firm fixed effects, so the time-trend variables measure the average within-firm changes in cash over each period. For the first two periods, the within-firm trends are very similar in both sign and magnitude to those in columns (1) and (2). In contrast, columns (7) and (8) show that during 1981-2000 and 2001 – 2014, the average within-firm change in cash is significantly negative, suggesting that the increase in the level of average cash from 1980-2000 is due entirely to firms *entering* the sample with higher cash to asset ratios.

In columns (9) and (10), we follow Bates et al. (2009) and remove the first 4 years of data for each firm. The coefficients in column (9) is still negative, though smaller in magnitude (relative to column (7)) and the coefficient for the post-2000 period turns slightly, though insignificantly, positive. These results indicate that much of the within-firm decline in cash balances since 1980 occurs among new firms during their first 4 years as public entities.[8] Moreover, even after removing the first 4 cash-burn years, within-firm cash is negative or at most indistinguishable from zero.

In sum, the information in Figure 4 and Table 2 indicates that other than IPO firms (which enter the sample with large cash-to-assets), there has not been an upward trend in mean cash holdings in the past few decades. Therefore, explanations for changes in cash policies in recent decades should be consistent with negative (or at best, flat) within-firm average cash holdings since 1945. We also repeat the analysis in Table 2 for NYSE firms only. The results (untabulated) are similar but for two exceptions. First, adding firm effects makes little difference for the estimated time trend in the 1980 –

[8] In light of this difference and to be consistent with prior research, in our subsequent regression analyses, we remove the first four years of data for each firm.

2000 period; the time trend is slightly negative in both specifications. Second, NYSE firms show a modest increase in cash after 2000, both on average and within-firm.

In Figures 5 and 6, we explore trends in cash relative to other scalers besides book assets. The motivation is twofold. First, early theories (Baumol, 1952; Miller and Orr, 1966) envision cash holdings as a buffer to absorb fluctuations in expenditures and receipts. As a result, the amount of cash needed is tied to a firm's transaction volume. In Panel A of Figure 5, we use sales revenue as a proxy for transaction volume and examine the trends in average and aggregate cash / sales ratios. Several features of the plot are instructive. One, while the cash / sales ratio is volatile from 1920 – 1950, there is no overall trend. This implies that the increase in cash/assets in the 1930s and 1940s was associated with an increase in asset productivity (sales / assets).[9] (Later, in our analysis of time-series changes in aggregate cash, in the first half of the sample we link increased cash holdings to macroeconomic productivity and GDP growth.) Two, there was a long, downward trend in cash / sales from about 1950 to 1980, consistent with improvements in the efficiency of cash management over this time period. Three, average cash / sales spikes sharply after 1980, indicating high cash balances among firms with low sales, suggesting other motives for holding cash beyond supporting corporate transactions. Panels B and C show that the modern spike in cash/sales is entirely attributable to Nasdaq firms.

Second, the evidence in this section suggests that the broadening of the distribution of cash holdings after 1980 relates to a break in the nature of firms going public (e.g., Fama and French (2001), Begenau and Palazzo (2017)). One implication is that as the nature of corporate assets shifts, accounting (book) assets may not provide the most appropriate scaling to measure cash policies. Therefore, in Figure 6 we examine the evolution of the ratio of cash to the market value of assets, defined as equity

[9] The lack of a 1940's spike in cash/sales suggests that 1940s war bond holdings are not entirely 'extra' corporate cash held for patriotic reasons but rather are held at least in part to support higher transaction levels. Thus, we perform our primary analysis without removing war bonds, though as discussed in Appendix B, we perform robustness checks filtering them out.

market capitalization plus total book liabilities. Not surprisingly, cash-to-value spikes during the early 1930s, due to the Great Depression market crash. With the exception of that brief period, from 1926 through 1980 cash-to-value behaves very similarly to cash-to-assets. In contrast, after 1980, average cash scaled by market value is fairly stable except for two abrupt market downturns (following the "dot-com bubble bursting" in the early 2000s and the 2008-9 financial crisis) and a modest rise in the last 15 years. Aggregate cash-to-market peaks at 21% in 1944, while over the last 50 years it remains within a fairly narrow range of about 4% to 8%. Thus, relative to the *value* of assets, firms may not be holding substantially more cash than they did 30 (or even 90) years ago.[10] Rather, financial statement book assets may simply understate the value of these assets. Alternatively, the shift toward intangible assets reflected in rising market values relative to book values may increase firms' optimal cash holdings, as suggested by Falato et al. (2013).

Summary of cash trends: Our descriptive evidence on cash holdings through the century can be briefly summarized as follows. We explore these trends further in the sections below:

1. Average cash holdings have increased recently, but we've seen equally large shifts in average cash historically, such as the run up in 1930s-40s and decline in 1950s-60s.
2. Aggregate cash has also increased recently – but much less than the average and only since 2000. Aggregate cash is about where it was in the 1920s and is much lower today than in the 1940s.
3. The cross-sectional dispersion in cash ratios was remarkably stable over the first 60 years of our sample period, but has widened dramatically since 1980.

[10] While scaling by market value may for some firms provide a useful measure of cash holdings relative to the size of the firm, in the analysis that follows we follow the literature and scale by book assets. In unreported analysis we repeat our main tests scaling by market values and find that doing so does not change the economic conclusions we draw.

4. In first half of century, levels and time trends in cash holdings were similar across firms of different sizes, industries and exchanges. Since 1980, though, there have been very different trends among small Nasdaq firms versus large NYSE firms. This increase in average cash is a sample composition effect, not a within-firm increase in cash among small firms. Moreover, holding size constant, the average is affected by the entry of new, cash-rich Nasdaq firms in health and tech industries. Established NYSE firms and aggregate cash ratios are scarcely if at all affected by these influences.

What factors underlie these changes in corporate cash holdings through time? Do the recent changes in the level and dispersion of cash holdings represent a shift in the nature of cash policies? Or can extant empirical models of cash holdings and changing firm characteristics account for the trends? Do the same forces drive both average and aggregate cash holdings? We attempt to answer these and related questions below.

3. Cross-sectional variation in cash holdings

To understand whether the trends documented in the previous section represent a change in firms' cash policies, we begin by exploring the evolution of the relation between cash ratios and firm characteristics over the century. We first review the literature that relates firm characteristics to cash holdings. Then, we investigate which of these relations are unique to the modern era and which stand the test of time.

3.1 Review of Literature Related to our Cross-Sectional Analysis

If capital markets were perfect, cash policy would be irrelevant for firm value. Investing excess cash in liquid assets would earn zero NPV and firms could costlessly meet any cash shortfalls by raising external finance, converting illiquid financial or real assets into cash, or reducing payout. In the presence

of market frictions, though, these activities are not costless. Therefore, a firm will manage cash so that the marginal benefit of holding the last dollar of cash just equals the marginal cost.

The benefits of holding cash typically result from financing frictions. Under a transactions motive (Keynes, 1936; Miller and Orr, 1966), firms hold sufficiently high cash balances to avoid the costs of selling non-cash assets if faced with an unexpected mismatch between cash inflows and outflows. This view predicts that there are economies of scale in cash management, such that larger firms will have lower cash targets. Under a precautionary motive (Opler et al. 1999), a benefit of cash is avoiding external finance costs when investment opportunities may unexpectedly exceed internal resources. Under this view, cash holdings should be optimally higher for firms with more valuable investment opportunities, lower expected cash flows, and greater uncertainty, as well as for more financially constrained firms.

Theories point to three main costs of holding cash and liquid assets. First, lower returns are earned on liquid assets (relative to more productive but less liquid assets) because of the ease with which liquid assets can be converted into cash.[11] Second, there may be a tax cost to holding cash, as interest earned on liquid assets is taxed at both the corporate level (Riddick and Whited, 2009) and potentially again at the personal level. Third, there may be an agency cost of managerial discretion (Jensen, 1986). If managerial incentives are not aligned with those of shareholders, managers may use excess cash to increase their private benefits at the expense of shareholder wealth. These costs lead to predictions that cash holdings are optimally lower when the liquidity premium increases, for firms facing higher corporate tax rates (relative to their investors' tax rates), and for firms with weaker governance, respectively.

[11] At the extreme, (as emphasized by Azar et al., 2016) firms forgo any return if they hold some portion of their cash in non-interest bearing checking accounts.

Prior literature has found some degree of support for many of these theoretical predictions. While earlier studies find mixed support for the expected negative relation between firm size and cash ratios, Opler et al. (1999) and Bates et al. (2009) confirm this relation in modern data. Several studies find a positive relation between cash holdings and proxies for investment opportunities and/or external finance costs.[12] On the cost side, Kim et al. (1998), Boileau and Moyen (2016) and Azar, Kagy, and Schmalz (2016) provide evidence that cash holdings are negatively related to measures of the liquidity premium and the cost of carry. Several studies provide evidence consistent with the agency costs of cash holdings. Harford (1999) and Harford, Mansi and Maxwell (2008) show that firms with more anti-takeover provisions hold less cash and make value-destroying acquisitions. Dittmar, Mahrt-Smith, and Servaes (2003) find that corporate cash holdings are greater in countries with weaker investor protections. Gao, Harford, and Li (2013) provide evidence that private firms (which are thought to be subject to fewer agency costs) hold half as much cash as public firms, and that poorly governed public firms quickly spend excess cash on excess investment. Nikolov and Whited (2014) use a dynamic model to argue that cash holdings can be explained by agency costs such as managers' private benefits from excess perquisite consumption and attribute the recent increase in cash to insufficient managerial shareholdings.

3.2 Determinants of cash through the century

Table 3 documents how the cross-sectional relations between cash holdings and firm characteristics have evolved through time. We partition the CRSP sample into 10-year windows, centered on each year ending in "8", estimate annual regressions (within each decade window) of cash holdings on firm characteristics, and present Fama-MacBeth mean coefficients within each decade. In Panel A, we limit

[12] See for example Kim, Mauer and Sherman, 1998; Opler et al., 1999; Bates et al., 2009; Riddick and Whited, 2009; Falato, Kadyrzhanova, and Sim, 2013; and Begenau and Palazzo, 2017.

the sample to NYSE firms to (broadly) isolate away from changing sample composition. Panel B presents results using the full CRSP sample. The included independent variables largely follow the extant literature (e.g., Opler et al., 1999; Bates et al., 2009).

Focusing first on the right-most column (the 10 years centered on 2008), we confirm many of the relationships documented by papers that study modern data. Cash ratios are higher for smaller firms and non-dividend payers (proxies for external financing costs), for firms with higher market-to-book ratios (expected investment opportunities), and firms with more volatile cash flows (uncertainty about future financing needs), which many studies interpret as being consistent with a precautionary motive to hold cash. The negative relation with firm size and positive relation with cash flow volatility can also be interpreted as consistent with transaction cost models. We also find evidence consistent with substitution between cash holdings and other current assets, as well as firms holding cash to offset current liabilities. Cash holdings are lower for firms with higher recent investment spending and (weakly) higher for NYSE firms with higher cash flow, consistent with use of internal funds for investment and accumulation of current cash flows. Finally, cash ratios are negatively correlated with corporate debt. While this relation is hard to interpret theoretically, it is potentially consistent with firms with better access to debt markets having lower precautionary motives to hold cash.

Looking across the columns in Panel A of Table 3, many of the cross-sectional relations documented for the 2004 – 2013 column are steady through time, despite dramatic changes in capital markets and the severity of financial frictions over the past century. While some magnitudes vary, with one exception, each of the cross-sectional relationships just discussed retains the same sign, and is statistically significant, in at least 7 of the 9 decades in our sample period. Many of the magnitudes are stable as well. Overall, this suggests that many cash holdings determinants are stable across NYSE firms over the years. The exception is that early in the century, dividend-paying firms held more cash than non-payers,

but less cash than non-payers since the 1960s. This dividend flip is surprising, given that the negative relation is typically interpreted as consistent with the relevance of external finance costs for cash policy and one would expect financing costs to be more severe when capital markets were less well developed. We also note that the intercept increases substantially across the first three columns. This gives an initial indication that relations to firm characteristic do not fully account for the increase in cash holdings over this period. We return to this issue in our analysis of aggregate cash holdings in the next section.

Panel B repeats the analysis on the full CRSP sample (which adds non-NYSE CRSP firms to Panel A). Again, the sign and significance of most cross-sectional relations are fairly stable through time (again with the exception of the dividend payer indicator). Two differences relative to Panel A are noteworthy. First, the relation between cash holdings and earnings becomes negative in the two most recent decades. This suggests that among Nasdaq firms, unprofitable firms have particularly high cash ratios. Second, the magnitude of the positive relation between cash holdings and cash flow volatility has increased in recent years, consistent with especially high cash holdings among Nasdaq firms in volatile industries (see Figure 3, Panel C). Finally, the coefficient on the Non-NYSE indicator shows that since the 1980s non-NYSE (i.e., Nasdaq) firms hold more cash than NYSE firms, even controlling for firm characteristics, and that this difference has become more pronounced in the past two decades.

3.3 Differing cash sensitivities for NYSE versus non-NYSE firms

In Section 2 we document that cash holdings evolved differently for NYSE and Nasdaq firms. Results in the previous section suggest this may be in part due to differences in determinants of cash policies across these groups of firms. In Table 4, we explore this implication in more depth by estimating cross-sectional regressions similar to those in Table 3, except we allow for different sensitivities for NYSE and non-NYSE firms. We use the extended sample in Panel A so we can study

how the difference in cash policies between NYSE and non-NYSE firms has evolved over the century. Recall that the extended sample data are just for a single year (1928, 1938, etc.) in each decade, so these are pure cross-sectional regressions. Because the extended sample lacks information on industry and market prices, we drop volatility and market/book from this specification. Investment is also dropped because it is not possible to calculate change in assets using the one-year-per-decade data in the extended sample. Offsetting this, we have credit rating information for the extended sample, and Panel A includes a variable indicating whether a firm is rated.

First, we note a dramatic shift in the intercept over time. In the 1920s and 1930s, non-NYSE listed firms held significantly less cash than NYSE firms, controlling for firm characteristics. However, the relative cash holdings of non-NYSE firms increased monotonically through the century, turning positive in the 1950s and becoming economically large and statistically significant since the 1980s. These patterns suggest that the forces that have led to substantial cash holdings by non-NYSE firms have been building for many decades and are not fully captured by the included firm characteristics.

Second, Panel A presents evidence that the relations between firm characteristics and cash holdings differ between NYSE and non-NYSE firms, and that these differences have become more pronounced over time. Thus, relative to the past, cash holdings are managed differently by non-NYSE firms in the modern era, both in the level of holdings and in sensitivities to firm characteristics. For example, in the cross-section of NYSE firms, higher earnings are associated with higher cash holdings, though the magnitude and significance of this relation has declined in recent decades. The relation between earnings and cash is always smaller for non-NYSE firms, and turns negative in the 1980s. (This is most easily seen in Figure 7, which presents a time series of estimated coefficients.) Also, for most of the century the coefficients are very similar for NYSE and non-NYSE firm for current assets, short-term- and long-term-debt, but become significantly and increasingly smaller for non-NYSE firms after the

1970s. This indicates that cash holdings are particularly high for unprofitable, low-current-asset Nasdaq firms with little debt financing. Low current assets can reflect low receivables and inventory due to low sales. Thus, elements of financial constraint appear to be associated with the high cash holdings of Nasdaq firms.[13] Notably, the effect of firm size does not vary by exchange. Thus, within both NYSE and Nasdaq firms, the negative size coefficient is potentially consistent with both precautionary and transaction cost motives to hold cash.

Panel B of Table 4 reports results of similar analysis of the sample of CRSP firms. Panel B largely confirms the implications of Panel A and adds that, relative to NYSE firms, cash holdings by non-NYSE companies are more positively related to volatility and investment opportunities (market-book), and more negatively associated with investment spending, starting in the 1990s.

To summarize so far, a primary objective of our paper is to determine whether the substantial shifts in cash holdings over the past century are due to changing cash policies, changing characteristics of firms, or something beyond firm characteristics. In Section 2 we showed that the modern increase in average cash ratios is tied to changing sample composition (namely Nasdaq firms IPOing and entering the sample with substantial cash holdings). The regression coefficients in this section begin to highlight which firm characteristics and policies might be associated with this increase. The evidence in Table 4 suggests that the well-known modern increase in average cash holdings is tied to specific investment and liquidity characteristics of these non-NYSE firms. Their holding more cash in anticipation of future investment is consistent with a precautionary motive to hold cash: high cash ratios among non-NYSE firms are pronounced among firms with high investment opportunities (market-to-book) and limited sources of funds (low profits, few current assets, little debt capacity). The use of cash to invest is

[13] Begenau and Palazzo (2017) attribute increased cash holdings in part to greater growth options among recent IPO firms, which is consistent with the positive sign on M/B in Panel B of our Table 4.

consistent with the realization of this precautionary need, though it may also have a more passive or mechanical explanation.

This combination of changing sample composition and characteristic sensitivity offers a plausible explanation for the 1980-2000 era increase in mean cash. However, we do not observe significant changes in composition or sensitivities during the increase in average and aggregate cash from 1920 to 1945, the reversal through 1970, or the increase in aggregate cash since 2000. This suggests other factors are necessary to explain the time-series variation in these other periods. We explore these implications in the next section.

4. Time series variation in aggregate cash

In this section, we explore the substantial variation over the past century in aggregate corporate cash holdings. This variation could be driven by several factors. The first is changing characteristics of publicly traded firms. The previous section documented stable relations between several firm characteristics and cash policies in the cross-section, especially for NYSE firms. This suggests that changes over time in aggregate firm characteristics could lead to changes in optimal cash holdings and result in shifts in aggregate corporate cash.

Second, macroeconomic conditions can affect the costs and benefits of holding cash in ways not fully captured by firm characteristics. For example, as real interest rates or expected inflation increase, the opportunity cost of holding cash in non-interest bearing accounts or fixed income instruments increases. Likewise, variation in the demand for (or supply of) liquid assets may impact the returns forgone by holding more of a firm's assets in cash and marketable securities. Further, the precautionary motive to hold cash may be influenced by business cycle fluctuations, which influence the value of

growth opportunities, and the level of uncertainty about economic conditions. Finally, variation in tax rates over time may affect the tax cost of holding cash inside the firm.

