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# Financial Distress in Chinese Industry: Microeconomic, Macroeconomic and Institutional Influences\*

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## Abstract

We study the impact of both microeconomic factors and the macroeconomy on the financial distress of Chinese listed companies over a period of massive economic transition, 1995 to 2006. Based on an economic model of financial distress under the institutional setting of state protection against exit, and using our own firm-level measure of distress, we find important impacts of firm characteristics, macroeconomic instability and institutional factors on the hazard rate of financial distress. The results are robust to unobserved heterogeneity at the firm level, as well as those shared by firms in similar macroeconomic founding conditions. Comparison with related studies for other economies highlights important policy implications.

*Key words:* Financial Distress, Macroeconomic Instability, Cox Proportional Hazards Model, Unobserved Heterogeneity, Emerging Economies.

*JEL classification:* E32, D21, C41, L16

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# 1 Introduction

In this paper, we investigate the impact of microeconomic factors and macroeconomic conditions, as well as institutional influences, on financial distress of Chinese listed firms. Using hazard regression analysis, we find substantial effect of firm level covariates (age, size, cash flow and gearing) on financial distress, but also a significant role for macroeconomic stability. Further, there are important institutional effects where, holding other factors constant, the hazard rate of financial distress varies with the stock exchange where the firm is listed. However, the effect of state ownership is not statistically significant. The results are robust to unobserved heterogeneity at the firm level, as well as those shared by firms in similar macroeconomic founding conditions. Comparison of our results with related studies for western economies highlight several important policy implications.

Following Chan and Chen (1991), financially distressed firms “have lost market value because of poor performance, they are inefficient producers, and they are likely to have high financial leverage and cash flow problems. They are marginal in the sense that their prices tend to be more sensitive to changes in the economy, and they are less likely to survive adverse economic conditions.” Therefore, investors demand a premium for holding such risky stocks and expect to be rewarded for bearing the risk.

Typically, financial distress of the above nature is measured by the probability of failure (Altman, 1993; Shumway, 2001). However, despite being financially distressed many firms do not exit. In the US, distressed firms often file for bankruptcy under Chapter 7 or Chapter 11, or de-list for performance related reasons, without necessarily going out of business (Campbell *et al.*, 2008). One of the reasons is the protectionist stance of bankruptcy codes (Bhattacharjee *et al.*, 2009a). Likewise, business exits in our data on Chinese quoted firms are vanishingly rare, arguably because of active state protection for the failing firm.

The divergence between exits and financial distress is closely related to the distinction between fixed and sunk costs. While both sunk costs and fixed costs are independent of firm output, they have different implications for firm exits (Owen and Ulph, 2002). Fixed costs relate to assets that are valuable to other firms, and therefore can be traded in the secondary market. By contrast, sunk costs involve assets that are valuable solely to the firm that creates them and unlike fixed costs, entail exit costs. Thus, an

incumbent firm exits only if its operating profit covers the fixed costs, but not necessarily its sunk costs plus fixed costs; in the latter case, it will be financially distressed.

Measurement of financial distress must recognise the above distinction with failure. In this paper, we construct our own indicator for financial distress at the firm level. This indicator measures the degree to which operating profits cover the financial costs of the firm, the total of debt obligations relating to firm-specific assets (sunk costs) and other capital assets (fixed costs), controlling for the possibility that some firms may undergo rapid expansion by accumulating debt. Against the institutional setting of active state protection, we develop a simple economic model of financial distress, where firms receive protection in the form of a guaranteed threshold return on their capital. Finally, we use our measure to study macroeconomic, microeconomic and institutional influences on firm turnover.

This paper makes several important contributions. First, we develop a model of state protection in an economy with high sunk costs and limited secondary market for acquired capital. Testable implications are verified using duration data on financial distress. Second, given the importance of the Chinese economy, understanding failure in Chinese industry is important for investors. Third, while the macroeconomy is a potentially important determinant of financial distress, the effect of macroeconomic conditions and instability on financial distress and exit has not been adequately studied in an emerging market context. Thus, our research is useful for credit risk measurement and management for China, and for emerging economies more generally. Fourth, our research quantifies the effect of institutional factors, which are expected to be important against the backdrop of massive economic transition experienced in China. Last but not the least, the current study provides a basis for comparison with related research for advanced economies. In particular, our comparative analysis provides valuable insights into regulatory reform and development of institutions in a transition economy context.

The paper is organised as follows. Section 2 reviews the literature and discusses the institutional background, while the data and variable construction are described in Section 3. Section 4 discusses our economic model of financial distress and the empirical framework for our analysis. We discuss the estimated hazard regression models in Section 5, focussing on comparison with related studies for advanced economies and implications for policy. Finally, Section 6 concludes.

## 2 Literature and Institutional Backdrop

### 2.1 Firm-level factors and industry

There is a large theoretical and empirical microeconomic literature pointing to the importance of firm- and industry-specific factors on financial distress, defaults and exits; see Siegfried and Evans (1994) and Caves (1998) for reviews. Indeed, current theories of industrial organisation (Ericson and Pakes, 1995; Jovanovic, 1982; Hopenhayn, 1992) predict that exit rates may decline with firm age and size. Consistent with the above theoretical models of firm-level learning, the credit scoring literature has highlighted financial ratios including leverage, cash flow, and profitability, in addition to firm age, size and industry, as determinants of failure, with binary response models providing the basis for probability scores of company failure (Taffler, 1982; Cuthbertson and Hudson, 1996; Lennox, 1999). Similarly, current theories and empirics of industrial organization highlights the importance of industry conditions; see, for example, Dunne *et al.* (1988), Audretsch (1995), Baldwin (1995) and Caves (1998).

### 2.2 Macroeconomic conditions and instability

At the same time as microeconomic factors are important, firm defaults increase dramatically during economic downturns (Fama, 1986; Carty and Fons, 1993; Koopman and Lucas, 2005). More generally, macroeconomic conditions have good explanatory power for corporate defaults and are useful in modeling credit risk; see, for example, Nickell *et al.* (2000), Bangia *et al.* (2002), Allen and Saunders (2003) and Carling *et al.* (2004). Default can be triggered either because the idiosyncratic shock has reached the default threshold in a given regime or because of a change in the value of the aggregate shock. The second type provides a rationale for clustering of exit decisions observed in many markets (Hackbarth *et al.*, 2006).

The economic cycle (and in particular, macroeconomic indicators such as interest rate, unemployment rate and retail sales) has been found to affect profitability, gearing, cash flow and thereby influence company failures (Everett and Watson, 1998; Hackbarth *et al.*, 2006). Firm exits through compulsory liquidation increase during periods of severe downturn in the aggregate economy (Caballero and Hammour, 1994), particularly if the downturn

is driven by demand shocks. Variations in the macroeconomic environment significantly affect the financial performance of firms as well (Machin and van Reenen, 1993; Higson *et al.*, 2002, 2004).

Young (1995) examines the effect of changes in interest rates on insolvencies, and finds that companies are vulnerable to unanticipated changes in real interest rates; see also Wadhvani (1986). Similarly, Goudie and Meeks (1991) simulate the financial statements of UK firms, contingent on macroeconomic conditions, and observe significant asymmetric and non-linear impact of the exchange rate upon failure rates. Koopman and Lucas (2005) provide further empirical evidence of a link between business cycles and default at the firm level, while Ferri *et al.* (2001) report cyclical behaviour of ratings agencies.

In addition to aggregate macroeconomic conditions, instability also plays an important role. Lenders are often less willing to lend when there is higher instability (Greenwald and Stiglitz, 1990), increasing credit constraints on firms and leading some firms to financial distress. Further, in the presence of credit constraints, the effect of uncertainty on business performance may be asymmetric (Bernanke and Gertler, 1989; Kiyotaki and Moore, 1997). Bhattacharjee *et al.* (2009a,b) examine firm exits through bankruptcies and acquisitions, for listed firms in the UK and the US, and find that both modes of exit depend on the macroeconomic environment, particularly, macroeconomic instability. At the same time, legal institutions can reduce the devastating effects of a large negative shock (Bhattacharjee *et al.*, 2009a).