Third, shocks to cash flow and investment opportunities can impact the time path of cash holdings. For example, several theoretical models (Baumol, 1952; Miller and Orr, 1966; Bolton, Chen and Wang, 2011) imply firms follow a double-barrier policy, allowing their cash ratios to vary within an optimal range. While the costs and benefits of holding cash determine the width of the optimal range in these models, firms may appear passive about cash management as long as cash holdings remain within that range. That is, until the cash ratio hits an upper or lower boundary, cash balances will increase (decrease) as current cash inflows exceed (fall short of) current investment opportunities, consistent with the pecking order of Myers and Majluf (1984).[14] In this case, much of the time series variation in cash holdings may be driven by contemporaneous cash flow and investment realizations. These firm-specific behaviors can affect aggregate cash holdings, for example in times of high aggregate profits.

To explore the determinants of aggregate corporate cash holdings, we estimate aggregate time-series regressions of the form:

$$C_t = \alpha + \beta X_t + \gamma M_t + \varepsilon_t, \quad (1)$$

where C_t is the aggregate ratio of corporate cash holdings to assets, X_t is a set of aggregate firm characteristics, and M_t is a set of macroeconomic variables. We estimate equation (1) in both levels (with the addition of a time trend control) and first differences. All explanatory variables are scaled by their time-series standard deviation to ease comparison of economic magnitudes. Coefficient estimates are shown in Table 5. In Figure 8 we plot the fitted and actual aggregate cash ratio based on the first

[14] Riddick and Whited (2009) show that cash holdings can be negatively related to cash flow in a dynamic model. For example, a positive productivity shock may lead to increased cash flows as well as more investment (the latter potentially reducing cash holdings).

difference specification; that is, we cumulate the fitted values for changes in the aggregate cash ratio and compare that series to the cumulated changes in the actual aggregate cash ratio.

The first and fourth columns of Table 5, along with Panel A of Figure 8, present results using only firm characteristics as independent variables. These include aggregate versions of the same set of variables used in Table 3, with one exception. For the time series analysis, we attempt to distinguish between firms' expected levels of cash flow and investment and their contemporaneous realizations. That is, target cash holdings should be lower for firms expecting greater cash flows and higher for firms with greater anticipated investment needs. On the other hand, as mentioned above, for firms following a double-barrier type of cash policy, the relation between end-of-period cash holdings and the current-year realization of earnings and investment are likely to be the opposite. We proxy for expected cash flow and investment with a trailing 3-year moving average of each variable. We then construct an aggregate version of each variable by calculating an asset-weighted average across firms each year.

Panel A of Figure 8 shows that very little of the large time series variation in aggregate cash holdings can be explained by changes in aggregate firm characteristics alone. Table 5 indicates few robust significant relations between aggregate characteristics and aggregate cash. Firm size is significant in both levels and changes, but not of consistent sign (positive in the level specification, negative in first differences). Market-to-book has a significant coefficient in the first difference specification, but of opposite sign from what would be expected based on the cross-sectional results in Section 3. The only variable in the first difference specification with a significant coefficient in the expected direction is Current Assets. While before we showed that there are systematic differences in cash holdings across firms with different characteristics, and that these cross-sectional relations are fairly stable over time, this analysis indicates that little of the time series variation in aggregate cash holdings is attributable to changes in these aggregate characteristics over time.

To understand what non-characteristic factors explain the large variation in aggregate cash, we next explore the role of macroeconomic conditions. We include two variables to proxy for the opportunity cost of holding cash: the cost of carry as defined by Azar, et al. (2016), which is essentially the nominal 3-month T-bill rate multiplied by the fraction of corporate liquid assets held in non-interest bearing accounts[15]; and the spread between rates on AAA-rated corporate debt and the 10-year Treasury yield as a measure of the liquidity premium. In addition, we include the standard deviation of market returns and the Economic Policy Uncertainty index of Baker et al. (2016) to capture aggregate uncertainty. We further include two measures of aggregate investment opportunities: real GDP growth and aggregate productivity (output to capital ratio). Finally, we include the corporate tax rate to capture variation in the tax cost of holding cash.

Columns (2) and (6) of Table 5 suggest these macro factors help explain some of the time-series variation in aggregate cash, although only a few coefficients are statistically significant. In the level specification, the cost of carry is highly negatively correlated with aggregate cash, consistent with results in Azar et al. (2016); however, in the first-difference specification (column (6)), cost of carry becomes insignificant. Aggregate productivity and GDP growth are each positive and statistically significant in both specifications.[16] Their economic magnitudes are also reasonably large. For example, from the levels specification (2), a one standard deviation change in aggregate productivity is associated with a 2.44 percentage point (roughly 0.6 standard deviation) change in aggregate cash.[17] This suggests that the value of growth opportunities or the expected volume of transactions is relevant for aggregate

[15] Since the fraction of liquid assets held in non-interest bearing accounts is measured using U.S. Flow of Funds data, it is not available prior to 1945. Therefore, for years between 1925 – 45, we assume it stays at the average level of 1945-49. This assumption is reasonable, given that the fraction is very stable and close to 1 prior to 1960 (see Azar et al., 2016).

[16] In untabulated analysis, we repeat the aggregate analysis for the first and second halves of the sample separately. As anticipated in our discussion of Figure 5, we find that aggregate cash is positively and significantly associated with real GDP growth and productivity in the first half of the sample, but not in the second half.

[17] Magnitudes are similar in the first difference specification. There, a one-standard deviation change in the first difference of productivity corresponds to a 0.7 standard deviation change in the first difference of the aggregate cash ratio.

cash holdings, beyond anything captured by firm-level variables such as market-to-book and firm size. Finally, the corporate tax rate has a significant coefficient in the level specification, but is positive in both levels and first differences, inconsistent with a tax cost incentive. Therefore, we drop this variable in columns (3) and (7).

Adding macro variables to Table 5 increases the adjusted r-squared by about a dozen percentage points in levels and by about 30 points in first differences. The improved fit is also reflected in Panel B of Figure 8. While much of the time-series variation remains unexplained in the middle of the sample, adding macro variables to the model captures some of the increase in cash holdings in the 1940s and the decline that follows.[18]

In Columns (4) and (8) of Table 5, we add contemporaneous earnings and investment to our set of firm characteristics. The coefficients on these variables are highly statistically significant and robust across both the level and first difference specifications. Their marginal effects are also among the largest of any of the included variables. From the level specification, a one-standard deviation change in either aggregate investment or earnings is associated with a 0.3 standard deviation change in aggregate cash holdings. We also see a marked increase in the adjusted r-square in the first difference specification, increasing from 0.36 to 0.53. This is further reflected in Panel C of Figure 8. This last panel demonstrates that a model that incorporates all three elements – characteristic-based proxies for target cash holdings, macroeconomic indicators, and current cash flow and investment realizations – is able to capture much of the time series patterns in aggregate corporate cash holdings over the past century.

[18] In unreported analysis we create a version of Figure 8, Panel B that adds cost of carry (but none of the other macro variables) to the firm characteristics. This graph is nearly identical to that shown for just firm characteristics in Panel A. Thus, while aggregate cash holdings are negatively correlated with cost of carry in levels, the insignificance in the first difference specification results in minimal incremental explanatory power of the time-series.

We note that the importance of current cash flow and investment realizations suggests that a significant portion of the time series variation in aggregate cash reflects accumulation of profits or use of internal funds. While such behavior may appear "passive" in the short-run, it is consistent with several theoretical models of cash policy. For example, in Miller and Orr (1966), due to transaction costs, firms only transfer funds between illiquid assets and liquid accounts when cash balances reach either an upper or lower boundary. In between, cash balances are allowed to evolve according to the difference between receipts and expenditures. More recently, Bolton, Chen and Wang (2011) derive similar dynamics in a more general model. Because of external financing costs, firms only add to cash balances by issuing securities or reduce cash via payout when those balances cross endogenous lower or upper bounds. In this framework, firms follow a dynamic pecking-order between internal and external funds. As a result, much of the time series variation in cash balances will be driven by cash flows and investment expenditures. Our results indicate that summing up this firm-level dynamic behavior helps explain time-series variation in aggregate cash holdings.

4.1 Understanding the Pre-war Cash Increase

While the analysis above helps to identify which factors are (or are not) associated with time series variation in aggregate cash over the past century, in this section and the next we attempt to understand more deeply the drivers of the two episodes of increasing aggregate cash: one in the 1930s and early 1940s and the recent increase that starts in 2000.

The transactions cost and precautionary savings models offer two potential explanations for the increase in corporate cash holdings leading up to WWII. The transaction cost models (Baumal, 1952; Miller and Orr, 1966) suggest the average level of cash holdings increases in the volume of receipts and expenditures flowing through the firm. This implies a positive relation between the cash to assets ratio

and sales to assets, which we find to be true: sales to assets increased on average in the years leading up to WWII, averaging roughly 90% from 1926 to 1935, then increasing to 160% by 1945.

In addition, there are reasons to believe that precautionary motives to hold cash may have increased in the late 1930s and early 1940s. First, this period was associated with a heightened level of uncertainty. The Economic Policy Uncertainty index of Baker et al. (2016) was less than 100 between 1925 and 1931, but subsequently rose and remained over 150 from 1932 until the end of the war. At the same time, the booming war-time economy increased the value of investment opportunities and the limited access to funding during the early 1930s was likely fresh on corporate managers' minds.

To test the relevance of these two explanations for the pre-war cash increase, in Table 6 we examine cross-sectional differences in the change in cash ratios over the 1936 – 1945 period. We first sort firms by several proxies for the severity of financing constraints using data from 1936. If precautionary motives were relevant, we would expect firms facing more severe constraints to increase cash balances more rapidly. We then sort firms based on their growth in sales to assets over the 1936 to 1945 period. If growth in transaction volume was a primary driver of the increasing cash balances over this time, we expect that those firms with larger increases in sales would see larger increases in cash.

We appeal to the prior literature for guidance on ex-ante proxies for financing constraints. Several authors have used credit ratings (Almeida and Campello, 2007), firm size (Hadlock and Pierce, 2010) and dividend status (Fazzari et al., 1988) to proxy for financing constraints (with small firms and non-payers assumed to be more constrained). In addition, Calomiris and Hubbard (1995) (CH) point out that a firm's response to the Undistributed Profits Tax (UPT) of 1936-37 reveals the firm's assessment of its cost of external (relative to internal) finance.

Beginning in 1936, but lasting only two years, firms faced a surtax on any earnings that were not paid out to shareholders. CH argue the imposition of this tax was largely unexpected. The tax rate was progressive, based on the fraction of earnings retained by the firm. Given that firms could avoid the tax (or lower the tax rate) by paying out more dividends, CH argue that the marginal rate paid by each firm indicates its willingness to pay in order to avoid having to raise an additional dollar of external finance. We follow CH and classify firms into three groups based on the marginal UPT rate they faced in 1936. Type A firms, considered the least constrained, had retention rates below 20% and faced marginal UPT rates of 12% or less. Type B firms, those that retained between 20% and 40% of their earnings, faced a 17% tax rate and are considered moderately constrained. The most financially constrained are Type C firms, which retained more than 40% of earnings, increasing their marginal UPT rate to 17% or 22%.

In the first 8 columns of Table 6, we report results of panel regressions over 1936-1945 of the cash to asset ratio on a time trend and the time trend interacted with proxies for financing constraints. All specifications include firm fixed effects; columns (5) through (8) add the set of firm characteristic controls used in Table 3. Across all specifications, we find a) a positive and significant time trend and b) a positive and significant coefficient on the interaction between the time trend and the ex-ante measure of financing constraints. The latter result is consistent with precautionary savings demand playing a role in the pre-war run-up in cash holdings. That is, firms for which we would expect precautionary savings motives to be more pronounced added cash at a faster rate during this period. Comparing the magnitudes of the coefficients on the time trend and interaction variables suggest that constrained firms added cash 35% – 73% faster than unconstrained firms[19]. The results also show that even relatively unconstrained firms increased their cash balances significantly, suggesting that precautionary demand was unlikely to be the only driver of the rise in cash.

[19] From column (2), 0.507/1.45 = 0.35 and from column (4), 0.809/1.102 = 0.73.

In columns (9) and (10), we sort firms by the change in sales to assets over this time period. In particular, we first calculate for each firm the difference between the average sales-to-assets ratio from 1943-45 and the average ratio from 1934-36.[20] We then sort firms into tertiles based on the change in sales-to-assets and estimate similar regressions as in the earlier columns, but now we interact the time trend with an indicator for firms in the high sales growth group. Interestingly, we find no evidence that firms that experienced higher sales growth increased their cash ratio more than firms with lower sales growth. The coefficient on the interaction is negative, though insignificant. This evidence is inconsistent with a transactions demand explanation for the pre-war cash run-up. We note that this is not an artifact of a lack of heterogeneity in sales growth rates. In fact, from 1936 to 1945, average sales to assets was essentially flat for firms in the lowest tertile, while for firms in the highest tertile, average sales to assets increased from 130% in 1936 to over 250% by 1943. Yet, despite these large differences in sales growth, these two groups showed roughly the same change in average cash ratios.

4.2 The Post-2000 Cash Increase and Repatriation taxes

Finally, we noted above that aggregate cash-to-assets does not increase substantially in the modern era until after 2000 (Figure 1), which we explore now in more detail. Recall also that average within-firm changes in cash are negative or at best flat (Table 2). Considering this, plus the size-weighted nature of aggregate data, we expect that the post-2000 increase in aggregate cash is tied to an explanation that applies to large firms.

Corporate taxes can affect cash holdings due to potential repatriation taxes paid on foreign profits earned by U.S. multinational firms. For example, profits earned in Ireland and taxed at 12% would in general be assessed an additional tax of 23% when they are returned to the U.S., given the 35%

[20] Results are robust to other measures of sales growth, such as the percentage difference in total sales between 1936 and 1945 and the average annual sales growth between 1936 and 1945.

US corporate income tax rate. Rather than pay repatriation taxes, many U.S. multinationals "permanently reinvest" these foreign profits overseas, and they can appear as cash on corporate balance sheets. Foley, Hartzell, Titman, and Twite (2007) show cross-sectionally that U.S. firms hold more cash in foreign affiliates for which the tax penalty to repatriating is greater. We explore whether repatriation taxes contribute to time-series increases in cash balances that are "trapped" overseas. Given that the U.S. corporate income tax rate has become increasingly greater than the mean tax rate for major trading partners since about 2000 (http://www.oecd.org/tax/tax-policy/tax-database.htm), we focus on whether trapped cash explains the rise in aggregate cash holdings among US firms in recent decades.

Interestingly, Panel A of Figure 9 indicates that the post 2000 increase in cash in Compustat data is much less apparent in data from US Flow of Funds. The key difference between these two data sources is that Compustat measures worldwide cash holdings (which for multinational firms include cash held in foreign affiliates), while the Flow of Funds balance sheet data are based on the *Statistics of Income*, which is collected from US corporate tax returns (and thus more closely represent domestic cash holdings). This suggests that the difference between the two series reflects cash held in foreign affiliates[21]. This interpretation is supported by Panel B, which plots the difference between the two series in Panel A versus the aggregate ratio of "permanently reinvested earnings" (PRE) from Harford, Wang and Zhang (2017).[22] PRE are foreign profits that US-domiciled companies have declared will be held permanently overseas (i.e., "trapped foreign cash"). The high correlation between the series is consistent with a large portion of the increase in aggregate Compustat cash since 2000 being due to trapped foreign cash.

[21] Additionally, the Flow of Funds series includes private firms, which are excluded from the CRSP/Compustat sample. However, this difference has little effect on the aggregate ratio due to the small relative size of the private firms.
[22] We thank Jarrad Harford for kindly providing the PRE data.

US-based firms have incentive to leave foreign profits overseas when the US corporate income tax rate is greater that the income tax rate in the foreign location. Panel C demonstrates that, starting in about 2000 and growing ever since, the US corporate income tax rate has been greater than the tax rates of the US's main OECD trading partners, which correlates with the increase in foreign-held cash by Compustat firms. This relation is seen even more sharply in Panel D, which plots the growth in foreign cash relative to the measure of repatriation tax cost used by Foley et al. (2007) in their cross-sectional analysis. We now explore whether including this repatriation tax variable helps explain the post-2000 increase in aggregate cash holdings.

In Table 7, we explore whether avoidance of repatriation taxes helps explain variation in aggregate cash holdings since 1981. We first estimate panel regressions (columns 1 and 2) of the cash to assets ratio on the firm-specific repatriation tax incentive variable along with the set of firm characteristic and macro controls used above.[23] Consistent with results in Foley et al. (2007) and Faulkender et al. (2017), we find that higher US taxes owed on foreign profits are associated with higher cash holdings.

We then explore whether these repatriation incentives relate to the post-2000 increase in aggregate cash holdings. We estimate time series regressions in which the dependent variable is either the aggregate cash ratio (columns 5 and 6) or the difference between aggregate cash as reported in Compustat and Flow of Funds (columns 3 and 4). The independent variables include the aggregate repatriation tax cost variable along with aggregate firm characteristic and macro controls. Since the availability of the tax cost variable (and indeed the incentive for and practice of leaving cash overseas) is relatively recent, we use only 34 annual observations in this regression (1981 through 2014).

[23] Since we are relating the flow of taxes owed on foreign profits to the stock of cash balances, we use a 3-year moving average of the repatriation tax incentive variable.

Nonetheless, we find a significant positive relation between the repatriation tax cost and aggregate cash holdings over this time period, even after controlling for a time trend and other determinants of cash policy.

Combining the results in Tables 5, 6, and 7, aggregate corporate profits and investment, precautionary motives, and macroeconomic effects (such as GDP growth and a growing tax disincentive to repatriate foreign cash) appear to explain a large part the evolution of aggregate cash over the last century.

5. Conclusions and directions for future research

While the near-tripling of average cash ratios since 1980 has received much attention, this is only one aspect of the rich evolution of corporate cash policies over the last century. From 1920 to 1945 corporate cash holdings for small and large firms tripled, and then returned to below their starting points by 1970. More recently, cash ratios among new entrants increased sharply from 1980 to 2000, while cash holdings among large and established firms were relatively stable until 2000. We explore these large and (in modern times) divergent cash trends using a hand-collected database for all public, unregulated U.S. firms.

Over our near-century of data, two important drivers of average and aggregate cash are that firms build up cash when they realize current-period profitability and use it to fund current investment. One explanation for this finding could be that firms follow loose, double-barrier cash policies, with cash holdings moving within those boundaries as profits and investment change. For this to explain the large movements in aggregate cash in the first half of the sample, either the boundaries must be extremely wide or they shifted through time as conditions changed. Empirically modeling the dynamic trends in the upper and lower boundaries is an interesting task for future research.