### 2.3 Unobserved factors

The empirical literature on firm dynamics has generally acknowledged the importance of unobserved heterogeneity in understanding firm exits. In the US shipbuilding industry, Thompson (2005) finds an important role for unobserved variation in initial experience. Bhattacharjee *et al.* (2006) study the role of unobserved human capital in entrepreneurial choice and its impact on the survival of newly created firms. Other important factors discussed in the literature include intangibles and R&D investments, often unobserved in emerging economies.

It is therefore important to recognise the role of unobserved heterogeneity on the financial fragility of firms. Such heterogeneity in the founding conditions of firms may be related both to entrepreneurial human capital and to macroeconomic conditions at the time of incorporation.

## 2.4 Institutional backdrop

Over the past 30 years, the Chinese economy has been going through complex transformation from a centrally planned towards a market economy. The liberalisation of the macroeconomy has played an important part in this transformation. This is in addition to industrial reforms, particularly for state-owned enterprises (SOEs), as well as changes in the legal framework. These developments are important for understanding financial distress and survival of firms in Chinese industry. While the pace of reforms has been gentle, it has been argued that the gradualist approach of retaining policies and institutional arrangements that are supposed to be highly inimical to economic activity<sup>1</sup> have worked to the benefit of Chinese industry (Rodrik, 2006); see also Blanchard and Kremer (1997), Roland and Verdier (1999) and Qian (2003).

In 1996, current account convertibility in the Yuan Renminbi (RMB) was initiated, but the capital account is still under restricted control. The foreign exchange market has therefore remained relatively underdeveloped, especially the derivatives market. This has potentially undermined the ability of Chinese companies to guard against exchange rate shocks. Further, the undervalued and relatively fixed exchange rate regime has encouraged import substitution. The Chinese economy has, therefore, become more dependent on exports and the industry more vulnerable to fluctuations in the external sector (Aziz and Li, 2007). At the same time, export performance of Chinese industry has been consistently robust, pointing to a remarkable capability to mitigate against adverse shocks in the external sector.

Similarly, while real interest rates have been relatively volatile, the likely impact of resulting instability on Chinese companies is by no means clear. For one, Chinese industry appears to have had substantial state protection against interest rate shocks, particularly the SOEs (Goodhart and Xu, 1996).<sup>2</sup> Also, it has been argued that nonperforming loans, borrowing constraints, and uncertainty in regulations relating to bank lending have promoted large transfers from households to firms, keeping cost of capital low

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<sup>1</sup>For example, absence of private property rights, state trading, substantial public ownership and high barriers to trade.

<sup>2</sup>Sometimes, state protection is rather explicit. Over the period 1998-2001, Chinese SOEs were shielded against increasing interest rates by debt-equity swaps and discounts in lending rates.

and encouraging investment (Aziz, 2008). On the other hand, a very high debt rate and predominance of borrowing under floating interest rates may render Chinese industry particularly susceptible to volatility in interest rates. Further, entry of foreign banks and increased competition in the banking sector has made financial resources more concentrated on the big state-owned companies while increasing credit constraints on small enterprises.<sup>3</sup>

Important reforms were also instituted in the SOE sector (Zhang, 2004). Since 1994, the state has maintained a policy whereby large SOEs are more actively protected at the cost of smaller ones. Also, a disconnect between ownership and control has been actively promoted for SOEs. Nevertheless, substantial agency problems exist, in addition to problems due to political controls (Zhang, 2004).

Protection of creditor rights as well as general legal infrastructure has been lacking in the Chinese economy, and this may have important implications for financial distress and business failure. The important role of legislation in cross-country differences in firm exits has been noted in the literature (Brouwer, 2006; Bhattacharjee *et al.*, 2009a). The Chinese bankruptcy code, first introduced for SOEs in 1986, was gradually extended to other collective and private firms (Harmer, 1996; Falke, 2007). A more extensive law governing bankruptcy and reorganisations for all enterprises has recently been introduced. A different bankruptcy system was introduced in 1994, aimed mainly at regulating mergers, restructuring and bankruptcy of state-owned firms in key industries. The mechanism is entirely state controlled, including periodic selection of key industries and specific firms, as well as firm specific bankruptcy procedures. The workers laid off from such selected firms are offered first preference to the proceeds from the sell-out of these firms in preference to the debtors; as a result, they obtain much higher compensation than similar workers laid off through the standard bankruptcy code. These idiosyncratic and selective aspects of state protection of Chinese firms in bankruptcy have potentially important implications for our study. This is particularly relevant against the finding in Guariglia and Poncet (2008) that financial distortions introduced by state interventions in China is an important impediment to economic growth and development.

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<sup>3</sup>According to a 2002 World Bank study, 80 percent of Chinese companies reported problems in obtaining capital (Huang and Khanna, 2003).



### 3 Data

Our empirical analysis uses financial data on Chinese quoted firms extracted from Bureau van Dijk's *Osiris* database.<sup>4</sup> We include the 1,609 nonfinancial firms listed at any time over the period under study – 1995 to 2006.<sup>5</sup> Compared with other datasets, the above data are unique in that they offer complete coverage of listed Chinese firms (and therefore do not suffer from potential selection biases), and contain information on ownership and exits, in addition to financial accounting variables. Admittedly, the incidence of exits and financial distress would be higher if we were to include private unlisted firms. However, in line with the literature (Campbell *et al.*, 2008; Bhattacharjee *et al.*, 2009a,b), we focus on listed firms for which financial distress has important implications for price premiums on stocks.

Notably, only 7 firm exits are recorded in the *Osiris* database.<sup>6</sup> At the same time, there are many firms which have survived periods of vanishingly low interest cover, concurrently with substantial depletion in both fixed assets and share capital. Note that, a reduction in fixed assets is not necessarily associated with distress, especially in the Chinese context where some firms have tended to overinvest in the past, and have undergone restructuring more recently. However, such restructuring would typically be associated with reduced debt obligations. Therefore, it is highly unlikely that a sharp fall in assets will be concurrent with decline in interest cover, particularly if the firm also experienced fall in share capital at the same time. It may be presumed that such firms suffered from immense financial distress, and

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<sup>4</sup>Bureau Van Dijk's *Osiris* database (van Dijk, 2003) provides financial accounts for the world's publicly quoted companies (more than 24,000).

<sup>5</sup>Listed in either of the three stock exchanges – Shanghai, Shenzhen or Hong Kong, or in a foreign exchange. There are five categories of shares issued by listed Chinese companies – A, B, H, N and S shares. While A shares are issued in the domestic markets (Shanghai and Shenzhen) and traded in Chinese currency (RMB), B shares are stocks in the domestic market that are traded in foreign currencies. H shares, N shares and S shares refer to Chinese firms listed in Hongkong, New York and Singapore stock exchanges respectively. Our data comprises all of these categories, as well as companies whose stocks are listed in the Tokyo Stock Exchange.

<sup>6</sup>According to official sources, 48 companies were delisted (51 stocks) from the domestic exchanges (Shanghai and Shenzhen) between 1990 and 2006. This, too, is a very small number compared to the size of the quoted population.

were saved from liquidation only through substantial state protection. We, therefore, base our analysis on a synthetic indicator of financial distress at the firm level.

Below we describe our data construction, including our indicator of financial distress, measures of macroeconomic conditions and instability, and firm and industry characteristics.

### 3.1 Measure of financial distress

The credit scoring literature has developed a wide range of measures for financial distress, typically used in bankruptcy prediction; see Altman (1993) and Allen and Saunders (2003) for extensive reviews. In the spirit of Zmijewski (1984) and Shumway (2001), we construct our own indicator for financial distress at the firm level.

Traditional distress scores incorporate ratios measuring profitability, liquidity, and solvency. However, given the specific context of Chinese industry, our construction is based on slightly different parameters. Our measure combines a debt sustainability measure (interest cover) with evidence that assets and equity in the firm is decreasing. Specifically, we consider the following three conditions:

- Interest cover  $< 0.7$  (in current or previous year),
- Decline in fixed assets (in current or next year), and
- Decrease in share capital (in current and next year).

The base criteria is based on repayment capability, measured by interest cover. This relates to the notion that financial distress is associated with the condition that operating profits cannot cover the total of fixed and sunk costs. However, a low interest cover can result from capital accumulation financed by borrowings. In this case, fixed assets in the firm should build up substantially. Similarly, while a low interest cover may result from debt equity swaps, such retirement of share capital is very unlikely to accompany simultaneous decline in fixed assets. Therefore, we designate a firm as being financially distressed in a given year if all the above three conditions

are satisfied.<sup>7</sup> Based on this measure, there were 289 instances of financial distress in 8,039 firm years over the 12 year period. The incidence of financial distress shows substantial variation over the period of analysis (Table 1). Based on the above measure, we will estimate a regression model, describing the hazard rate of financial distress as a function of macroeconomic, firm-specific and industry factors, after conditioning on age of the firm since incorporation; see Shumway (2001) for a related approach.

**TABLE 1: Financial Distress Incidence**

| Year    | Distressed firms | Total | Incidence rate |
|---------|------------------|-------|----------------|
| 1995-96 | 1                | 26    | 3.85           |
| 1997-98 | 6                | 77    | 7.79           |
| 1999    | 13               | 334   | 3.89           |
| 2000    | 30               | 726   | 4.13           |
| 2001    | 40               | 939   | 4.26           |
| 2002    | 39               | 1069  | 3.65           |
| 2003    | 32               | 1107  | 2.89           |
| 2004    | 49               | 1246  | 3.93           |
| 2005    | 58               | 1237  | 4.69           |
| 2006    | 21               | 1278  | 1.64           |

In terms of hazard model analysis, our age (duration) data are right-censored and left-truncated.<sup>8</sup> The Bureau van Dijk's *Osiris* database includes data on incorporation years for the included firms. However, these data are not entirely clean, and display unrealistic lumping of entries in certain years. We verified and corrected the incorporation years for our sample companies from other sources – stock exchanges and company annual reports.

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<sup>7</sup>Admittedly, the cut-off for interest cover, as well as choice of periods is somewhat subjective. Therefore, we verify that our findings are robust to alternate constructions of the synthetic measure. Specifically, we consider alternative cut-offs at 0.5 and 1.0, and three year windows centred on the current year. Our empirical results are robust to these investigations.

<sup>8</sup>For each company included in our sample, the data used pertain to years, since 1995, during which the company is listed in either of Shanghai, Shenzhen, Hong Kong or foreign stock exchanges. Hence, for each company, the available data are left-truncated, and do not pertain to the entire period that it is listed.

## 3.2 Macroeconomic conditions and instability

We use the following empirical proxies for macroeconomic conditions:

- As a measure of the business cycle we use an index, the so-called “consistent macro index” published by the Chinese National Bureau of Statistics. The index is derived from consistent indicators whose peak and trough approximately coincide with that of per capita output at business cycle frequencies. This measure is easily computed and regularly published, and provides a reliable snapshot of the overall state of the economy. The index of industrial production, number of industrial employees, growth rate of completed investment in fixed assets, total retail sales of consumer goods, total customs duties on imports and exports, revenue and total profits of industrial enterprises, and the disposable income of urban residents are the indicators included in the above index.
- Real interest rates are measured as the benchmark rate on 3-5 year RMB loans for financial institutions (published by the People’s Bank of China),<sup>9</sup> minus the annual rate of inflation.
- US business cycle, our proxy for export demand, is measured by the Hodrick-Presscott filtered series of quarterly US GDP per capita averaged over the four quarters of each year.

Figure 1 plots the annual incidence of financial distress and the business cycle indicator for the year. Incidence is measured as the proportion (percentage) of firms that were financially distressed (for the first time) that year to the total number of listed companies. As expected, quoted firm financial distress is generally countercyclical, being higher in recessions and lower during upturns of the business cycle. However, the relationship between the two must be conditioned on other factors, both microeconomic and macroeconomic, that are potentially important. Therefore, we also include in our analysis real interest rates as well as measures of macroeconomic instability.<sup>10</sup>

Bhattacharjee *et al.* (2009a,b) report an important role of macroeconomic stability on the survival of quoted UK and US firms, in addition to firm and

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<sup>9</sup>Interest rates on commercial loans are directly linked to the benchmark rate. Between 1999 and 2003, lenders are allowed to set interest rates within a band between 0.7 to 1.3 times the benchmark rate of interest; the range was widened to 0.9 times to 1.7 times in

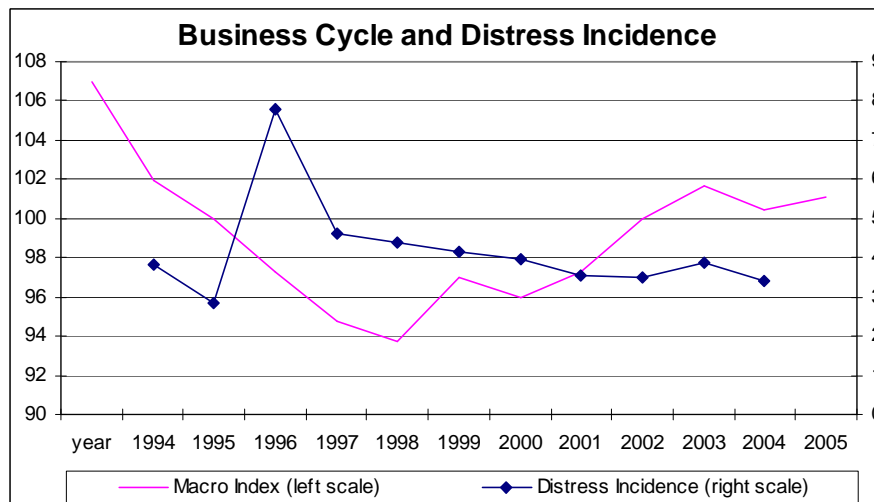


Figure 1: Business Cycle and Distress Incidence

industry factors. It has been argued in the literature that macroeconomic instability may have adverse effects on the performance of firms.

Further, the impact of such uncertainty is asymmetric. For example, in economies with credit constraints, credit imperfections generate a transmission mechanism through which a small, temporary shock can generate large, persistent domestic balance sheet effects. This feature has motivated financial accelerator-type models (Bernanke *et al.*, 1996), including the borrowing constraint in Kiyotaki and Moore (1997), costly state verification in Bernanke and Gertler (1989) and sudden stops in Calvo (2000). The amplification effect can explain why a small fundamental problem can evolve into a large-scale deterioration of economic performance. The credit constraint interacts with aggregate economic activity over the business cycle and generates asymmetric effects in response to unexpected productivity shocks.<sup>11</sup> There is related

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January 2004, and the upper limit was withdrawn in October 2004.

<sup>10</sup>See also Koopman and Lucas (2005), Hackbarth *et al.* (2006) and Bhattacharjee *et al.* (2009a,b).

<sup>11</sup>While a positive shock has only a small effect, a negative shock (even if temporary) can reduce the value of the firm to a discounted liquidation value. Since the liquidated assets

empirical work on mechanisms which create asymmetric volatility responses (Engle and Ng, 1993); see Bhattacharjee *et al.* (2009b) for further discussion.