We also find that productivity and real GDP growth help explain the dramatic increase in cash holdings from 1920 to 1945. The increase in cash holdings over this time period is most pronounced among financially constrained firms, such as firms that chose to pay higher taxes on undistributed profits during the Great Depression. Together, these findings are consistent with a precautionary motive to hold cash affecting pre-war cash accumulation.

The decrease in cash/assets and cash/sales from 1945 to 1970 is consistent with improving efficiency of cash management. Future research should measure cash management efficiency directly and explore this issue. The increase in aggregate cash holdings since 2000 is consistent with the direction and magnitude of increased holdings of cash trapped overseas due to repatriation taxes.

Most of the recent papers that study cash examine the increase in average cash holdings from 1980 to 2000. Either explicitly or implicitly (because they study cash using equally-weighted regressions[24]) many results in these papers are primarily driven by increasing cash ratios among small firms. We attribute the increase in mean cash to changes in sample composition. We find that the sign and magnitude of the recent increase in average cash holdings is entirely consistent with a 'Nasdaq effect' in which Nasdaq firms IPO'd with ever-increasing amounts of cash from 1980 to 2000. This Nasdaq effect is stronger for unprofitable, low sales, low current asset, low debt, high growth, high volatility, health and tech firms. We emphasize that this is not purely a firm size effect. Our extended sample holds the proportion of small firms in the sample relatively constant, and yet we still observe a sharp increase in average cash holdings from 1980 to 2000. Thus, the sample-composition-driven increase in mean cash does not occur because more small firms enter the sample starting in 1980 but rather because the non-size characteristics of Nasdaq IPO firms changed. It should be noted that these Nasdaq firms burn through a lot of cash in their first four years of existence (see also Bates et al., 2009).

[24] One exception is Azar et al. (2015) who estimate size-weighted least squares regressions.

Another take-away from our findings, as well as those of Booth and Zhou (2013) and Beganau and Palazzo (2017) is that characteristic-based explanations of increased average cash holdings need to be consistent not with individual firms increasing cash over time, but with the influence of Nasdaq firms as we have described. For example, while we do not explicitly examine agency explanations of cash holdings, an agency explanation of the mean increase in modern cash would need to manifest primarily in the changing nature of Nasdaq firms, and for the most part, be consistent with negative within-firm cash holdings. Likewise for volatility explanations, changes in working capital components, etc.

Setting aside this sample composition effect, we find that for NYSE firms the sensitivities of firm-specific cash holdings to commonly studied variables are surprisingly stable over our near-century of data. One of the stronger findings throughout the firm-specific analysis is that debt, especially short-term debt, is negatively related to cash holdings. While we offer some tentative interpretations above, we find this relation somewhat hard to interpret and look forward to future research that explores this relation in more depth. Also noteworthy, even with the stability of firm-specific cash sensitivities, and changes in firm characteristics over time, we do not find that changes in firm characteristics explain time-series changes in aggregate cash holdings. One must also consider macroeconomic effects, aggregate corporate investment and profitability, and repatriation tax incentives to explain the long-term aggregate trends in corporate cash holdings.

Finally, we also document that regulated firms hold substantially less cash than the unregulated firms typically studied; time-series trends are similar though tempered for regulated firms. We leave a detailed exploration of these issues to future research.

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Appendix A: Variable Definitions

Cash / Assets: Sum of cash and short-term investments, scaled by total book assets.

Cash flow: Income before extraordinary items minus expected dividends, where expected dividends is the product of dividends per share from the previous fiscal year (adjusted for any stock splits) times the number of shares outstanding at the end of the current fiscal year.

Industry cash flow volatility: For each firm-year, we calculate the standard deviation of *Cash flow* over the past 10 years. If fewer than 10 years of lagged data are available, the standard deviation is calculated over all available years, but is set to missing if there are fewer than three years available. We then calculate the average standard deviation across all firms in each industry-year, where industry is defined by 3-digit SIC code.

Real Assets: The natural logarithm of total book assets in 2004 dollars.

MA / BA: The ratio of the market value of assets to the book value of total assets. Market value of assets is defined as the product of shares outstanding and stock price as of end of fiscal year plus book value of total liabilities.

Investment: Annual change in net Property, Plant and Equipment, scaled by lagged total assets.

E[*Cash flow*]: The average of *Cash flow* (scaled by total assets each year) over years *t-1* through *t-3*. Set to missing if fewer than two past observations are available.

E[*Investment*]: The average of *Investment* over years *t-1* through *t-3*. Set to missing if fewer than two past observations are available.

Div. Payer: An indicator equal to one if common dividends exceed zero in year *t*.

Current Assets / A: Current assets (total) less cash and short-term investments, scaled by total book assets.

Current Liabilities / A: Current liabilities (total) less short-term debt, scaled by total book assets.

Repatriation Tax Cost: The maximum of zero and the difference between the U.S. tax burden on foreign profits and taxes paid to foreign governments, scaled by book assets. The U.S. tax burden on foreign profits is estimated as pre-tax income from foreign operations times the U.S. statutory tax rate of 35%.

3-month T-bill rate: End of year secondary market rate on 3-month treasury bills, minus inflation. (Source: Federal Reserve)

Inflation: Percent change (December to December) in the Al Urban CPI (Source: US Bureau of Labor Statistics)

AAA-Treasury spread: Difference between the year-end Moody's seasoned AAA bond yield and the 10-year Treasury constant maturity yield. (Source: Federal Reserve)

sd(Mkt Return): Standard deviation of the daily value-weighted market returns. (Source: CRSP)

Real GDP growth: Annual percent change in real US Gross Domestic Product (chained 2009 $). (Source: US Bureau of Economic Analysis)

Productivity: Nominal GDP scaled by prior year total nonresidential fixed assets. (Source: US Bureau of Economic Analysis)

Personal tax rate: Weighted average household marginal tax rate on dividends from Poterba (2004).

Corporate tax rate: Top statutory US federal corporate income tax rate.

Appendix B: World War II

This appendix discusses corporate holdings of cash and marketable securities in the years surrounding World War II (WWII). We focus particularly on the influence of US government securities issued to fund the war on corporate holdings of liquid assets. A large spike in the corporate cash ratio in the early 1940s is apparent in Figure 1. The solid line in Panel A of Figure A.1 shows the ratio of corporate holdings of government securities to total assets, taken from *Statistics of Income* data. The figure suggests that at least some of the spike in the cash ratio in Figure 1 is attributable to firms holding Treasury securities issued to fund the war. Further, a comparison with the aggregate ratio of short-term investments to assets taken from our data collected from Moody's Manuals (dashed line) reveals that during the war years, most of the non-cash liquid assets held by firms were Treasury securities. This contrasts with modern data, in which firms hold very little in Treasuries.

Panel B of Figure A.1 indicates that cash holdings increased in the 1940s, above and beyond this temporary spike in Treasury holdings. The figure displays the aggregate ratio of cash to assets (solid line) and cash and short-term investments to assets (dashed line) from our panel data sample.[25] While we do not see as pronounced a spike in the pure cash component during the war years (1942 – 1945), the overall pattern is similar. That is, even excluding short-term investments, the cash ratio roughly doubles, from 5 – 6 % prior to 1935 to over 10% by the mid-1940s, before falling back to around 5% of assets by the 1960s.

Importantly, the WWII increase in corporate holdings of marketable securities does not alter the primary conclusions of our paper. If we exclude holdings of marketable securities to the extent our data allow, there is still a mid-1940s spike in cash holdings (though not as severe), and more importantly, the regression results and conclusions we draw about explaining the evolution of corporate cash holdings do not change. Specifically, we filter out the Treasury holdings associated with war bond sales by first estimating a regression of aggregate Treasury holdings to corporate assets on defense spending scaled by GDP and a number of other control variables.[26] For the years between 1936 and 1949, we then estimate war-related Treasury holdings as the

[25] The aggregate cash to assets ratio from *Statistics of Income* is very similar.
[26] Controls include all the macro variables used in Table 5 along with aggregate firm characteristics.

estimated coefficient on defense spending times the actual defense spending in each year. We use this estimate to construct a "filtered" aggregate cash series by subtracting the war-related Treasury holdings from total cash and marketable securities holdings. We re-estimate the regressions in Table 5 and Figure 8 using this filtered series and obtain similar results to those presented.

Appendix C: Extended Sample

This appendix describes the cross-sectional distribution of firm sizes for our extended sample, which contains data on all firms covered by the Moody's manuals. We hand-enter these data once per decade: 1928, 1938, … 2008. Our main sample (or "CRSP sample") comprises all non-financial, unregulated firms covered by CRSP, which limits the sample to NYSE firms prior to 1962. By contrast, the extended sample includes many small, regional stock exchange firms.

The first four panels in Figure A.2 plot the cumulative size (book assets) distribution in the extended sample and our main sample of CRSP firms for the first four decades of our sample period (1928, 1938, 1948 and 1958). As the plots indicate, this extended sample greatly broadens our coverage of small firms in these years, relative to the CRSP universe. The bottom two panels plot the 10^{th} and 25^{th} percentiles, respectively, of the distribution of real book assets in each year ending in "8." As the plots indicate, the CRSP sample has many fewer small firm proportionally, relative to the extended sample, before the 1980s. In contrast, in the extended sample, the size of "small" firms (in real dollar terms) is fairly consistent throughout the century.

Thus, with respect to firm size, the extended sample provides a more stable comparison across decades than does the CRSP sample.

Appendix D: Long-lived Sample

Figure A.3 presents cash-assets plots for each of the 66 firms for which we have 80+ years of data. Several patterns are notable. First, there is a good deal of variation in cash holdings within a given firm, especially in the first half of the sample. The average firm varies its cash holdings over a range (inter-quartile range) of 34 (12) percent of assets before 1970, but only 21 (7) percent of assets from 1970 on. Second, many long-lived firms follow a time-series pattern similar to the overall average displayed in Panel C of Figure 1. As a result, cash balances for most firms were near historic lows as recently as the late 1990s. For example, in 2000, almost 90 percent of these firms had cash ratios below their firm's time-series median, and over 60% had cash ratios in the bottom quartile of their historical values. This is surprising given that most of the increase in average cash ratios (Panel A of Figure 1) that has stimulated research on the modern run-up in cash holdings had already occurred by 2000. Cash balances tended to rise among long-lived firms only after 2000, but not to unprecedented levels. By 2014, the median firm had a cash ratio very close to its historical average.

Figure 1
Average and Aggregate Cash Ratios Through Time

The solid (dashed) line presents the annual average (aggregate) ratio of cash and short-term investments to total assets. Aggregate cash-to-assets is defined each year as the cross-sectional sum of total cash and short-term investments divided by the sum of total book assets. Panels A and C use the "CRSP sample," which includes all firms in the CRSP database that are also covered either in Compustat or Moody's Industrial Manuals. Panel B uses the "extended sample," which includes all firms in the Moody's Industrial Manual for years ending in "8" (e.g., 1938). Financial firms, utilities and railroads are excluded.

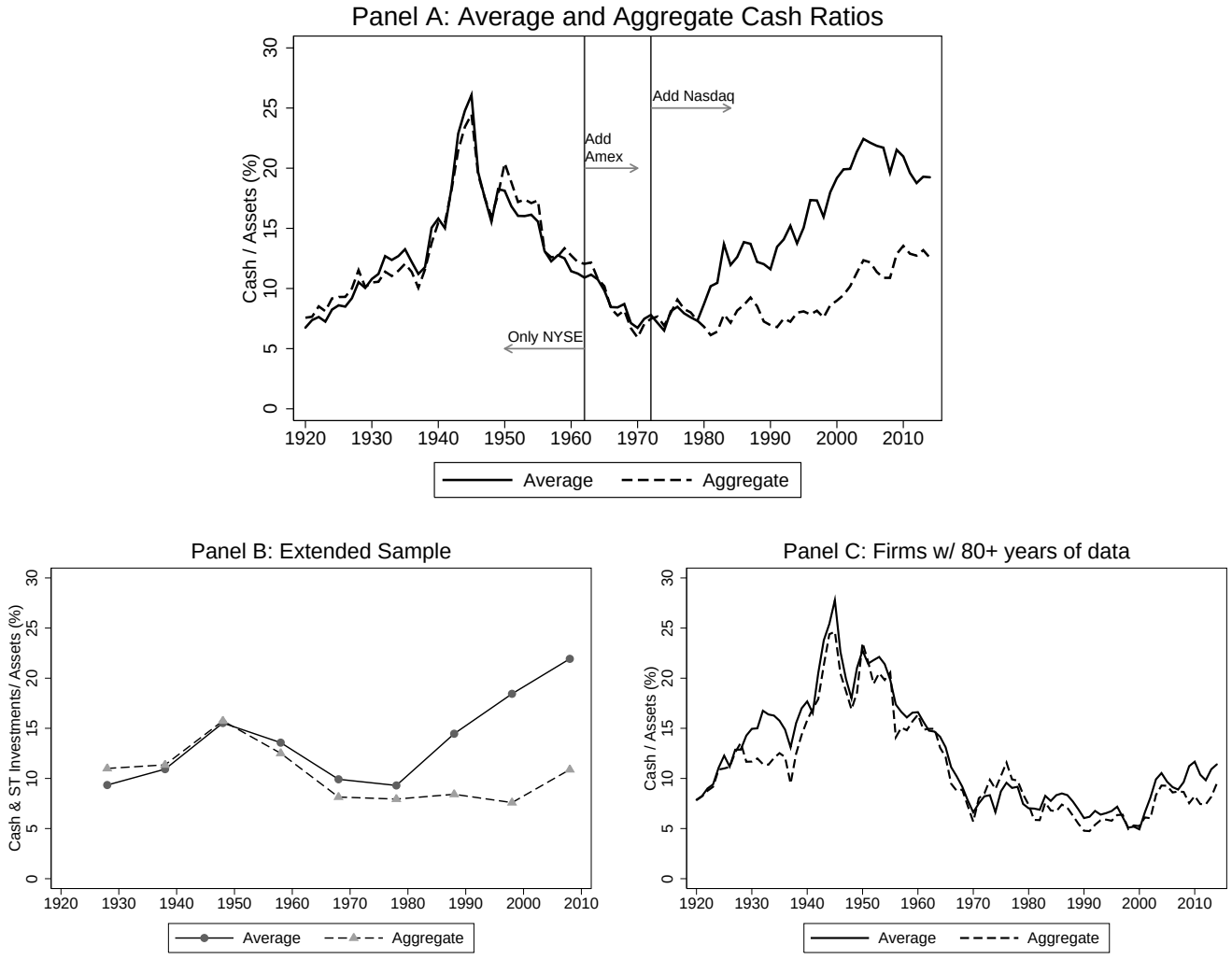


Figure 2
Cross-sectional Dispersion in Cash Ratios

Panels A and B present the cross-sectional standard deviation of the cash ratio (ratio of cash and short-term investments to total book assets) for each year based on, respectively, the "CRSP sample" and "extended sample." Panel C plots the 25th percentile, median, and 75th percentile of each year's cross-sectional distribution from the CRSP sample. Panel D displays a scatter plot of the distribution of cash ratios each year for the extended sample.

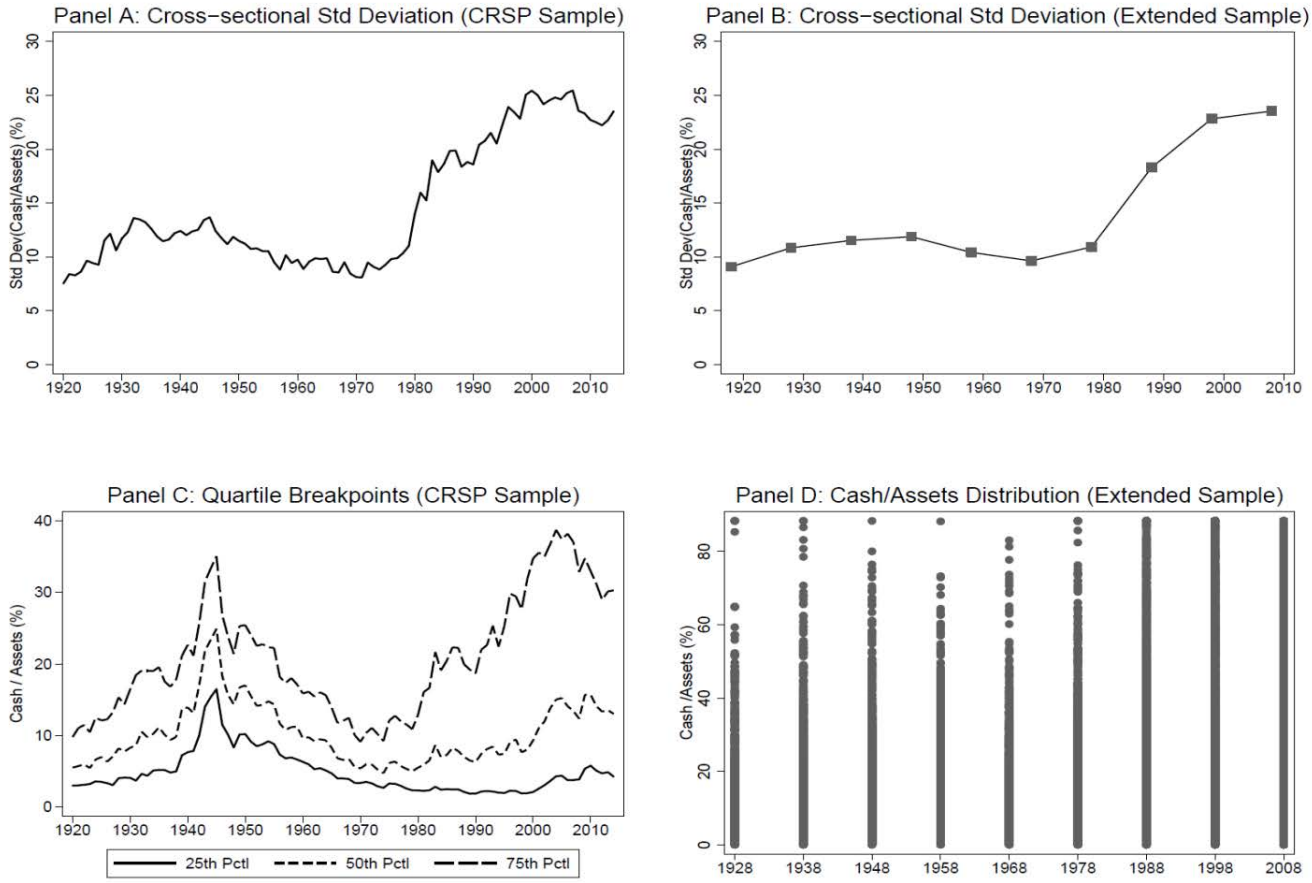


Figure 3
Cross-sectional Heterogeneity in Cash Trends

The extended sample in Panels A and B includes all firms in the Moody's Industrial Manuals for each fiscal year ending in "8". In Panel C, the sample includes all firms in the CRSP database that are also covered either in Compustat or Moody's Industrial Manuals. Financial firms, utilities and railroads are excluded. Non-NYSE firms include Amex listed firms starting in 1962 and Nasdaq firms starting in 1972. Technology and healthcare firms are defined using the Fama and French 12-industry definitions and represent both NYSE and non-NYSE firms. Data in panel D are from *US Statistics of Income*. Regulated sectors include utilities, transportation and telecommunications. Unregulated sectors include all other non-financial industries. Cash includes short-term investments in Panels A, B and C, but excludes short-term investments in Panel D.

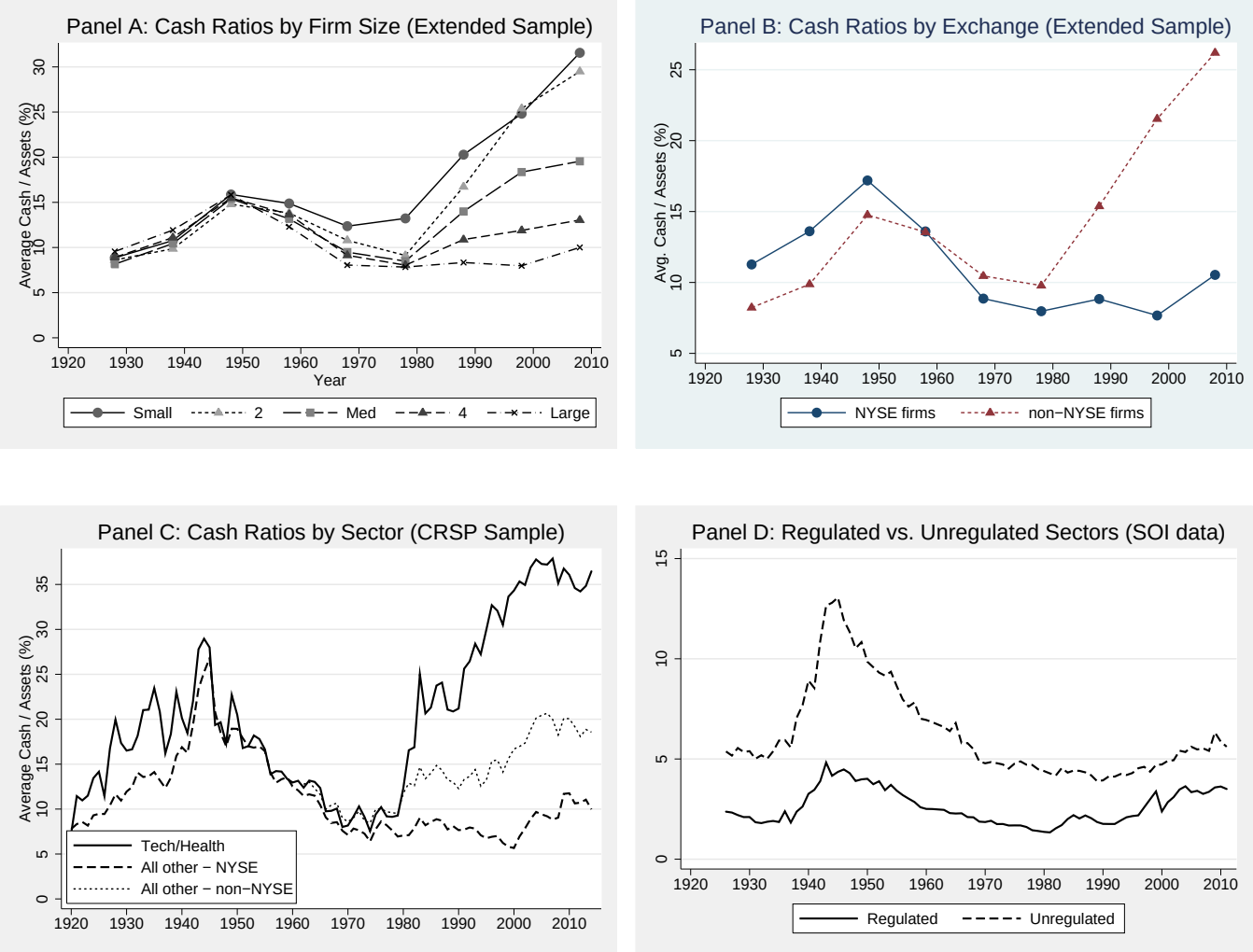


Figure 4
Average Cash Holdings for New Entrants Versus Existing Firms

The CRSP sample is presented and includes all firms in the CRSP database that are also covered either in Compustat or Moody's Industrial Manuals. Financial firms, utilities and railroads are excluded. New firms are those firms that appear in the sample for the first time in each year t. Each line represents the average ratio of cash and short-term investments to book assets. "All, pre-1980 entrants" is all unregulated non-financial firms on NYSE, Amex or Nasdaq that entered the CRSP sample before 1980.

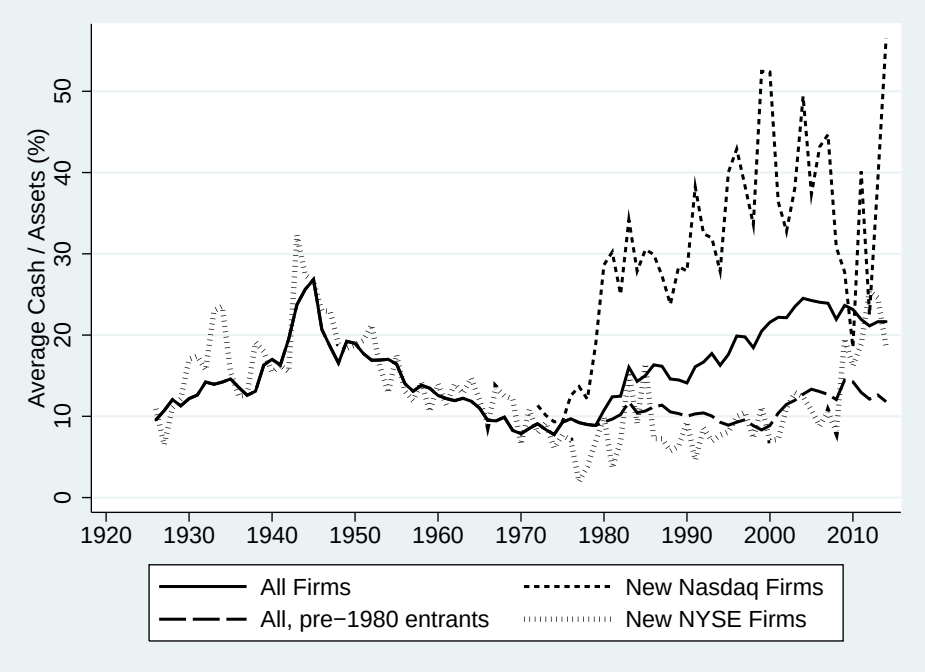
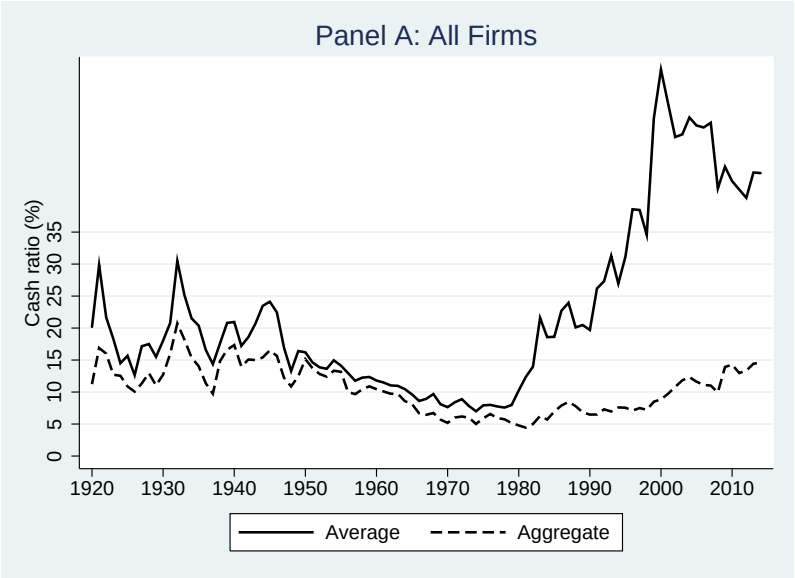
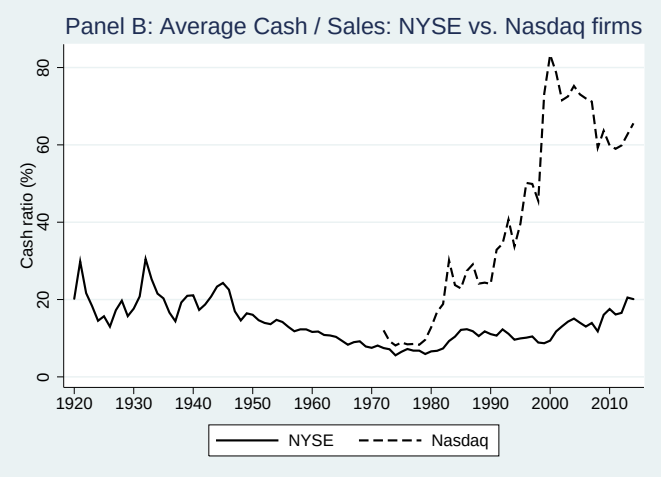


Figure 5
Cash to Sales

Figures are based on the CRSP sample, which includes all firms in the CRSP database that are also covered either in Compustat or Moody's Industrial Manuals. Financial firms, utilities and railroads are excluded. Averages are equally weighted, with firm-level ratios trimmed at the 5th and 95th percentiles to minimize the impact of outliers. Aggregate ratios are formed by summing cash and marketable securities holdings across all firms each year and scaling by the cross-sectional sum of total sales.





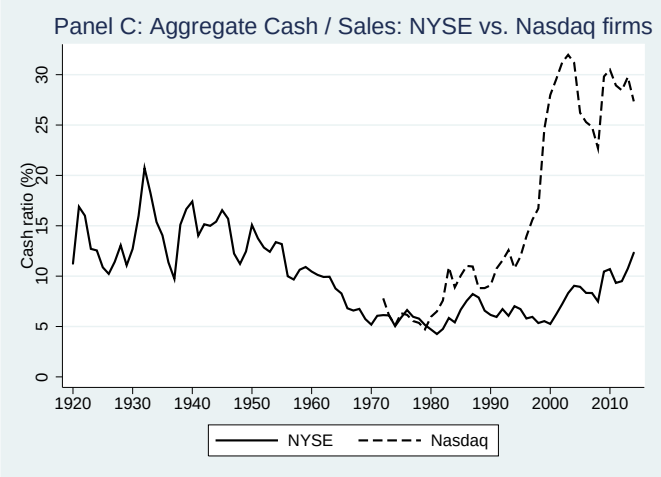


Figure 6
Cash to Market Value

Figure is based on the CRSP sample, which includes all firms in the CRSP database that are also covered either in Compustat or Moody's Industrial Manuals. Financial firms, utilities and railroads are excluded. Market value is defined as the sum of the book value of total liabilities and the product of the fiscal year-end stock price and the number of common shares outstanding. Averages are equally weighted, with firm-level ratios trimmed at the 5th and 95th percentiles to minimize the impact of outliers. Aggregate ratios are formed by summing cash and marketable securities holdings across all firms each year and scaling by the cross-sectional sum of market values.

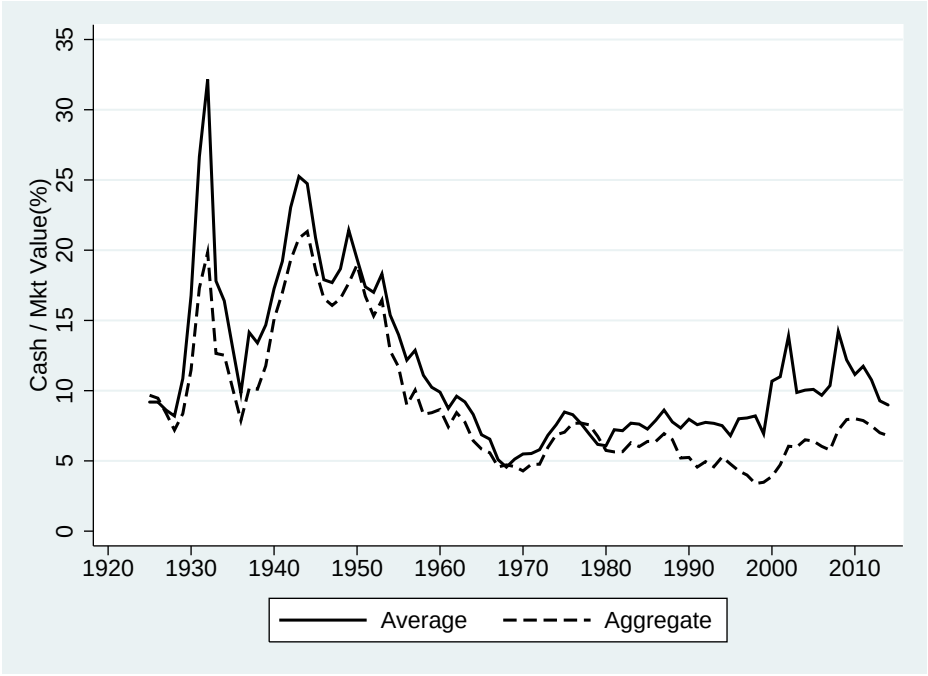


Figure 7
Cross-sectional Regressions: Coefficient Estimates Over Time

The figure plots coefficient estimates from cross-sectional regressions in Panel A of Table 4 using the extended sample. Values plotted for non-NYSE firms are calculated as the sum of the coefficient on the main effect of each variable plus the coefficient on the non-NYSE interaction variable.

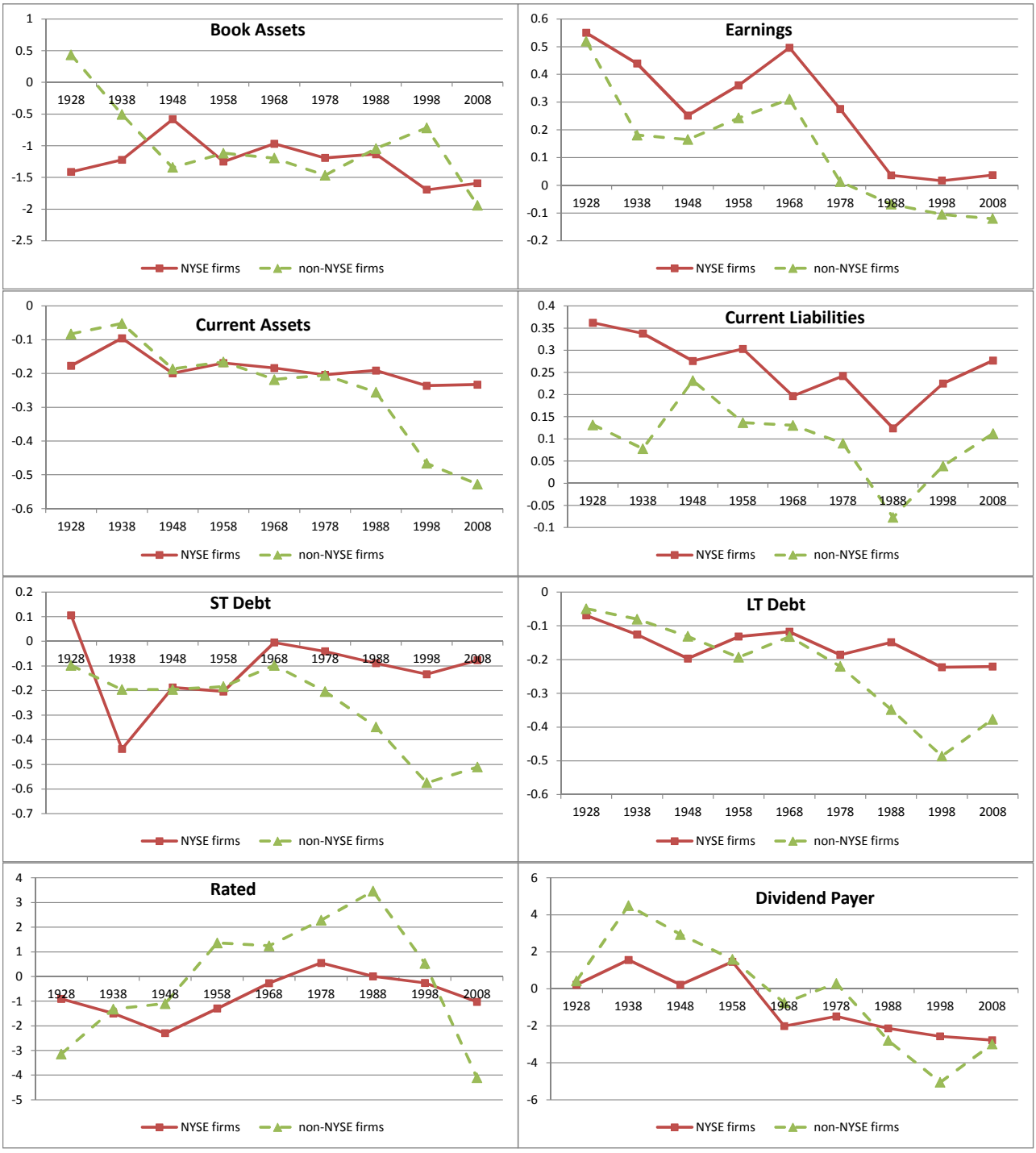


Figure 8
Cumulative Changes in Aggregate Cash Ratio: Fitted vs. Actual

The figure is based on the CRSP sample, which includes all firms in the CRSP database that are also covered either in Compustat or Moody's Industrial Manuals from 1925 - 2014. Financial firms, utilities and railroads are excluded. The solid line presents cumulative annual changes in the aggregate ratio of cash and short-term investments to total assets. The dashed lines display cumulative predicted changes from estimating equation (1) in first difference form. In Panel A, the estimation includes only the firm-specific target determinants in column (5) of Table 5; in Panel B, we add the macroeconomic variables in column (7) of Table 5. Panel C is based on column (8) of Table 5, in which we add contemporaneous cash flow and investment.