Traditional measures of instability, for example those based on standard deviations, are not able to capture such asymmetric effects. We use signed gradients in monthly measures of macroeconomic indicators to identify sharp changes. We use the following measures of macroeconomic instability:

- We measure interest rate instability by standard deviation of effective interest rates (interest payments divided by total borrowings) across the cross-section of firms in each year, signed by annual first differences of the cross-section median. Bhattacharjee *et al.* (2009a,b) use, as their measure of interest rate instability, the annual first differences of average short term real interest rates prevailing during each year. While benchmark interest rates in China show substantial volatility over the period of analysis, there are long periods over which there is little variation in this measure. At the same time, cross-section variation in effective interest rates is substantial, indicating that credit available to firms are charged at variable interest rates. Our measure captures this variation, as well as potential asymmetric effects of interest rate instability.
- Instability in exchange rate is measured by the largest month-to-month rate of variation within the calendar year, based on monthly average real effective exchange rates (published by the Bank for International Settlements).

### 3.3 Firm-level and industry-level characteristics

We include a number of variables characterising the firm and its financial performance, and dummies to capture industry effects. Firm-level financial ratios are typically strongly collinear with macroeconomic aggregates (Bhattacharjee *et al.*, 2009a,b). This poses an empirical issue, not only because of potential endogeneity, but also because our economic model presented later is based on the assumption that firm level efficiency draws are independent of macroeconomic shocks. We regress size, cash flow, profitability and gearing at the firm-level on the macroeconomic variables included in our analysis

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cannot be restored when the shock is over, the amplification effect becomes persistent.

and collect residuals. These residuals, representing “excess” values over what would be expected for the prevailing macroeconomic conditions are used as measures of the firm-level factors. These computations are applied to the following underlying measures of firm conditions.

- Firm size is measured as the logarithm of fixed capital in real terms, incremented by unity. Firm size is often an important determinant of a firm’s competitive ability. Large firms are also likely to have less financing constraints, which is reflected in the much higher failure rates of small firms (Geroski and Gregg, 1996).
- Profitability is measured by gross profit margin, which is calculated as the ratio of gross profits to sales. It measures how much out of every unit of sales a company actually keeps in earnings. Profit margin is useful when comparing companies in similar industries. A higher profit margin indicates a more profitable company that has better control over its costs compared to its competitors.
- We measure the firm’s financial structure by its gearing ratio, the ratio of debt to the sum of debt and equity. This measure focuses on the claims of debt investors and measures the extent to which the firm funds its capital employed using debt. While financial leverage usually increases the returns on equity, it also increases the volatility of earnings. Companies with low gearing ratios are reported to outperform the market in the long run (Taffler, 1982; Altman, 1993). A low debt to equity ratio is an attractive feature for investors as it is indicative of lower financial risk and provides the firm with the opportunity to raise more debt financing in the future.
- Cash flow from operations is an important measure of the financial health of a firm. Cash rich firms are potentially attractive takeover targets (Bhattacharjee *et al.*, 2009a,b). However, cash is also a relatively free financial resource with potential for enhancing agency costs (Jensen, 1986).<sup>12</sup> We include the ratio of cash flow (CF) to capital (measured by total assets) in our analyses.

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<sup>12</sup>Theory suggests that cash may be wasted by managers on poor (low NPV) investments. In the case of Chinese industry, this is particularly important, since prior research has suggested overinvestment and overcapacity (Felipe *et al.*, 2003), as well as misallocation of investment into relatively unproductive sectors (Blanchard and Giavazzi, 2006).

- We also include a dummy for state ownership in our model. As discussed earlier, Chinese state-owned firms and private firms are subject to different competitive environments, and different financial and policy support when they face the same macroeconomic shock. Therefore, their propensity for financial distress may be different.
- Dummies for stock exchanges – Shanghai, Shenzhen and Hong Kong, the benchmark being foreign listed firms, are included in our analysis to capture potential institutional differences in corporate control and governance mechanisms.
- The theory and practice of industrial organisation highlights the role of industry in firm dynamics, in terms of concentration, capital intensity, innovation and various related factors. We collect data, from several external sources, on the industry to which each of our sample firms belong, and use industry dummies to control for systematic variation in financial distress across different industries.

**TABLE 2: Sample characteristics of the explanatory variables**

| Variables  | N     | Mean     | Std.Dev. | Min.   | Max.   |
|--|-------|----------|----------|--------|--------|
| <b>FIRM <math>\times</math> YEAR LEVEL</b>             |       |          |          |        |        |
| (Excess) size:<br>$\ln(\text{real fixed capital} + 1)$ | 8,039 | -0.0116  | 1.342    | -7.277 | 6.778  |
| (Excess) Cash flow to Capital                          | 8,039 | -2.64e-4 | 0.068    | -0.415 | 0.408  |
| (Excess) Gross Margin                                  | 8,039 | 0.0023   | 0.308    | -3.049 | 3.020  |
| (Excess) Gearing                                       | 8,039 | 1.58e-5  | 0.090    | -0.327 | 0.596  |
| <b>MACROECONOMIC CONDITIONS</b>                        |       |          |          |        |        |
| Business Cycle   | 12    | 98.428   | 2.76     | 93.73  | 101.93 |
| Real interest rate                                     | 12    | 6.687    | 3.32     | 0.05   | 12.24  |
| US Business Cycle                                      | 12    | 0.431    | 1.20     | -1.14  | 2.82   |
| <b>MACROECONOMIC INSTABILITY</b>                       |       |          |          |        |        |
| Instability - Interest rate                            | 12    | 2.534    | 0.55     | 1.75   | 4.05   |
| Instability - Exchange rate                            | 12    | 0.045    | 0.10     | -0.09  | 0.17   |

The sample characteristics of the firm-level and macroeconomic explanatory factors included in our empirical model show substantial variation across firms included in our sample, and over the period under study (Table 2). Further, there is also substantial variation in the incidence of financial distress,



as well as firm-level explanatory variables, across different categories of ownership and stock exchanges (Table 3). Specifically, despite higher median profitability, foreign firms show a higher incidence of financial distress. Is this because of protection potentially offered to state firms, or simply an outcome of lower cash flow and profitability for some firms? Likewise, there is also large variation in distress incidence across the stock exchanges. Can this be explained by variation in the institutional setting related to corporate governance, holding firm and macroeconomic factors constant? These are questions that our empirical analysis will address, based on an economic model developed in the next section.

**TABLE 3: Distress and Firm level variables  
by Ownership and Stock Exchange**

| Category   | Firm-years | Distress Incidence | Firm $\times$ Year Level (median) |         |        |         |
|------------|------------|--------------------|-----------------------------------|---------|--------|---------|
|            |            |                    | Size                              | CF/Cap. | Margin | Gearing |
| OWNERSHIP  |            |                    |                                   |         |        |         |
| Private    | 2,082      | 0.0495             | 7.525                             | 0.0590  | 0.0726 | 0.342   |
| State      | 5,899      | 0.0314             | 8.150                             | 0.0601  | 0.0606 | 0.332   |
| Collective | 58         | 0.0172             | 7.610                             | 0.0817  | 0.0712 | 0.266   |
| EXCHANGE   |            |                    |                                   |         |        |         |
| Foreign    | 708        | 0.0155             | 7.058                             | 0.0770  | 0.0781 | 0.340   |
| Hong Kong  | 708        | 0.0226             | 9.303                             | 0.0848  | 0.0952 | 0.316   |
| Shanghai   | 3,755      | 0.0325             | 8.042                             | 0.0565  | 0.0600 | 0.336   |
| Shenzhen   | 2,868      | 0.0488             | 7.930                             | 0.0576  | 0.0593 | 0.336   |

## 4 Model and Econometrics

### 4.1 Economic model

Our economic model builds on the framework in Jovanovic and Rousseau (2002) and Bhattacharjee *et al.* (2009b), but accomodates the main special feature of Chinese industry highlighted in this paper – that firms are shielded from exit by active state protection. The low incidence of exits in Chinese industry points to higher sunk costs relative to fixed costs (Owen and Ulph, 2002). This may also imply inadequate secondary markets where the firm can sell its assets in the event of exit. State protection in the form of an assured

rate of return on assets, possibly at different rates for state and private firms, can be viewed as a non-market mechanism to partly address this problem.