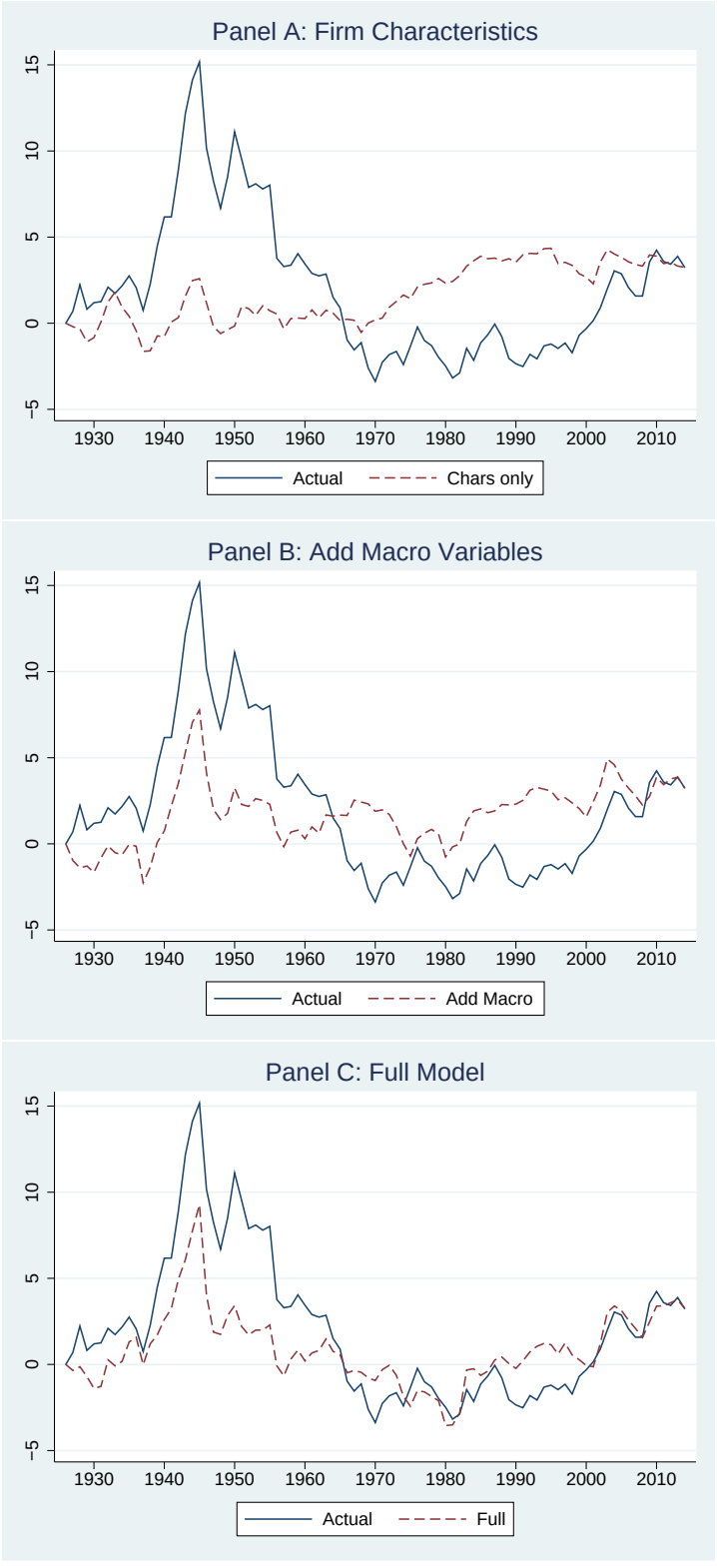
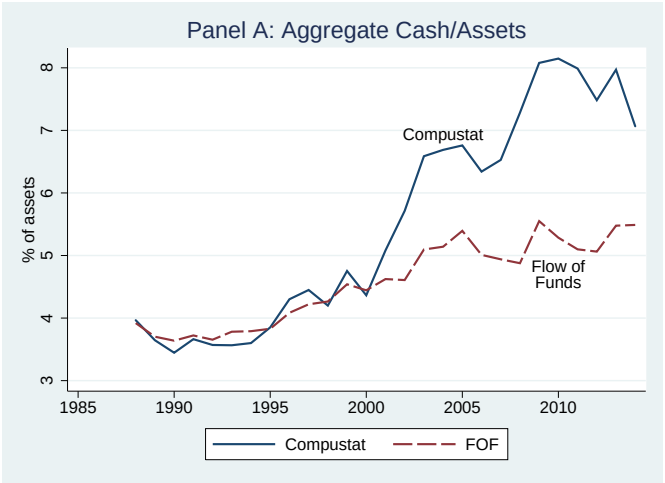
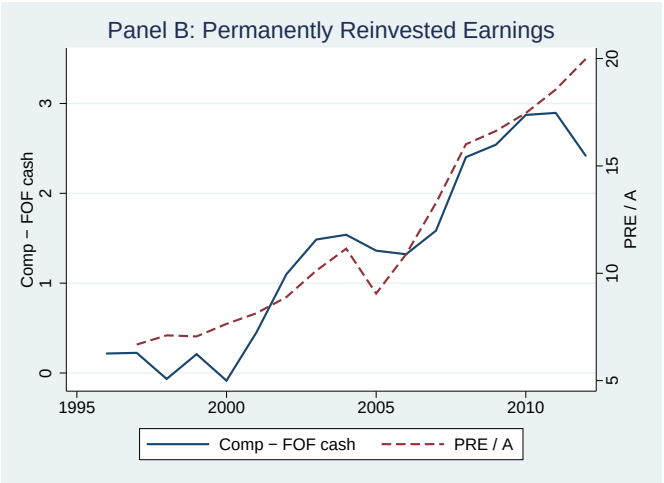
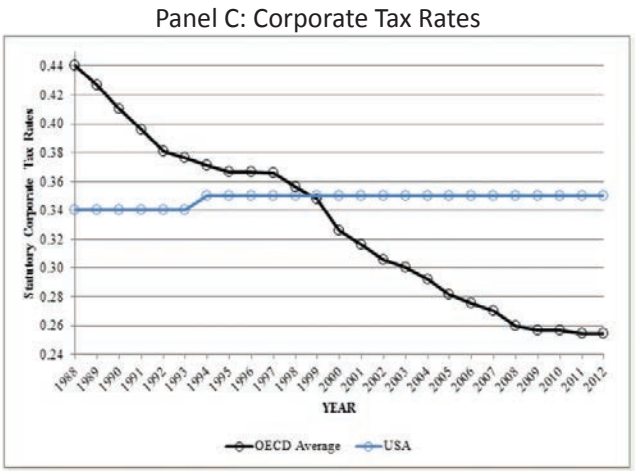


Figure 9
Cash Holdings and Repatriation Tax Incentives

In Panel A, the sample includes all firms in the intersection of the CRSP and Compustat databases, excluding financial firms, from 1985 - 2014. The Flow of Funds (FOF) data are aggregate balance sheet data for nonfinancial, non-farm businesses from US Flow of Funds. Cash excludes short-term investments. Panel B plots the aggregate ratio of permanently reinvested earnings (PRE) from Harford, Wang, and Zhang (2017) to assets versus the difference between the two lines in Panel A. Panel C presents statutory income tax rates for the US versus OECD countries. In Panel D, repatriation tax cost is calculated as in Foley et al. (2007) as foreign income times the US tax rate minus taxes paid on foreign profits (or zero if this difference is negative). The time series plotted is the aggregate ratio of this estimated tax cost to total book assets.







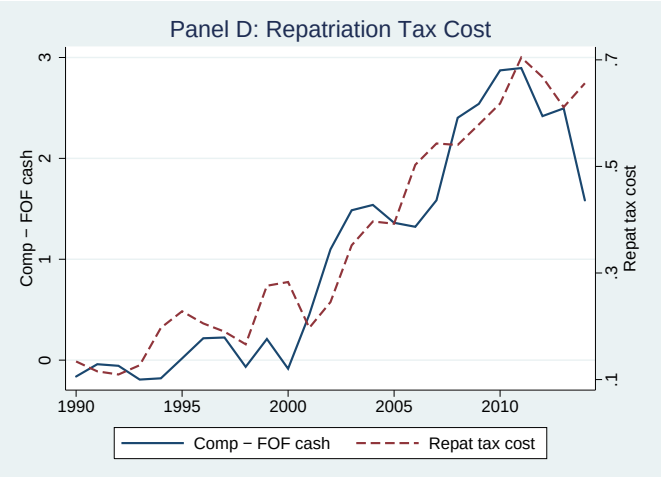


Table 1

Summary Statistics

The "CRSP sample" reported in Panels A and B covers the period 1920 - 2014 and includes all firms in the CRSP database that are also covered either in Compustat or Moody's Industrial Manuals. There are 176,853 firm-year observations. Financial firms, utilities and railroads are excluded. The "Extended sample" in Panel C includes all non-financial unregulated firms in the Moody's Variable Industrial Manual in each year ending in "8" (1928, 1938, etc.). In Panel B (C), averages are calculated as the equal-weighted mean of all firm-year observations within each decade (year). Variable definitions are provided in Appendix A.

Panel A: Panel Data Summary Statistics (CRSP Sample)

	mean	sd	min	max
Cash / Assets (%)	15.69	18.60	0.04	88.60
Cash / Sales (%)	25.63	71.38	0.03	587.10
Cash flow volatility	0.08	0.06	0.00	0.81
Mkt assets / Book assets	1.73	1.61	0.01	20.00
ln(Real book assets)	5.26	1.95	-1.85	12.55
(Curr. Assets - Cash) / A (%)	39.00	21.88	1.16	86.76
Curr. Liab. / A (%)	19.87	11.76	1.80	65.84
ST Debt / A (%)	5.23	8.78	0.00	50.26
LT Debt / A (%)	16.22	17.02	0.00	76.96
Dividend payer	0.45	0.50	0.00	1.00
Sales / A (%)	146.31	100.92	0.26	570.18
Earnings / A (%)	0.24	19.85	-105.56	33.36
Investment / A (%)	3.55	11.09	-23.23	64.98

Panel B: Averages by Decade (CRSP Sample)

	Obs.	Cash/ A	Cash/ S	CF vol	MA/ BA	ln(Real assets)	Curr. A/ A	Curr. Liab./A	ST D/ A	LT D/ A	Div. Pay.	Sales/ A	Earnings/ A	Invest./ A
1921–1930	1,938	11.37	18.10	0.05	1.21	5.84	29.28	6.48	2.27	8.16	0.75	95.83	7.79	3.09
1931–1940	4,994	14.18	20.67	0.06	1.00	5.68	29.24	7.61	1.84	7.99	0.62	98.50	4.91	-0.65
1941–1950	6,230	20.70	18.92	0.04	1.05	5.76	39.86	18.85	2.06	6.76	0.95	168.63	9.67	2.71
1951–1960	6,619	15.15	12.95	0.03	1.16	6.19	43.03	17.67	3.26	11.42	0.92	160.88	7.08	3.26
1961–1970	11,646	9.76	8.91	0.02	1.58	6.03	47.43	17.99	5.43	16.39	0.79	171.04	6.77	4.84
1971–1980	27,022	8.67	7.54	0.03	1.22	5.32	49.45	20.64	6.52	19.13	0.65	181.81	6.37	4.68
1981–1990	34,913	13.23	17.63	0.07	1.72	4.54	42.43	20.65	7.34	17.95	0.40	150.07	-0.63	4.21
1991–2000	41,952	16.73	31.06	0.11	2.11	4.84	37.46	21.13	5.63	16.59	0.26	142.88	-4.03	4.29
2001–2014	41,539	22.64	47.34	0.13	2.04	5.74	29.38	20.55	3.51	15.98	0.29	116.74	-3.96	1.85

Panel C: Cross-sectional Averages by Year (Extended Sample)

	Obs.	Cash/ A	Cash/ S	ln(Real assets)	Curr. A/ A	Curr. Liab./A	ST D/ A	LT D/ A	Div. Pay.	Sales/ A	Earnings/ A
1928	1,579	9.35	13.38	4.37	29.95	7.81	2.88	11.45	0.48	98.69	7.00
1938	2,213	10.93	15.29	4.05	29.29	8.63	3.26	9.58	0.46	104.47	2.62
1948	2,622	15.53	12.70	4.27	41.28	16.75	3.43	8.36	0.78	166.73	9.10
1958	2,536	13.60	12.33	4.83	43.44	15.63	4.27	11.22	0.77	151.04	4.57
1968	3,151	9.98	9.92	5.32	48.34	19.08	6.33	17.27	0.69	158.76	5.88
1978	4,638	9.37	7.90	4.76	49.83	22.06	7.23	19.58	0.60	164.13	4.95
1988	5,048	14.52	20.56	4.43	40.62	20.93	8.11	18.47	0.32	126.18	-5.05
1998	5,944	18.32	34.60	5.09	34.63	20.94	5.55	17.91	0.25	112.93	-7.88
2008	3,806	21.94	43.07	5.87	27.80	20.22	4.44	17.09	0.31	105.76	-10.63

Table 2

Time Trends in Cash Holdings

The presented CRSP sample includes all firms in the CRSP database that are also covered either in Compustat or Moody's Industrial Manuals. The dependent variable is the ratio of cash and short-term investments to total assets. The first four columns capture time trends in average cash holdings. Columns (5) - (8) include firm fixed effects and therefore measure average within-firm changes in cash ratios. Columns (9) and (10) measure within-firm changes in cash excluding the first four years after each firm's IPO, proxied by the first year the firm appears in our database. $t-$statistics are in parentheses. Statistical significance at the 1%, 5% and 10% levels is indicated by ***, **, and *, respectively. Standard errors are adjusted for clustering at the firm level.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	1920-45	1945-80	1980-2000	2000-14	1920-45	1945-80	1980-2000	2000-14	1980-2000	2000-14
Time trend	0.636***	-0.316***	0.404***	-0.039	0.558***	-0.409***	-0.392***	-0.092***	-0.111***	0.046
	(23.93)	(-27.35)	(19.95)	(-1.01)	(18.40)	(-33.41)	(-20.37)	(-2.97)	(-5.95)	(1.42)
Firm FE					Yes	Yes	Yes	Yes	Yes	Yes
Remove 1st 4 yrs									Yes	Yes
Adj. R^2	.124	.082	.013	.000	.142	.134	.019	.001	.003	.000
N	13,529	59,803	94,968	50,217	13,529	59,803	94,968	50,217	57,135	38,858

Table 3

Cross-sectional Determinants of Cash Holdings

The sample includes all firms in the CRSP database that are also covered either in Compustat or Moody's Industrial Manuals, excluding financial firms, utilities and railroads. The first four years of data for each firm are excluded. The dependent variable is the ratio of cash and short-term investments to total assets. Reported are the average coefficient estimates from ten cross-sectional regressions (Fama and MacBeth, 1973) over the years listed in each column heading. Column (1) includes only eight cross-sections, from 1926 through 1933 due to data limitations. $t-$statistics are in parentheses. Statistical significance at the 1%, 5% and 10% levels is indicated by ***, **, and *, respectively. Standard errors are adjusted for clustering at the firm level.