Firms receive random efficiency draws in each period, and in addition are affected by macroeconomic shocks. Efficiency and macroeconomic shocks are independent of each other, positively autocorrelated and evolve jointly as a first order Markov process. Our model implies that adverse macroeconomic conditions, in terms of both the level of macroeconomic aggregates and instability, lead to more distressed firms, and so too does poor random draws of firm-level efficiency.<sup>13</sup> Further, we acknowledge the potential effect of unobserved heterogeneity in founding conditions and human capital (Thompson, 2005; Bhattacharjee *et al.*, 2006).

At any time,  $t$ , each firm,  $i$ , is at risk of financial distress which depends both on its level of efficiency and the macroeconomic conditions. The  $i$ -th firm's state of technology (or efficiency) at time  $t$  is denoted by  $z_{it}$  and its capital by  $K_{it}$ . Firms operate under a AK type production function which takes the form  $f(z)K$ . Here  $f(z)$  is akin to the output-capital ratio and depends on firm efficiency:  $\partial f(z)/\partial z > 0$ . We assume that the dynamics in  $z$  and the economy wide macro-environment variable  $u$  jointly follows a Markov transition process. We further assume that  $z$  and  $u$  are positively autocorrelated and independent of each other. Hence,  $z$  and  $u$  are jointly Markov, *i.e.*,

$$Pr[z_{i,t+1} \leq z^*, u_{t+1} \leq u^* | z_{it} = z, u_t = u] = F(z^*, u^* | z, u).$$

Evolution of capital occurs through investments  $X$

$$K_{i,t+1} = (1 - \delta) K_t + X_t,$$

where  $\delta$  is the depreciation rate. Internal costs of adjustment,  $\widehat{C}(K, X)$ , are homogenous of degree 1 in  $K$  and  $X$ , so that

$$\widehat{C}(K, X) = K \widehat{C}\left(1, \frac{X}{K}\right) = KC(x),$$

where  $x = X/K$  is investment per unit of capital, and we assume that  $C$  is a differentiable, increasing and convex function that is defined only for nonnegative  $x$ , with  $C(0) = 0$ .

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<sup>13</sup>See Figure 1 in Bhattacharjee *et al.* (2009b).

Then, profits are given by

$$[f(z) - C(x) - qx - g(u)]K,$$

where  $q$  denotes the cost of capital and  $g(u)$  is the firm specific impact of economic shocks on profits.  $g(u)$  is increasing and convex in  $u$ , and  $g(0) = 0$ . Firms choose their investment to maximise perpetual profit streams.

In line with evidence that exits are almost non-existent, we assume that there is some mechanism (like state protection) which guarantees the firms a certain minimum return on its capital; we denote this lower threshold by  $\underline{q}$  ( $< q$ ). If the firm is financially distressed, or in other words the value of its capital in the next period  $V(z^*, u^*)$  falls below the required return on capital ( $q$ ), the residual value of the firm falls to the lower guaranteed threshold,  $\underline{q}$ . Then, given  $\underline{q}$ , the market value of the firm per unit of capital under the optimal investment plan is:

$$V_{\underline{q}}(z, u) = \max_{x \geq 0} \{f(z) - C(x) - qx - g(u) + (1 - \delta + x)V_{\underline{q}}^*(z, u)\},$$

where

$$\begin{aligned} V_{\underline{q}}^*(z, u) = & \frac{1}{\beta} \int \int \left\{ V_{\underline{q}}(z^*, u^*) \cdot 1 [V_{\underline{q}}(z^*, u^*) \geq q] \right. \\ & \left. + \underline{q} \cdot 1 [V_{\underline{q}}(z^*, u^*) < q] \right\} dF(z^*, u^* | z, u) \end{aligned}$$

is the expected present value of capital in the next period given the firm's  $z$  and the economy's  $u$  today, and  $\beta$  is the discount rate.<sup>14</sup>

At an interior maxima, the optimal  $x \geq 0$  satisfies the FOC

$$C'(x) = V_{\underline{q}}^*(z, u) - q.$$

Now, since  $z$  and  $u$  are independent and positively autocorrelated,  $V_{\underline{q}}(z, u)$  is increasing in  $z$  and decreasing in  $u$ . For given macroeconomic condition  $u$  and threshold return  $\underline{q}$ , we denote by  $z_d(u, \underline{q})$  the threshold level of efficiency  $z$  at which the firm becomes just financially distressed:

$$V_{\underline{q}}(z_d(u, \underline{q}), u) = q.$$

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<sup>14</sup>Bhattacharjee *et al.* (2009b) consider a similar model, where in each period a firm chooses between continuation or selling its capital in the market for acquired capital. Here, in line with the Chinese institutional setting, there is no exit, but incapacity to service its debt (or financial distress) drives the rate of return on the firm's assets to the floor,  $\underline{q}$ .

Then,  $z_d(u, \underline{q}) \uparrow u$  and  $z_d(u, \underline{q}) \downarrow \underline{q}$ . In other words, there is a larger pool of distressed firms whenever macroeconomic conditions are unfavourable, and a smaller pool when the threshold return is higher.

Therefore, testable implications of the the model are: (a) the hazard rate of financial distress decreases with  $\underline{q}$ , (b) the hazard rate of distress is higher in adverse macroeconomic conditions, and (c) microeconomic firm-level factors positively related to firm efficiency level affect the probability of financial distress negatively. Further, in line with Bhattacharjee *et al.* (2006), there may be a role for unobserved heterogeneity in the form of founding conditions and unobserved human capital.

## 4.2 Econometrics

We employ hazard regression models to study the impact of various explanatory factors (covariates) on financial distress of Chinese firms. We allow the effect of age on the hazard rate of distress to be flexible, and include covariates (regressors) corresponding to macroeconomic factors as well as firm and industry characteristics. Unobserved heterogeneity in the form of entrepreneurial human capital and founding conditions also play a potentially important role.

### 4.2.1 Cox proportional hazards model

First, we estimate a Cox proportional hazards (PH) model (Cox, 1972), which is the corner-stone for regression analysis of duration data. Initially, we do not allow for unobserved heterogeneity. Consider a sample of size  $n$  from the population of newly created firms. The conditional probability of financial distress at duration  $t$ , given the vector of explanatory variables  $x$ , is measured by the hazard rate function  $h(t|x)$ . For each firm  $i$ , the data provides information on its life span  $t_i$  measured in years,<sup>15</sup> the covariates ( $x_i$ ), and also an indicator that the firm was not distressed by the end of the period covered by the study. The latter information may be summarized by defining a binary variable ( $a_i$ ) describing censoring as follows.

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<sup>15</sup> $t_i$  is the difference between the date of financial distress and the incorporation year for the  $i$ -th firm.

$$a_i = \begin{cases} 0 & \text{if firm } i \text{ was not distressed over the study period 1995-2006} \\ 1 & \text{if firm } i \text{ was financially distressed at some point of time.} \end{cases}$$

The continuous time Cox proportional hazards model is given by

$$h(t|x; \beta) = h_0(t) \cdot \exp(x'\beta), \quad (1)$$

where  $h_0(t)$  is an unspecified function of  $t$  called the baseline hazard function and  $\beta$  is a vector of the regression coefficients. Cox (1972, 1975) proposed estimation based on maximising the partial likelihood function:

$$PL = \prod_{i=1}^n \left[ \frac{\exp(x'_i \beta)}{\sum_{j=1}^n Y_{ij} \exp(x'_j \beta)} \right]^{a_i},$$

where  $Y_{ij} = 1$  if  $t_j \geq t_i$  and  $Y_{ij} = 0$  if  $t_j < t_i$ .<sup>16</sup> The maximum partial likelihood estimators  $\hat{\beta}$  are obtained by maximising the logarithm of the above partial likelihood function with respect to  $\beta$ . Since the distress times (durations) are grouped into years since entry, there are a substantial number of ties. These ties are resolved using the popular method proposed by Breslow (1974). The estimation exercise was carried out using the STATA software.

We estimated two versions of the Cox PH model. In the first, a full set of year dummies (fixed effects) were included to capture macroeconomic effects. In the second, we model the macroeconomic effects explicitly by including measures of macroeconomic conditions and instability. These estimates are reported in the first two columns of Table 4 respectively.

#### 4.2.2 Discrete time proportional hazards model

Next, we address the discrete (annual) nature of our duration data by considering a grouped time version of the Cox proportional hazards model, also

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<sup>16</sup>The  $Y$ 's are a convenient method to exclude from the denominator the firms who have already experienced financial distress and are thus not part of the risk set. In other words, the population included in the denominator includes only the firms that had not been under financial distress before  $t_i$ . For censored firms the duration at distress is not observed, and therefore they do not contribute to the probability of distress in the partial likelihood. This is why  $a_i = 0$  for such individuals.

called the complementary log-log model or discrete PH model (Cox, 1972; Prentice and Gloeckler, 1978)

$$\ln[-\ln\{1 - h_j(x; \beta)\}] = x'\beta + \gamma_j, \quad (2)$$

where the time intervals are indexed by  $j = 1, 2, \dots$  and  $h_j$  denotes the discrete hazard rate in interval  $j$  (assumed constant over the interval). This discrete proportional hazards model assumes that latent continuous failure times have a proportional hazards specification but are grouped into intervals. Extending the typical implementation of this model assuming a constant baseline hazard rate, we capture time variation in the baseline hazard function across periods by including the duration dummies  $\gamma_j$ . In other words, like the continuous time Cox proportional hazards model, we allow the baseline hazard function to change with age of the firm. Specifically, we allow the baseline hazard rate to vary over four time periods corresponding to the age intervals 0-3 years, 4-8 years, 9-23 years and “more than 23” years. This model was also estimated using the STATA software, and reported in the third set of results in Table 4.

### 4.2.3 Unobserved heterogeneity

As discussed before, there is potentially an important effect of unobserved heterogeneity on the hazard rate of financial distress. This can be partly attributed to unobserved factors affecting the hazard rate, such as entrepreneurial human capital and founding conditions of firms.

We address this issue in two ways. First, we account for macroeconomic founding conditions by estimating a shared frailty model, where a Gamma distributed unobserved random factor is shared by all firms incorporated in the same year. The effect of such heterogeneity turns out to be statistically insignificant, and therefore these results are not reported. Second, we consider the grouped time proportional hazards model (2) and assume Gamma distributed scalar unobserved random effects,  $\ln(u_i)$ , specific to each firm:

$$\begin{aligned} \ln[-\ln\{1 - h_j(x_i; \beta, u_i)\}] &= x_i'\beta + \gamma_j + \ln(u_i), \quad i = 1, \dots, n, \\ \ln(u_i) &\sim \text{Gamma}(\gamma), \end{aligned} \quad (3)$$

where  $\text{Gamma}(\gamma)$  denotes the Gamma distribution with unit mean and

shape parameter  $\gamma$ .<sup>17</sup> While the assumption of Gamma heterogeneity is to some extent arbitrary, some asymptotic justification for the choice has been provided by Abbring and van den Berg (2007). The model is estimated using the ‘*pgmhaz8*’ STATA code; see also Jenkins (1995). Estimates of the model are reported in the final column of Table 4.

#### 4.2.4 Nonproportional covariate effects

The proportional hazards and MPH models (1), (2) and (3) substantially restrict interdependence between the explanatory variables and duration. Specifically, the restriction that coefficients of the regressors are constant over time may not hold in many situations, or may even be unreasonable from the point of view of relevant economic theory. In particular, the effect of a covariate on the hazard is often empirically found to be increasing or decreasing in age (sometimes over the whole covariate space, and sometimes over a range of the covariate space). This clearly constitutes a violation of the proportional hazards assumption. Several tests for such violation of the proportional hazards assumption are available in the literature; see, for example, Grambsch and Therneau (1994) and Bhattacharjee (2008).

An appealing solution to such violation of proportionality is to allow the covariate to have different effects on the hazard according to the age of the firm. Several such estimators have also been proposed in the literature. In this paper, we used the histogram-sieve estimators of Murphy and Sen (1991), which are intuitively appealing and permit useful inference. This method entails dividing the duration axis into several intervals and including the covariate interacted with an indicator function corresponding to each interval as covariates in a modified hazard regression model; see also Bhattacharjee (2004) and Bhattacharjee *et al.* (2009a,b).

## 5 Results and discussion

The model estimates are reported in Table 4. Overall, the estimates are in line with *a priori* expectations, offering points of comparison with related studies for western economies and leading to important policy conclusions.

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<sup>17</sup>This is a special case of the mixed proportional hazards (MPH) model (van den Berg, 2001) with discretely observed durations.

## 5.1 Model estimates

Results in the first column of Table 4 correspond to the continuous time Cox PH model including a full set of year dummies, while the second set includes our measures of macroeconomic conditions and stability in place of the year fixed effects. The two sets of results are very similar. We prefer the second, which is both parsimonious and facilitates understanding the effect of the macroeconomy on financial distress.

**TABLE 4: Model Estimates**<sup>18,19,20</sup>

| Variables                   | Cox PH                        | Cox PH                        | Disc.PH                       | Disc.MPH                        |
|-----------------------------|-------------------------------|-------------------------------|-------------------------------|---------------------------------|
| <b>LOG BASELINE HAZARD</b>  |                               |                               |                               |                                 |
| – Duration 1                | –                             | –                             | –3.0492<br>(–0.33)            | –20.585 <sup>+</sup><br>(–1.71) |
| – [Duration 2 – Duration 1] | –                             | –                             | 6.2795*<br>(2.10)             | 7.5144 <sup>+</sup><br>(1.93)   |
| – [Duration 3 – Duration 1] | –                             | –                             | 6.3285*<br>(2.12)             | 7.8029*<br>(2.00)               |
| – [Duration 4 – Duration 1] | –                             | –                             | 6.5302*<br>(2.19)             | 8.1903*<br>(2.10)               |
| <b>INDUSTRY DUMMIES</b>     |                               |                               |                               |                                 |
|                             | YES                           | YES                           | YES                           | YES                             |
| <b>OWNERSHIP</b>            |                               |                               |                               |                                 |
| (Base = Private)            | 0                             | 0                             | 0                             | 0                               |
| State                       | –0.0661<br>(–0.48)            | –0.0796<br>(–0.57)            | –0.0987<br>(–0.69)            | –0.2608<br>(–1.02)              |
| Collective                  | –1.5692<br>(–0.99)            | –1.4892<br>(–0.96)            | –2.8174*<br>(–2.52)           | –0.9956<br>(–0.63)              |
| <b>STOCK EXCHANGE</b>       |                               |                               |                               |                                 |
| (Base = Foreign exchanges)  | 0                             | 0                             | 0                             | 0                               |
| Hong Kong                   | 0.6442<br>(1.52)              | 0.7224 <sup>+</sup><br>(1.73) | 0.6786 <sup>+</sup><br>(1.65) | 1.5143*<br>(2.26)               |
| Shanghai                    | 0.4519<br>(1.26)              | 0.4710<br>(1.34)              | 0.4154<br>(1.17)              | 0.7413<br>(1.42)                |
| Shenzhen                    | 0.7066 <sup>+</sup><br>(1.94) | 0.7577*<br>(2.12)             | 0.7356*<br>(2.08)             | 1.2264*<br>(2.33)               |

<sup>18</sup>z-scores in parentheses; \*\*, \*and <sup>+</sup>– significant at 1%, 5% and 10% level respectively.