Panel A: NYSE Firms

	(1) 1926 - 1933	(2) 1934 - 1943	(3) 1944 - 1953	(4) 1954 - 1963	(5) 1964 - 1973	(6) 1974 - 1983	(7) 1984 - 1993	(8) 1994 - 2003	(9) 2004 - 2013
Ind. CF vol.	41.840*	16.678*	14.391	21.393	46.966***	28.264***	18.289***	23.197***	32.551***
	(3.36)	(2.32)	(1.22)	(2.11)	(6.75)	(12.05)	(8.15)	(9.64)	(19.30)
MA/BA	1.466	3.296***	2.309***	0.761*	1.385***	1.843***	1.595***	1.461***	1.800***
	(2.07)	(7.41)	(6.59)	(2.66)	(7.45)	(5.42)	(6.54)	(5.85)	(7.13)
Real Assets	-0.573**	-1.030***	-0.621**	-1.238***	-1.064***	-1.092***	-1.563***	-1.463***	-1.236***
	(-4.73)	(-10.21)	(-3.87)	(-28.77)	(-17.12)	(-10.34)	(-24.26)	(-20.20)	(-15.61)
Earnings/A	0.372***	0.305***	0.460***	0.448***	0.313***	0.261***	0.132***	0.028	0.093*
	(9.24)	(10.06)	(7.84)	(12.29)	(8.75)	(15.72)	(4.92)	(1.05)	(2.59)
Invest/A	-0.147***	-0.226***	-0.343***	-0.278***	-0.208***	-0.226***	-0.198***	-0.201***	-0.231***
	(-10.04)	(-6.78)	(-10.89)	(-13.42)	(-8.44)	(-16.42)	(-10.15)	(-15.16)	(-15.69)
STD / A	-0.207	-0.331***	-0.117*	-0.128***	-0.026	-0.071*	-0.102***	-0.160***	-0.162***
	(-2.30)	(-5.41)	(-3.14)	(-5.27)	(-1.84)	(-3.09)	(-8.44)	(-6.38)	(-7.36)
LTD / A	-0.106***	-0.204***	-0.175***	-0.109***	-0.091***	-0.127***	-0.154***	-0.178***	-0.200***
	(-10.41)	(-7.09)	(-15.62)	(-16.86)	(-20.43)	(-10.76)	(-17.09)	(-20.06)	(-21.63)
Curr. Assets / A	0.002	-0.102***	-0.206***	-0.175***	-0.159***	-0.147***	-0.176***	-0.151***	-0.118***
	(0.10)	(-5.05)	(-11.21)	(-21.98)	(-16.56)	(-15.73)	(-27.53)	(-19.38)	(-9.11)
Curr. Liab./ A	0.169	0.159**	0.288***	0.261***	0.128***	0.174***	0.113***	0.112***	0.136***
	(1.56)	(3.46)	(14.83)	(13.75)	(9.44)	(15.41)	(6.01)	(12.15)	(11.31)
Div. payer	2.954*	1.678	1.319	0.865*	-1.013***	-0.769*	-2.609***	-2.493***	-1.550***
	(3.20)	(1.78)	(2.23)	(2.36)	(-5.49)	(-3.17)	(-10.89)	(-10.28)	(-7.29)
Constant	8.202***	18.264***	20.746***	21.798***	18.790***	18.322***	26.196***	23.770***	20.891***
	(13.87)	(12.65)	(13.58)	(30.97)	(21.93)	(13.42)	(36.04)	(38.59)	(15.63)
Avg. R^2	0.314	0.324	0.330	0.355	0.340	0.293	0.222	0.244	0.291
N	2,439	4,407	6,097	6,459	7,641	9,805	7,820	8,497	8,094

Panel B: All Firms

	(1) 1926 - 1933	(2) 1934 - 1943	(3) 1944 - 1953	(4) 1954 - 1963	(5) 1964 - 1973	(6) 1974 - 1983	(7) 1984 - 1993	(8) 1994 - 2003	(9) 2004 - 2013
Ind. CF vol.	41.840*	16.678*	14.391	20.660	32.597***	24.768***	9.695*	50.359***	62.730***
	(3.36)	(2.32)	(1.22)	(2.08)	(5.04)	(4.95)	(2.67)	(11.36)	(43.49)
MA/BA	1.466	3.296***	2.309***	0.743*	1.175***	1.627***	1.673***	2.144***	2.615***
	(2.07)	(7.41)	(6.59)	(2.65)	(9.12)	(8.34)	(11.86)	(27.80)	(30.99)
Real Assets	-0.573**	-1.030***	-0.621**	-1.242***	-1.100***	-1.189***	-1.172***	-0.739***	-1.221***
	(-4.73)	(-10.21)	(-3.87)	(-28.12)	(-18.09)	(-10.75)	(-15.48)	(-11.62)	(-10.70)
Earnings/A	0.372***	0.305***	0.460***	0.454***	0.280***	0.221***	0.128***	-0.015	-0.100***
	(9.24)	(10.06)	(7.84)	(12.89)	(11.42)	(12.41)	(6.31)	(-0.92)	(-7.38)
Invest/A	-0.147***	-0.226***	-0.343***	-0.269***	-0.193***	-0.234***	-0.208***	-0.273***	-0.320***
	(-10.04)	(-6.78)	(-10.89)	(-13.99)	(-8.95)	(-20.86)	(-19.05)	(-20.08)	(-12.64)
STD / A	-0.207	-0.331***	-0.117*	-0.134***	-0.078**	-0.149***	-0.277***	-0.353***	-0.343***
	(-2.30)	(-5.41)	(-3.14)	(-5.25)	(-4.70)	(-8.87)	(-15.12)	(-18.79)	(-12.93)
LTD / A	-0.106***	-0.204***	-0.175***	-0.109***	-0.112***	-0.180***	-0.247***	-0.294***	-0.297***
	(-10.41)	(-7.09)	(-15.62)	(-16.73)	(-16.08)	(-17.18)	(-25.14)	(-37.99)	(-34.98)
Curr. Assets / A	0.002	-0.102***	-0.206***	-0.173***	-0.140***	-0.157***	-0.200***	-0.261***	-0.345***
	(0.10)	(-5.05)	(-11.21)	(-20.63)	(-15.47)	(-19.30)	(-38.28)	(-19.48)	(-46.03)
Curr. Liab./ A	0.169	0.159**	0.288***	0.257***	0.067***	0.094***	-0.008	0.039*	0.092***
	(1.56)	(3.46)	(14.83)	(12.33)	(8.27)	(6.82)	(-0.64)	(2.95)	(7.80)
Div. payer	2.954*	1.678	1.319	0.776	-0.420	-0.731**	-2.422***	-2.669***	-1.421***
	(3.20)	(1.78)	(2.23)	(1.93)	(-1.40)	(-3.36)	(-11.34)	(-11.10)	(-7.69)
Non-NYSE					-0.286	-0.255**	0.968**	3.367***	4.112***
					(-2.20)	(-4.25)	(3.44)	(11.30)	(22.62)
Constant	8.202***	18.264***	20.746***	21.865***	20.180***	23.273***	30.029***	24.182***	27.979***
	(13.87)	(12.65)	(13.58)	(30.05)	(27.27)	(16.35)	(50.20)	(52.52)	(26.01)
Avg. R^2	0.314	0.324	0.330	0.355	0.289	0.284	0.295	0.421	0.492
N	2,439	4,407	6,097	6,535	10,672	21,497	22,522	25,467	23,062

Table 4

Cross-sectional Determinants of Cash Holdings: NYSE vs. Non-NYSE firms

Panel A uses the extended sample, which includes all firms in the Moody's Industrial Manual for each year ending in "8" (e.g., 1938) from 1928 through 2008 and presents coefficient estimates from one cross-sectional regression for each of these years. The sample in Panel B covers the period 1926 - 2014 and includes all firms in the CRSP database (excluding financial firms, utilities and railroads) that are also covered either in Compustat or Moody's Industrial Manuals. Panel B presents average coefficient estimates from ten cross-sectional regressions (Fama and MacBeth, 1973). The dependent variable is the ratio of cash and short-term investments to total assets. $t-$statistics are in parentheses. Statistical significance at the 1%, 5% and 10% levels is indicated by ***, **, and *, respectively.

Panel A: Extended Sample

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	1928	1938	1948	1958	1968	1978	1988	1998	2008
Book Assets	-1.413*	-1.224***	-0.583	-1.252***	-0.969***	-1.193***	-1.133***	-1.695***	-1.592***
	(-2.12)	(-3.87)	(-1.88)	(-5.23)	(-4.79)	(-5.92)	(-3.67)	(-5.33)	(-5.72)
x non-NYSE	1.848**	0.716	-0.761	0.132	-0.227	-0.273	0.089	0.977*	-0.350
	(2.59)	(1.77)	(-1.89)	(0.41)	(-0.83)	(-1.09)	(0.24)	(2.49)	(-0.86)
Earnings / A	0.550***	0.439***	0.252***	0.361***	0.496***	0.275**	0.036	0.017	0.037
	(3.63)	(5.14)	(3.80)	(4.40)	(5.38)	(2.93)	(0.98)	(0.61)	(1.49)
x non-NYSE	-0.030	-0.258**	-0.087	-0.118	-0.185	-0.262**	-0.104**	-0.122***	-0.157***
	(-0.18)	(-2.60)	(-1.16)	(-1.09)	(-1.81)	(-2.69)	(-2.66)	(-4.08)	(-5.46)
STD / A	0.105	-0.438***	-0.188**	-0.204***	-0.005	-0.041	-0.089	-0.134***	-0.077
	(0.64)	(-6.25)	(-2.89)	(-4.96)	(-0.14)	(-0.95)	(-1.93)	(-3.63)	(-1.82)
x non-NYSE	-0.203	0.242**	-0.008	0.020	-0.093*	-0.163***	-0.259***	-0.441***	-0.434***
	(-1.21)	(3.11)	(-0.10)	(0.39)	(-2.16)	(-3.43)	(-5.03)	(-9.44)	(-7.41)
LTD / A	-0.069	-0.126***	-0.197***	-0.132***	-0.118***	-0.186***	-0.149***	-0.223***	-0.221***
	(-1.08)	(-4.19)	(-5.78)	(-4.96)	(-4.62)	(-7.16)	(-5.67)	(-11.00)	(-10.41)
x non-NYSE	0.020	0.046	0.066	-0.061	-0.014	-0.034	-0.199***	-0.263***	-0.156***
	(0.29)	(1.36)	(1.56)	(-1.85)	(-0.45)	(-1.16)	(-6.55)	(-9.34)	(-4.52)
Curr. Assets / A	-0.177***	-0.096***	-0.199***	-0.169***	-0.184***	-0.204***	-0.191***	-0.236***	-0.233***
	(-5.34)	(-3.33)	(-8.26)	(-7.57)	(-9.67)	(-11.15)	(-9.65)	(-9.38)	(-8.04)
x non-NYSE	0.094*	0.044	0.012	0.003	-0.034	-0.001	-0.064**	-0.230***	-0.295***
	(2.56)	(1.38)	(0.42)	(0.12)	(-1.42)	(-0.07)	(-2.68)	(-7.82)	(-8.30)
Curr. Liab./ A	0.362**	0.338*	0.276***	0.303***	0.197***	0.242***	0.124***	0.225***	0.277***
	(3.29)	(2.43)	(5.16)	(6.22)	(5.00)	(6.81)	(3.49)	(6.30)	(6.96)
x non-NYSE	-0.230	-0.260	-0.044	-0.166**	-0.066	-0.152***	-0.202***	-0.186***	-0.165**
	(-1.86)	(-1.80)	(-0.66)	(-2.79)	(-1.41)	(-3.74)	(-4.72)	(-4.34)	(-3.17)
Div. payer	0.218	1.558	0.226	1.467	-2.014*	-1.491	-2.144*	-2.570***	-2.777***
	(0.18)	(1.69)	(0.17)	(1.43)	(-2.14)	(-1.80)	(-2.56)	(-4.43)	(-4.12)
x non-NYSE	0.214	2.946**	2.719	0.129	1.257	1.791	-0.648	-2.489**	-0.211
	(0.16)	(2.63)	(1.85)	(0.11)	(1.20)	(1.95)	(-0.62)	(-2.66)	(-0.18)
Rated	-0.907	-1.499	-2.304*	-1.298*	-0.266	0.548	0.011	-0.263	-1.024
	(-0.59)	(-1.72)	(-2.45)	(-2.37)	(-0.68)	(1.26)	(0.01)	(-0.43)	(-1.56)
x non-NYSE	-2.241	0.178	1.203	2.665*	1.510*	1.734*	3.445**	0.795	-3.087*
	(-1.30)	(0.17)	(0.91)	(2.50)	(2.24)	(2.03)	(2.82)	(0.64)	(-2.08)
non-NYSE	-8.305*	-7.228***	-3.428	0.969	3.767	5.385	13.846***	20.027***	24.140***
	(-2.20)	(-3.80)	(-1.49)	(0.42)	(1.40)	(1.81)	(5.09)	(6.56)	(6.81)
Constant	15.796***	17.787***	22.549***	21.006***	19.834***	22.738***	26.412***	30.800***	32.022***
	(4.30)	(10.23)	(11.04)	(10.40)	(8.40)	(8.34)	(10.70)	(11.21)	(10.95)
Adj. R^2	0.264	0.224	0.247	0.273	0.294	0.301	0.334	0.479	0.459
N	1,571	2,211	2,622	2,535	3,150	4,573	4,867	5,776	3,733

Panel B: CRSP Sample

	(1) 1926 - 1933	(2) 1934 - 1943	(3) 1944 - 1953	(4) 1954 - 1963	(5) 1964 - 1973	(6) 1974 - 1983	(7) 1984 - 1993	(8) 1994 - 2003	(9) 2004 - 2013
Ind. CF vol.	41.840*	16.678*	14.391	20.660	46.089***	28.025***	17.459***	24.008***	32.559***
	(3.36)	(2.32)	(1.22)	(2.08)	(6.79)	(11.37)	(7.82)	(10.04)	(19.26)
x non-NYSE					-53.284**	-5.646	-12.146	36.106***	41.141***
					(-3.45)	(-0.68)	(-1.85)	(6.68)	(11.80)
MA/BA	1.466	3.296***	2.309***	0.743*	1.378***	1.811***	1.653***	1.485***	1.836***
	(2.07)	(7.41)	(6.59)	(2.65)	(7.50)	(5.10)	(6.42)	(6.01)	(7.47)
x non-NYSE					-0.855*	-0.568	0.118	0.649*	0.582*
					(-3.12)	(-1.32)	(0.34)	(2.39)	(2.32)
Real Assets	-0.573**	-1.030***	-0.621**	-1.242***	-1.070***	-1.091***	-1.578***	-1.466***	-1.220***
	(-4.73)	(-10.21)	(-3.87)	(-28.12)	(-16.61)	(-9.61)	(-23.46)	(-21.65)	(-16.00)
x non-NYSE					-0.373*	-0.233*	0.707***	1.280***	0.006
					(-2.42)	(-2.62)	(4.88)	(10.88)	(0.04)
Earnings/A	0.372***	0.305***	0.460***	0.454***	0.314***	0.262***	0.133***	0.028	0.086*
	(9.24)	(10.06)	(7.84)	(12.89)	(8.09)	(15.63)	(4.80)	(1.09)	(2.50)
x non-NYSE					-0.042	-0.057	-0.008	-0.038	-0.178***
					(-0.64)	(-1.88)	(-0.31)	(-1.35)	(-4.95)
Invest/A	-0.147***	-0.226***	-0.343***	-0.269***	-0.209***	-0.225***	-0.198***	-0.202***	-0.230***
	(-10.04)	(-6.78)	(-10.89)	(-13.99)	(-8.51)	(-17.36)	(-10.06)	(-14.14)	(-15.24)
x non-NYSE					0.022	-0.012	-0.011	-0.092***	-0.134*
					(0.53)	(-1.09)	(-0.66)	(-5.37)	(-3.10)
STD / A	-0.207	-0.331***	-0.117*	-0.134***	-0.025	-0.069*	-0.103***	-0.160***	-0.163***
	(-2.30)	(-5.41)	(-3.14)	(-5.25)	(-1.75)	(-2.89)	(-8.25)	(-6.22)	(-7.64)
x non-NYSE					-0.125**	-0.106***	-0.204***	-0.204***	-0.224***
					(-4.64)	(-7.33)	(-16.62)	(-11.75)	(-8.63)
LTD / A	-0.106***	-0.204***	-0.175***	-0.109***	-0.091***	-0.125***	-0.155***	-0.178***	-0.201***
	(-10.41)	(-7.09)	(-15.62)	(-16.73)	(-21.20)	(-10.60)	(-18.45)	(-20.74)	(-23.68)
x non-NYSE					-0.045*	-0.082***	-0.133***	-0.165***	-0.120***
					(-2.50)	(-10.40)	(-14.74)	(-17.31)	(-5.69)
Curr. Assets / A	0.002	-0.102***	-0.206***	-0.173***	-0.159***	-0.149***	-0.179***	-0.151***	-0.118***
	(0.10)	(-5.05)	(-11.21)	(-20.63)	(-16.75)	(-16.68)	(-28.04)	(-20.59)	(-9.24)
x non-NYSE					0.050**	-0.015**	-0.031***	-0.144***	-0.289***
					(4.30)	(-3.51)	(-4.80)	(-6.01)	(-29.66)
Curr. Liab./ A	0.169	0.159**	0.288***	0.257***	0.129***	0.176***	0.114***	0.108***	0.136***
	(1.56)	(3.46)	(14.83)	(12.33)	(9.74)	(16.55)	(5.76)	(10.25)	(11.69)
x non-NYSE					-0.157***	-0.122***	-0.157***	-0.092**	-0.084***
					(-5.62)	(-7.91)	(-10.26)	(-4.59)	(-5.54)
Div. payer	2.954*	1.678	1.319	0.776	-0.946**	-0.740*	-2.670***	-2.542***	-1.578***
	(3.20)	(1.78)	(2.23)	(1.93)	(-4.77)	(-2.99)	(-10.14)	(-11.08)	(-7.86)
x non-NYSE					0.873	0.005	0.492	-0.022	0.220
					(1.26)	(0.02)	(1.13)	(-0.06)	(0.69)
Non-NYSE					5.434**	7.807***	5.469**	2.769**	13.344***
					(4.58)	(9.32)	(4.68)	(4.77)	(16.86)
Constant	8.202***	18.264***	20.746***	21.865***	18.793***	18.326***	26.452***	23.761***	20.778***
	(13.87)	(12.65)	(13.58)	(30.05)	(21.19)	(13.06)	(33.17)	(46.81)	(16.64)
Adj. R^2									
N	2,439	4,407	6,097	6,535	10,672	21,497	22,522	25,467	23,062

Table 5

Determinants of Aggregate Cash

The sample covers the period 1926 - 2014 and includes all firms in the CRSP database that are also covered either in Compustat or Moody's Industrial Manuals. Financial firms, utilities and railroads are excluded. The dependent variable is the aggregate ratio of cash and short-term investments to total assets. The model is estimated in levels in columns (1) - (4) and in first differences in columns (5) - (8). Newey and West(1987) standard errors, assuming two non-zero lags are used to compute all $t-$statistics (in parentheses). Statistical significance at the 1%, 5% and 10% levels is indicated by ***, **, and *, respectively.

	Levels				1st Diffs			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Time	-0.120*	-0.105**	-0.048	-0.059				
	(-1.70)	(-2.08)	(-0.87)	(-1.36)				
Firm Characteristics								
CF vol.	1.377*	1.724***	1.197**	0.598	-0.186	-0.016	-0.030	-0.000
	(1.83)	(3.28)	(2.01)	(0.75)	(-1.07)	(-0.10)	(-0.19)	(-0.00)
MA/BA	0.114	-1.646***	-1.454***	-0.897	-0.291**	-0.542***	-0.516***	-0.327**
	(0.28)	(-3.55)	(-2.79)	(-1.64)	(-2.43)	(-3.36)	(-3.24)	(-2.06)
Real Assets	1.449***	-0.108	0.470	0.384	-0.119	-0.046	-0.010	0.009
	(2.87)	(-0.30)	(1.33)	(1.25)	(-1.30)	(-0.49)	(-0.10)	(0.11)
E[CF]	-0.204	0.726**	0.117	0.080	0.011	-0.146	-0.062	0.164
	(-0.46)	(2.22)	(0.30)	(0.20)	(0.05)	(-0.78)	(-0.33)	(0.80)
E[Invest]	-0.024	-0.352	0.290	0.651**	-0.138	0.260	0.277	0.116
	(-0.06)	(-1.37)	(0.98)	(2.21)	(-0.78)	(1.33)	(1.47)	(0.69)
STD/A	-1.098*	-2.074***	-2.130***	-1.537***	-0.037	-0.005	0.014	0.002
	(-1.69)	(-4.69)	(-5.06)	(-3.34)	(-0.27)	(-0.04)	(0.12)	(0.02)
LTD/A	-1.943	1.912**	0.589	-0.013	0.107	-0.033	0.013	-0.053
	(-1.60)	(2.12)	(0.62)	(-0.02)	(0.86)	(-0.18)	(0.08)	(-0.40)
Curr. Assets/A	0.150	-0.966*	0.330	-0.319	-0.570**	-0.236	-0.437**	-0.382*
	(0.16)	(-1.85)	(0.50)	(-0.33)	(-2.03)	(-1.32)	(-2.06)	(-1.72)
Curr. Liab/A	3.699***	0.869	1.370*	2.092***	0.494	-0.157	-0.017	-0.005
	(3.85)	(1.16)	(1.69)	(3.08)	(1.34)	(-0.86)	(-0.09)	(-0.03)
Earn/A				1.323***				0.610***
				(3.48)				(3.30)
Invest				-1.229***				-0.802***
				(-3.32)				(-4.68)
Macroeconomic Factors								
Cost of carry		-0.735***	-1.220***	-1.027***		-0.201	-0.084	-0.072
		(-2.80)	(-4.59)	(-3.32)		(-1.27)	(-0.55)	(-0.59)
AAA-Treasury spread		0.031	-0.268	-0.183		-0.182	-0.159	-0.145
		(0.13)	(-1.03)	(-0.75)		(-1.25)	(-1.20)	(-1.25)
sd(Mkt Ret.)		-0.037	0.269	0.269		-0.001	-0.150	-0.083
		(-0.17)	(1.23)	(1.23)		(-0.01)	(-0.90)	(-0.63)
Econ policy uncert.		0.119	-0.031	0.186		0.112	0.162	0.162
		(0.48)	(-0.11)	(0.62)		(0.75)	(1.16)	(1.31)
Real GDP growth		0.363	0.534*	0.108		0.914***	0.769***	0.479**
		(1.39)	(1.78)	(0.32)		(3.57)	(2.85)	(2.04)
Productivity		2.437***	2.171***	1.745***		1.000***	0.901***	0.775***
		(5.99)	(4.99)	(4.21)		(5.48)	(4.50)	(4.61)
Corp. tax rate		13.056***				0.138		
		(3.68)				(1.37)		
Adj. R^2	0.81	0.94	0.92	0.93	0.09	0.44	0.36	0.53
N	89	86	89	89	88	85	88	88

Table 6

Pre-War Cash Run-up: Cross-sectional evidence

The sample period is 1936 through 1945. Regressions use the CRSP sample, which includes all firms in the CRSP database that are also covered either in Compustat or Moody's Industrial Manuals. Financial firms, utilities and railroads are excluded. The dependent variable is the ratio of cash and short-term investments to total assets. All models include firm fixed effects. Other controls in columns (4) through (8) include all independent variables used in Table 3. Standard errors are clustered by firm. $t-$statistics are in parentheses. Statistical significance at the 1%, 5% and 10% levels is indicated by ***, **, and *, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Financial Constraint Measures								Sales Growth	
	Unrated/ speculative	Small Firms	Non-Payers	UPT Margin	Unrated/ speculative	Small Firms	Non-Payers	UPT Margin		
Time	1.161***	1.450***	1.420***	1.102***	0.856***	1.163***	1.136***	0.901***	1.500***	1.309***
	(6.54)	(11.10)	(14.41)	(6.39)	(5.73)	(9.69)	(12.73)	(5.66)	(8.86)	(8.18)
Time x Constr.	0.856***	0.507*	0.861**		0.671***	0.399*	0.558*			
	(3.85)	(2.23)	(3.24)		(4.19)	(2.14)	(2.43)			
Time x Type B				0.357				0.263		
				(1.51)				(1.40)		
Time x Type C				0.809***				0.487**		
				(3.63)				(2.72)		
Time x High									-0.286	-0.418
									(-1.08)	(-1.72)
Constant	4.982***	10.083***	10.759***	10.759***	35.436***	39.201***	25.870***	26.355***	10.846***	18.851
	(8.27)	(16.14)	(21.37)	(21.50)	(3.44)	(4.59)	(3.88)	(3.95)	(14.75)	(1.83)
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other controls					Yes	Yes	Yes	Yes		Yes
Adj. R^2	0.387	0.312	0.275	0.279	0.505	0.456	0.414	0.415	0.249	0.353
N	1,580	2,200	3,300	3,300	1,555	2,169	3,254	3,254	1,165	1,163

Table 7

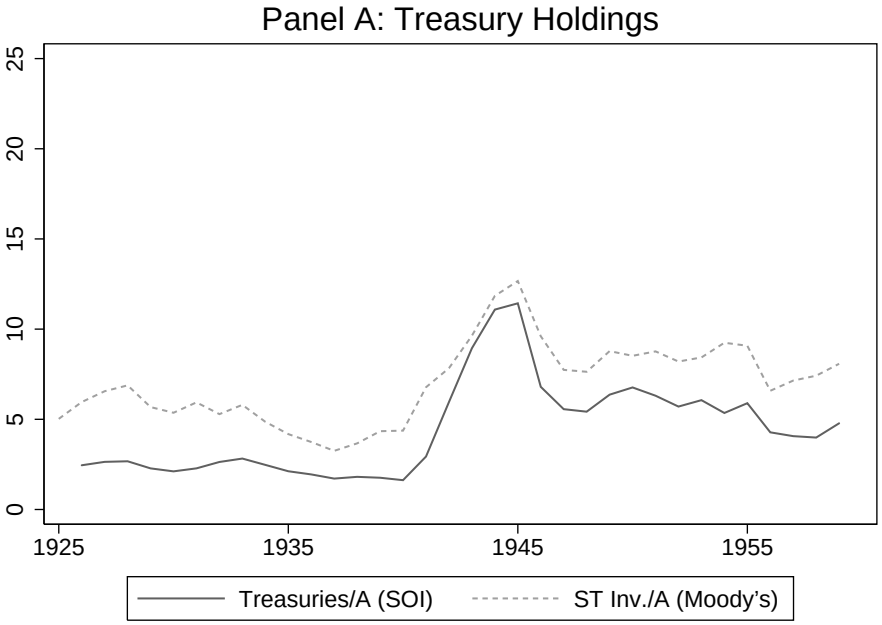
Aggregate Cash and Repatriation Tax Cost

The sample period is 1981 through 2014. Columns (1) and (2) present panel regressions, where the dependent variable is the cash-to-assets ratio. Columns (3)-(6) present aggregate time-series regressions. In columns (3) and (4), the dependent variable is the difference between the ratios of aggregate cash to assets measured using data from US Flow of Funds versus using Compustat and is interpreted as a proxy for "trapped" foreign cash. In columns (5) and (6), the dependent variable is the aggregate ratio of cash and short-term investments to assets from Compustat, which includes domestic plus foreign held cash. *Repat tax cost* is calculated, as in Foley et al. (2007), by first subtracting foreign taxes paid from the product of a firm's foreign pretax income and the U.S. corporate tax rate. Then the maximum of this difference and zero is aggregated across all firms each year and scaled by aggregate book assets. *Earnings* is income before extraordinary items. *NWC* is current assets, net of cash and short-term investments, minus current liabilities. Newey-West (1987) standard errors assuming two non-zero lags are used to compute all t-statistics (in parentheses).

	(1)	(2)	(3)	(4)	(5)	(6)
	Panel Regs.		Aggregate Regressions			
			Comp - FOF cash	Comp - FOF cash	Compustat	Compustat
Repat tax cost (MA)	0.67***	0.50***	1.81***	2.29***	1.68***	2.47***
	(5.64)	(4.22)	(4.35)	(3.42)	(3.16)	(3.29)
Time			-0.03	-0.35***	0.03	-0.41***
			(-0.70)	(-3.09)	(0.44)	(-3.35)
CF vol.	0.14	0.24		-0.10		-0.13
	(0.75)	(1.29)		(-0.26)		(-0.24)
MA/BA	1.70***	1.94***		0.08		0.32
	(5.18)	(5.70)		(0.27)		(0.90)
NWC/A	-6.32***	-6.28***		-0.02		-0.05
	(-20.12)	(-19.16)		(-0.06)		(-0.11)
Real size	-3.47***	-4.05***		1.72***		2.01***
	(-7.97)	(-8.74)		(3.82)		(3.36)
D/A	-2.07***	-1.94***		-0.29**		-0.59***
	(-9.21)	(-8.55)		(-2.14)		(-3.55)
Earn/A	1.43***	1.47***		0.17		0.09
	(5.80)	(5.88)		(1.01)		(0.43)
Capex/A	-1.90***	-1.81***		-1.03***		-1.43***
	(-14.56)	(-13.36)		(-3.14)		(-2.92)
Cost of carry		-0.19		-0.03		-0.17
		(-1.60)		(-0.07)		(-0.37)
AAA-Treas. spread		-0.49***		-0.12		-0.20
		(-3.59)		(-0.58)		(-0.93)
sd(Mkt return)		-5.61		0.30**		0.26**
		(-0.35)		(2.77)		(2.43)
Econ policy uncert.		0.00		0.34**		0.28*
		(1.05)		(2.73)		(1.85)
Real GDP growth		0.00		0.04		0.03
		(0.08)		(0.31)		(0.22)
Productivity		-29.02***		0.70**		0.72*
		(-10.40)		(2.58)		(2.02)
Fixed Effects	Yes	Yes				
Adj. R^2	0.172	0.188	0.852	0.930	0.833	0.947
N	31,163	31,163	34	34	34	34

Figure A.1. Cash and Treasury Holdings around WWII

Panel A plots the aggregate ratio of corporate holdings of government securities to book assets from U.S. *Statistics of Income* (solid line) and the aggregate ratio of Short-term investments to assets using data collected from Moody's Industrial manuals (dashed line). The latter is from the CRSP sample, which includes all firms in the CRSP database that are also covered either in Compustat or Moody's Industrial Manuals. Financial firms, utilities and railroads are excluded. Panel B plots the aggregate ratio of cash and short term investments to assets (dashed line) and cash excluding short-term investments to assets (solid line), using data collected from Moody's Industrial manuals.



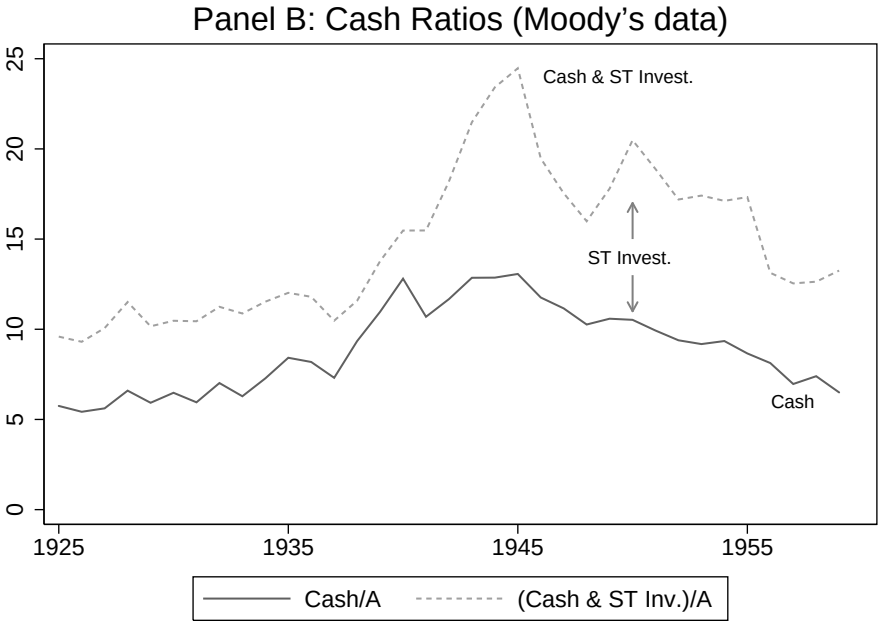


Figure A.2. Distribution of Firm Size: Extended Sample vs. CRSP Sample

The CRSP sample includes all firms in the CRSP database that are also covered either in Compustat or Moody's Industrial Manuals. Financial firms, utilities and railroads are excluded. The Extended sample includes all firms covered in the Moody's Industrial Manual each year (for years ending in "8"). Firm size is measured by book assets, expressed in constant (1994) dollars. For ease of presentation, we winsorize the upper 5% of the size distribution each year.

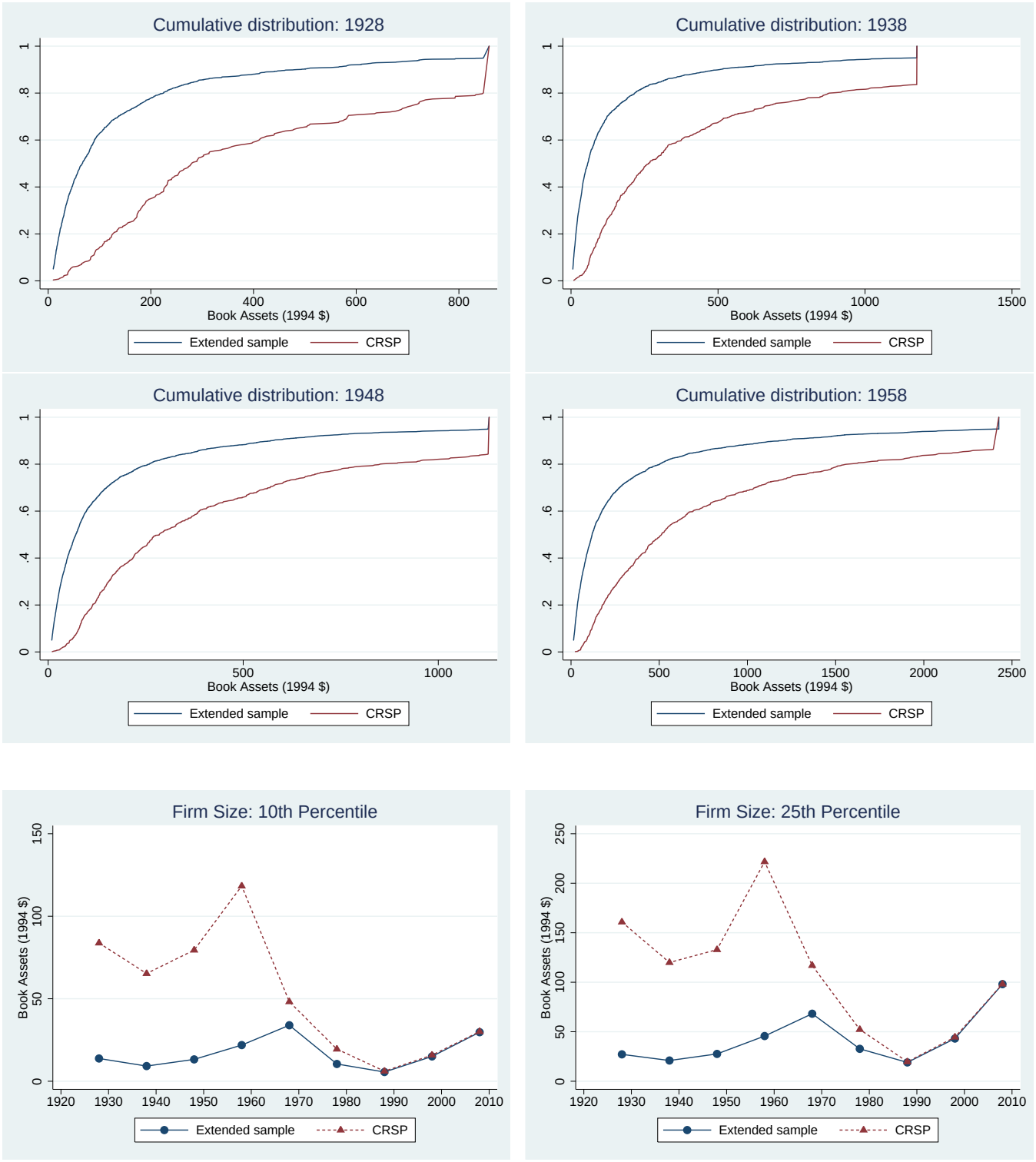
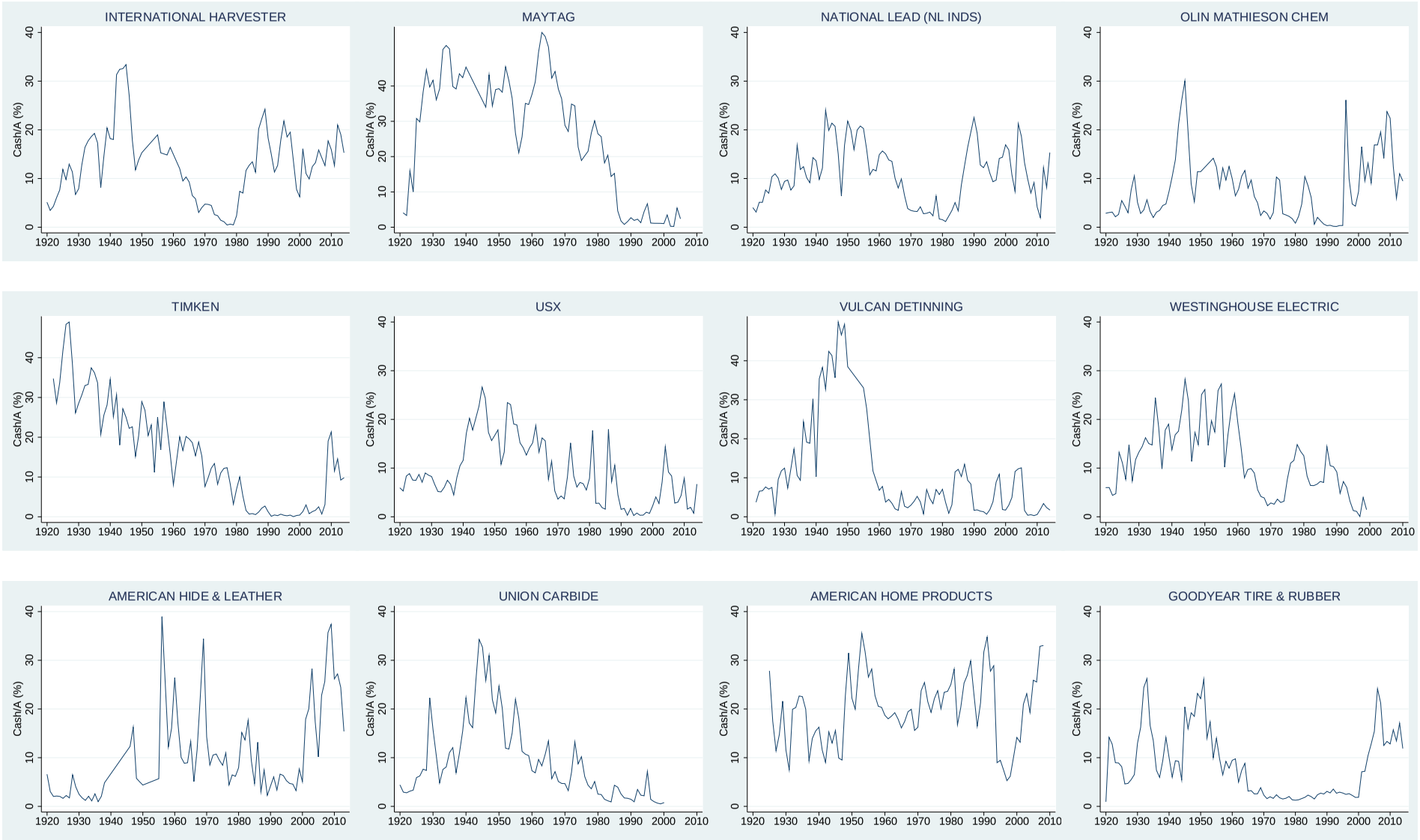
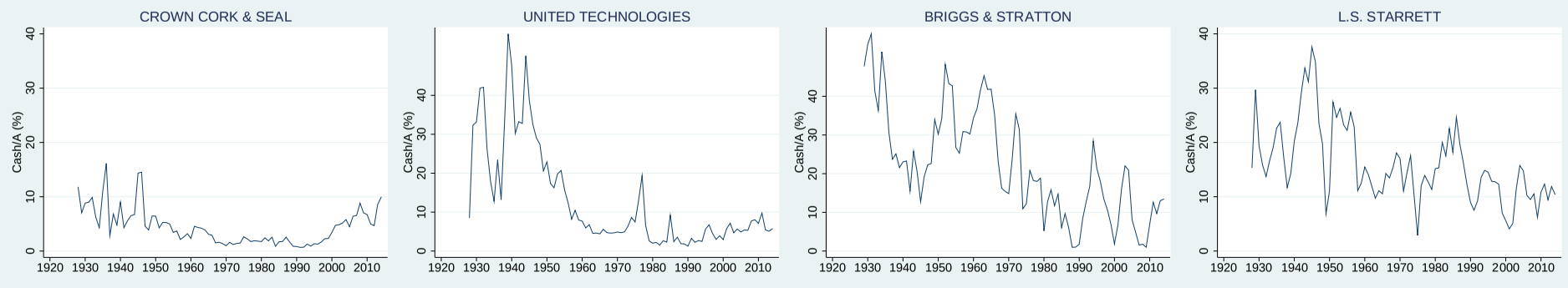