<sup>19</sup>Durations 1–4 refer to the age intervals 0-3, 4-8, 9-23 and “> 23” years respectively.

<sup>20</sup>Test for proportionality of hazards is rejected at the 5% level against a monotone hazard ratio alternative, for the macroeconomic variables interest rate instability and US business cycle, both for the Cox PH and Discrete PH model specifications. We therefore allow the effect of these variables to vary with age of the firm. For further details on the methodology, see Bhattacharjee (2008).



**TABLE 4: Model Estimates (Contd.)**

| Variables  | Cox PH                | Cox PH                | Disc.PH                         | Disc.MPH              |
|--|-----------------------|-----------------------|---------------------------------|-----------------------|
| <b>FIRM × YEAR LEVEL</b>   |                       |                       |                                 |                       |
| (Excess) size:<br>ln(real fixed capital + 1)                             | −0.0636<br>(−1.02)    | −0.0745<br>(−1.18)    | −0.0921 <sup>+</sup><br>(−1.65) | −0.2940**<br>(−2.62)  |
| (Excess) Cash flow to Capital  | −12.314**<br>(−14.62) | −12.199**<br>(−14.60) | −12.964**<br>(−18.00)           | −30.536**<br>(−12.25) |
| (Excess) Gross Margin  | 0.1273<br>(0.96)      | 0.0960<br>(0.73)      | 0.0218<br>(0.18)                | −0.3154<br>(−1.17)    |
| (Excess) Gearing   | 0.0123<br>(0.02)      | −0.0963<br>(−0.15)    | −0.1996<br>(−0.29)              | 3.8479**<br>(2.73)    |
| <b>MACROECONOMY</b>  |                       |                       |                                 |                       |
| Year dummies   | YES                   | NO                    | NO                              | NO                    |
| Business Cycle   | —                     | −0.1396<br>(−1.47)    | −0.0852<br>(−0.94)              | −0.0160<br>(−0.66)    |
| Real interest rate   | —                     | −0.0967<br>(−0.77)    | −0.0254<br>(−0.21)              | 0.0754<br>(0.51)      |
| Interest rate instability<br>× I(age 0-3 years)                          | —                     | 1.9307**<br>(2.88)    | 1.8567*<br>(2.19)               | 2.2377*<br>(1.96)     |
| × I(age > 3 years)   | —                     | 0.4226<br>(0.83)      | 0.1963<br>(0.40)                | −0.2711<br>(−0.46)    |
| Exchange rate instability  | —                     | 0.6227<br>(0.59)      | −0.9044<br>(−0.95)              | 1.1011<br>(0.81)      |
| US Business Cycle<br>× I(age 0-3 years)                                  | —                     | 0.4378<br>(0.66)      | 0.4137<br>(0.63)                | −0.8332<br>(−1.06)    |
| × I(age > 3 years)   | —                     | 0.1100<br>(1.15)      | 0.1057<br>(1.13)                | 0.0026<br>(0.02)      |
| No. of firms (No. in distress)   | 1, 609(289)           | 1, 609(289)           | 1, 609(289)                     | 1, 609(289)           |
| Total time at risk (firm-yrs)  | 8, 039                | 8, 039                | 8, 039                          | 8, 039                |
| Log-likelihood   | −1168.425             | −1172.669             | −843.822                        | −764.253              |
| LRT – Joint significance of<br>industry dummies (d.f. / <i>p</i> -value) | 16/0.448              | 16/0.000**            | 16/0.008**                      | 16/0.202              |
| LRT – Joint significance of macro.<br>variables (d.f./ <i>p</i> -value)  | 9/0.005**             | 7/0.033*              | 7/0.061 <sup>+</sup>            | 7/0.371               |

The Grambsch and Therneau (1994) test fails to reject the proportional hazards assumption for both models. However, the Bhattacharjee (2008) test rejects proportionality against monotone nonproportional covariate effects for two variables: interest rate instability and the US business cycle. Therefore,

we allow these covariates to have potentially age varying effects, using the histogram sieve estimator of Murphy and Sen (1991).

We also estimate a model with shared frailty, where firms incorporated in the same year are clustered *a priori* to have the same draw of a Gamma distributed random effect. Estimates are similar, but evidence for unobserved heterogeneity in macroeconomic founding conditions is not significant. Nevertheless, we suspect a potential role for unobserved heterogeneity at the firm level, possibly related to unobserved entrepreneurial human capital, initial efficiency level, or other endowments (Bhattacharjee *et al.*, 2006).

Further, since our duration data are recorded in annual frequency, the data generating process is better modeled as a grouped duration data proportional hazards model, or discrete PH model. As discussed above, we incorporate an useful variation and allow the baseline hazard function to vary over the lifetime of the firm.<sup>21</sup> Model estimates, presented in the third set of results in Table 4 are similar to the continuous time Cox PH model.

Finally, we estimate the model in discrete time, after accounting for unobserved heterogeneity at the individual firm level. Estimates with Gamma distributed heterogeneity allowing for nonproportional covariate effects are presented in the final set of results in Table 4.<sup>22</sup> The null hypothesis of “no unobserved heterogeneity” is rejected at the 1 percent level. While the estimates are similar to the previous models in signs of the coefficients, magnitude and significance of the covariate effects are somewhat different. Further, the effect of interest rate instability clearly varies with age of the firm.<sup>23</sup>

We check our results for robustness in several ways. First, in allowing for unobserved heterogeneity at the firm level, we verify that our findings are robust to ignored firm specific factors. Second, as discussed earlier, we

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<sup>21</sup>Specifically, the baseline hazard function is allowed to take different values over the four age intervals: 0-3 years, 4-8 years, 9-23 years and “more than 23” years respectively.

<sup>22</sup>We also estimated a similar model with unobserved heterogeneity modeled nonparametrically as a discrete mixture of degenerate distributions in a sequence with increasing number of components; for further discussion of this methodology, see Jenkins (1995) and van den Berg (2001). We do not find evidence of such discrete mixture frailty.

<sup>23</sup>As discussed earlier, we statistically test the hypothesis that each of the covariates included in the analysis has proportional effects on the hazard rate of financial distress. The tests proposed in Bhattacharjee (2008) used for this purpose indicate that two of the included covariates, namely interest rate instability and the US business cycle, have nonproportional effects. We therefore interact the effect of these two explanatory variables with firm age.

experiment with several alternative constructions of our measure of financial distress; the estimates are very similar, both quantitatively and qualitatively. Third, we estimate a logit model with firm level fixed effects and verify the our findings are consistent.

Overall, our empirical results underscore the importance of allowing for unobserved heterogeneity and nonproportional covariate effects.

### 5.1.1 Firm attributes and industry

Our findings on the impact of firm level factors on the hazard rate of financial distress fall along expected lines. Further, these effects are strong and robust to the impact of firm-specific unobserved heterogeneity.

The hazard rate of financial distress declines significantly with size. With gradual liberalisation of the Chinese industrial sector, goals of firms have progressively concentrated on profit maximization. As a consequence, more resources have concentrated on the large enterprises and departments, and small SOEs and private enterprises have faced increasing financial difficulties. Concurrently, through its reform of the SOE sector, the state has also concentrated its supportive role on the big state-owned companies.

As expected, financial distress increases with gearing; companies with lower gearing have a more sustainable debt profile and are therefore less susceptible to financial distress. While the effect of profitability on financial distress is not significant, companies with higher cash flow have lower hazard of financial distress. This finding is consistent with the idea that the financial strength gained from a stronger cash flow dominates potential agency costs related to free cash flow.

The age of firms significantly affects financial distress in the discrete time models. The baseline hazard rate for firms over 8 years of age is significantly higher than the youngest firms below 3 years of age. This evidence is somewhat unexpected. Nevertheless, the finding is not inconsistent with the active learning model (see also Pakes and Ericson, 1998), and may reflect special protection offered to very young firms, specially in strategic industries.