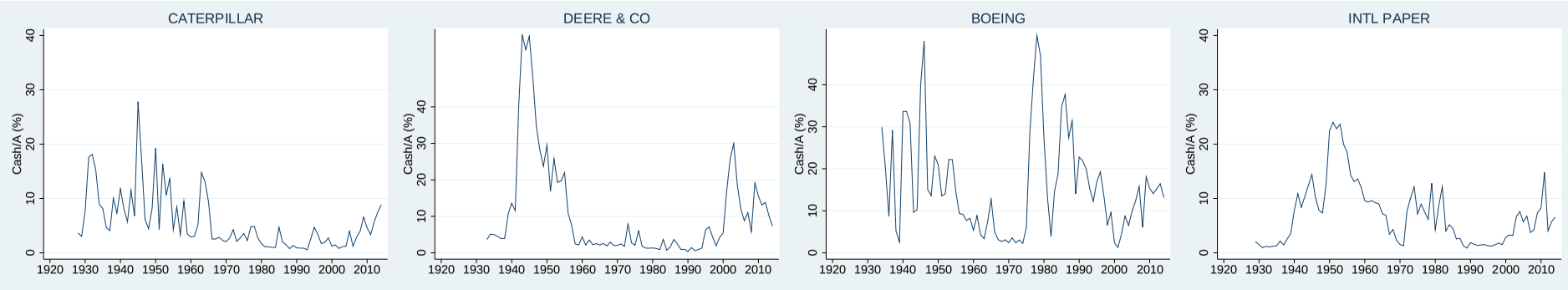
Figure A.3. Cash Holdings by Firm

Data are from Moody's Industrial Manuals and Compustat. The plots display the ratio of cash and marketable securities to total book assets for each firm-year.

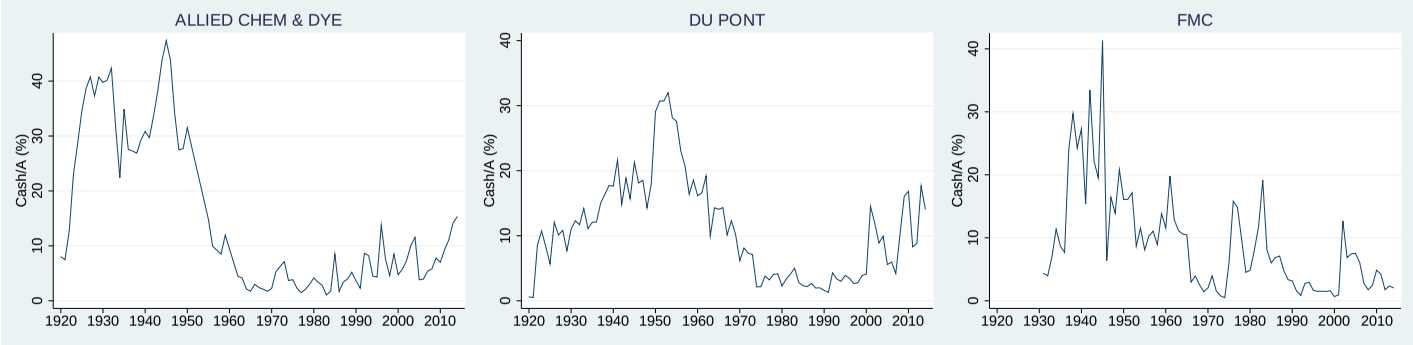
Panel A: Manufacturing


INTERNATIONAL HARVESTER
MAYTAG
NATIONAL LEAD (NL INDS)
OLIN MATHIESON CHEM
TIMKEN
USX
VULCAN DETINNING
WESTINGHOUSE ELECTRIC
AMERICAN HIDE & LEATHER
UNION CARBIDE
AMERICAN HOME PRODUCTS
GOODYEAR TIRE & RUBBER
Cash/A (%)
0
10
20
30
40
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010

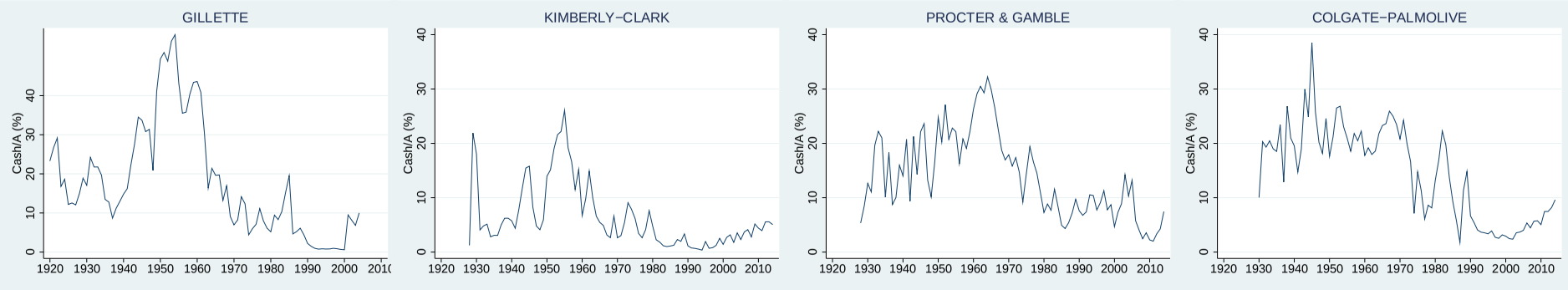




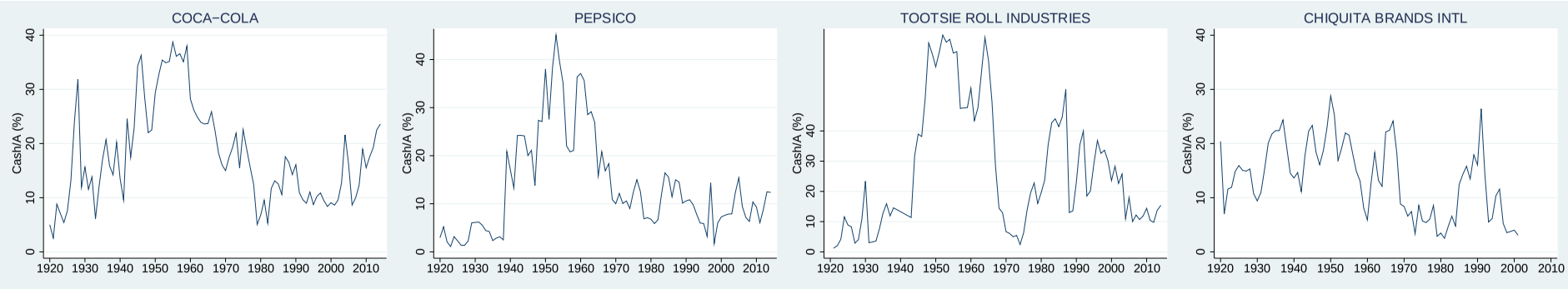
Panel B: Chemicals

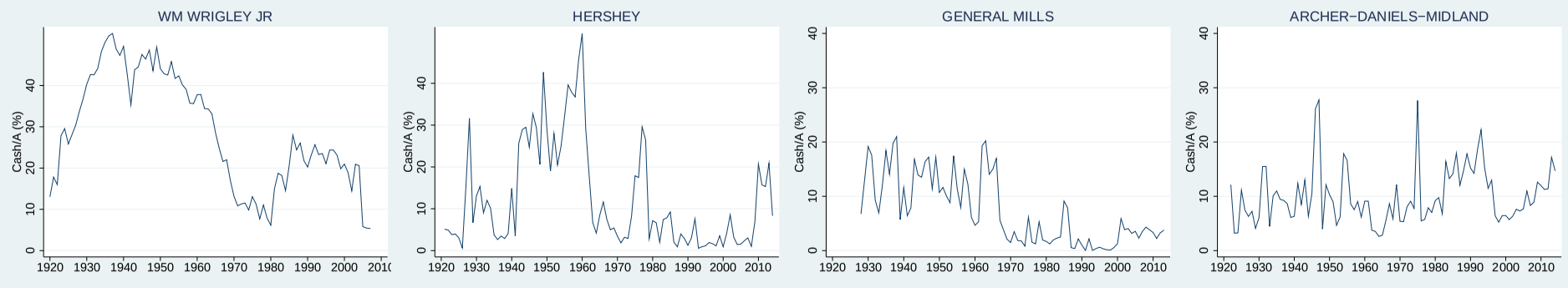


Panel C: Consumer products

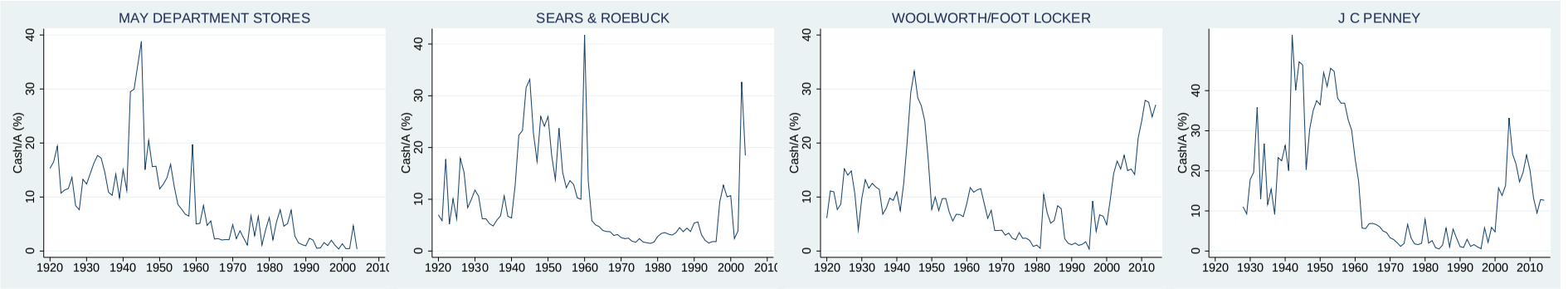


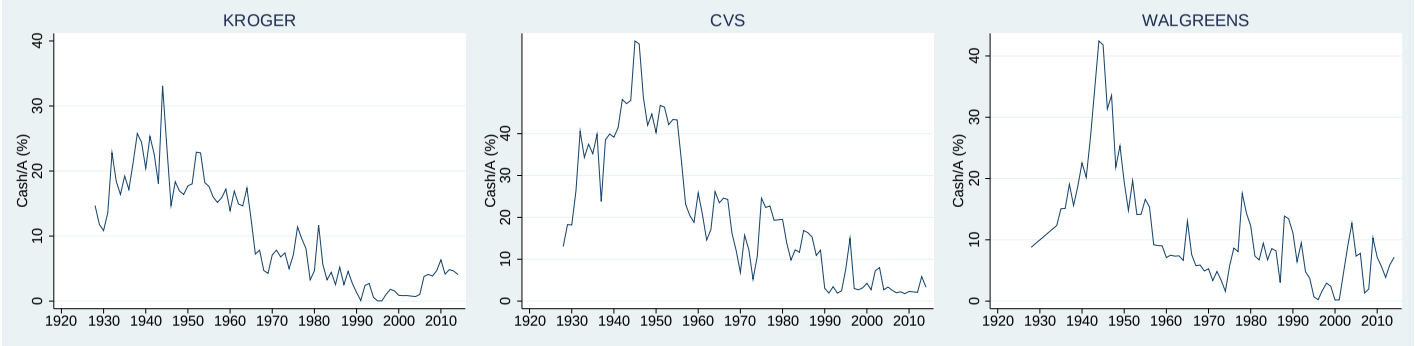
Panel D: Food Products



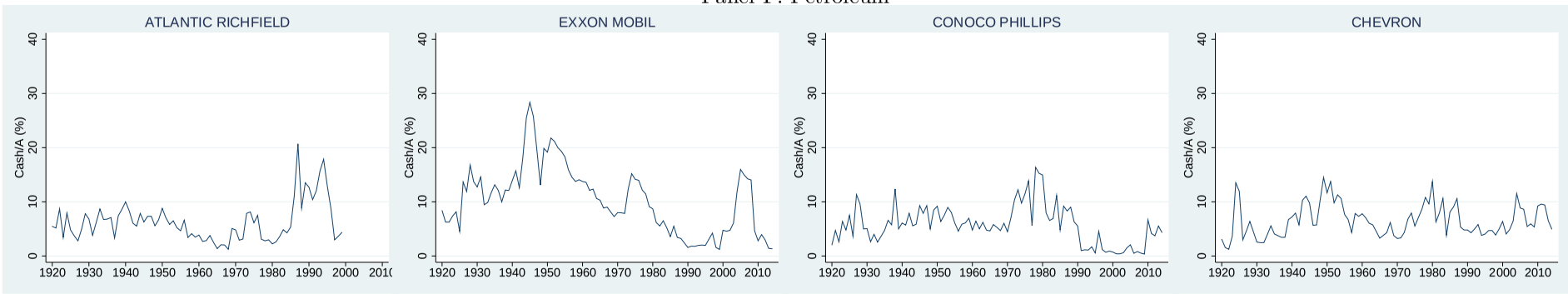


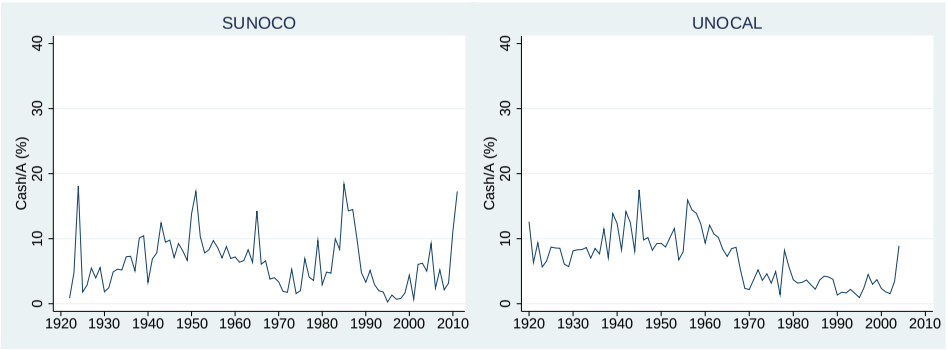
Panel E: Retail



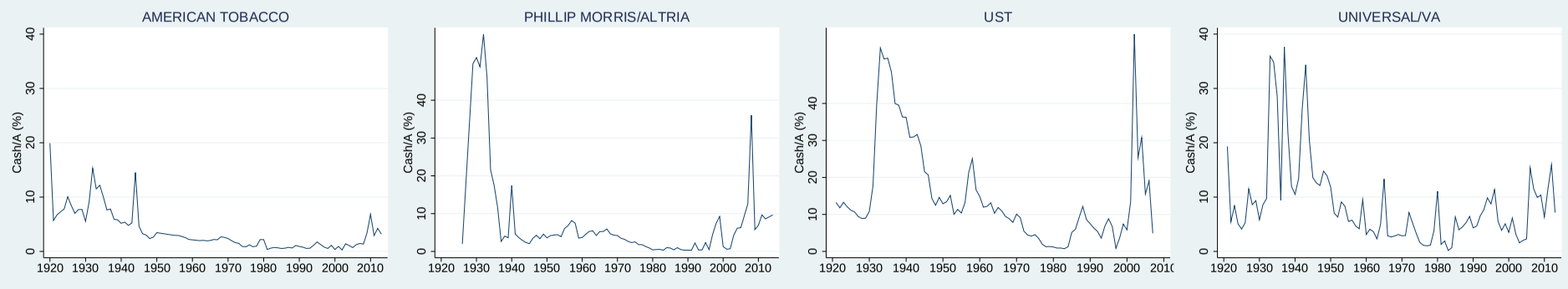


Panel F: Petroleum





Panel G: Tobacco



Panel H: Other Industries