However, the industry fixed effects are jointly significant at the 5 percent level only in the estimated discrete PH model without frailty. This evidence is in line with the idea that lack of an appropriate competitive business environment may inhibit development of strong industry effects.<sup>24</sup>

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<sup>24</sup>Evidence from India (Bhattacharjee and Majumdar, 2007) suggests that indus-

### 5.1.2 Macroeconomic conditions and instability

The annual fixed effects representing macroeconomic conditions (not reported in Table 4) show evidence of a sharp decline over the period 1998 to 2006. This provides evidence that the operating environment for Chinese firms has improved over time, notwithstanding significant macroeconomic fluctuations. Although none of these year effects are individually significant at the 5 percent level, they are jointly significant at the 1 percent confidence level. Since the period under study covers various stages of the business cycle, the above evidence points to the important role of macroeconomic management for Chinese industry.

Overall, our findings point to the impact of macroeconomic instability on enhanced financial distress. In fact, the only prominent macroeconomic effects are observed for interest rate instability. Further, this adverse effect depends on the age of firms since listing, being statistically significant only for the youngest firms. Young firms, primarily private firms, suffer from greater credit constraints compared to state firms. Even otherwise, the adverse effect of macroeconomic shocks may be greater on younger firms, because of learning and other related effects (Bhattacharjee *et al.*, 2009b). This underscores the nonproportional effect of interest rate instability and justifies our empirical strategy to allow for age varying covariate effects.

There is also limited evidence that Chinese firms are likely to face higher financial distress during years when the Yuan Renminbi (RMB) appreciates sharply. However, this effect is significant either when interest rate instability is not included in the model, or when high exchange rate instability is interacted with concurrently high interest rate instability. This can be partly explained by the link between the fixed exchange rate regime and lower flexibility in interest rate setting in the Chinese macroeconomy.<sup>25</sup>

The business cycle is not significant and neither is the US business cycle, our proxy for export demand. Similarly real interest rates also have no significant effect. The general lack of significant effects of macroeconomic

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trial reforms have enhanced the role of industry in determining inter-firm profitability differentials.

<sup>25</sup>Contrary to claims by the Chinese monetary authority of a managed floating exchange rate policy, the Dollar/RMB exchange rate had been stable around 8.27 over the 11 year period 1994 to 2005. The constraints of fixed exchange rate is strongly reflected in China's interest rate policy over this period.

conditions, rather than instability, on financial distress appears to underscore relatively robust macroeconomic management. Weaker firms may be offered protection against adverse macroeconomic shocks, and despite the export orientedness, it would appear that Chinese industry has been by and large successful in finding alternative export markets and thereby avoiding strong adverse effects of external shocks. At the same time, state interventionism may be negatively associated with growth and productivity (Guariglia and Poncet, 2008).

### 5.1.3 Institutional influences

The most important institutional influences coming out of our results lie in the consistent and significant effect of stock exchanges. In particular, as compared with foreign stock exchanges, firms listed in domestic exchanges have higher distress hazard, and the effect is particularly high for Hong Kong and Shenzhen exchanges. Previous research has highlighted several structural and institutional differences across Chinese stock exchanges; see, for example, Mookherjee and Yu (1995). In particular, it has been noted that Shanghai and Shenzhen stock exchanges suffer from poor legal infrastructure, as well as inefficiencies (Li, 2003). Our evidence appears to point towards an important disciplining role played by stock exchanges, particularly Hong Kong and Shanghai.

As discussed earlier, the fact that state protection for the failing firm is substantial in China. Against this backdrop, one would expect state owned and collective firms to have a lower hazard of financial distress. Somewhat surprisingly, while there is a consistent negative effect, this is not statistically significant. One explanation could be interaction with size, since most of the SOEs are very large. Indeed, when size is not included in the model, ownership turns out to be significant. However, this is a tentative suggestion which requires to be examined further.

## 5.2 Comparison with advanced economy studies

Our study highlights several important similarities and differences with advanced economy studies on the determinants of firm exits, defaults and distress, such as those reported in Ilmakunnas and Topi (1999) and Bhattacharjee *et al.* (2009a,b).

First, we highlight the fact that there are indeed very few exits in Chinese industry. This primarily points to very weak debtor protection, an institutional setting that the economic model developed here fits very well. A new bankruptcy code has recently been introduced, and its impact on ensuring appropriate and progressive legal infrastructure for reorganisation and bankruptcy remains to be seen; see Falke (2007) for a discussion of the code and its likely implications. Also, it is evident that substantial state protection is offered to weak firms, but also some private firms. Such interventionist industrial policy appears to be effective, somewhat in the same way as Chapter 11 in the US partially protects firms from immediate dissolution (Brouwer, 2006; Bhattacharjee *et al.*, 2009a). However, notwithstanding limited positive influences, lack of disciplining influence of debtors, and potentially stock markets too, is likely to encourage inefficiency in Chinese industry; see also Guariglia and Poncet (2008).

Second, in terms of microeconomic firm-level factors, our results are very similar to western studies, in that size, cash flow and gearing are found to be important determinants of financial distress.

Third, our results point to a substantially lower effect of industry as compared to western studies such as Bhattacharjee *et al.* (2009a,b). This may not be very surprising. Evidence from India (Bhattacharjee and Majumdar, 2007) points to the fact that it often takes an intensive period of industrial reforms for western type industry structure to develop.

Fourth, and perhaps most surprisingly, we find much weaker macroeconomic effects as compared with western studies on firm exit (Ilmakunnas and Topi, 1999; Bhattacharjee *et al.*, 2009a,b). The main explanations rest in active state protection of weak firms and credible macroeconomic management. In this context, particularly important is our finding that the US business cycle also has no substantial effect, in spite of a high dependence on exports; this evidence is in sharp contrast with listed firms in the UK (Bhattacharjee *et al.*, 2009a,b). It appears that Chinese industry is very effective in locating demand for its exports overseas.

Finally, our observation of an increasing baseline hazard rate is somewhat unusual, though not inconsistent with the active learning model; see Pakes and Ericson (1998), for example. Institutional explanations can be potentially found in the nature of Chinese state protection, an issue for future study.

### 5.3 Policy implications

Several important policy implications emerge from our analysis, particularly against the context of ongoing transition in the Chinese economy.

First, interest rate instability, measured by cross-section variation in effective interest rates, have a devastating effect on the youngest firms. As discussed earlier, credit constraints in Chinese industry are very high (Huang and Khanna, 2003) and presumably this affects the youngest firms hardest. This points to the need for development of appropriate markets. Similarly, though relatively weaker, exchange rate instability also has some detrimental effect on Chinese firms. Here too, further liberalisation of foreign exchange markets (particularly in derivatives products) may provide better opportunity for Chinese firms to guard against exchange rate shocks.

Second, active state protection for the failing firm is likely to diminish with the implementation of new laws and reorganisation systems (Harmer, 1996; Falke, 2007). This will potentially make Chinese firms more susceptible to macroeconomic shocks in the future. The importance of good macroeconomic management will then be even more enhanced. In particular, as evident from the increasing baseline hazard rate, an important positive aspect of the current institutional setting appears to be strong protection offered to weaker (younger) firms. While such state protection may reduce through legal reform, adequate provisions need to be built into the new legislation. Chapter 11 in the US offers similar protection to firms while upholding debtor rights too (Bhattacharjee *et al.*, 2009a). The legislation and practice of Chapter 11 may thus serve as an important model for Chinese bankruptcy and reorganisation laws.

Finally, China has so far followed a rather gradualist approach to reforms in industrial policy. Our evidence shows that the kind of industry effects typical in advanced economies are yet to emerge. “Command and control” industrial policies in many developing countries inhibit the development of typical industry structures one finds in advanced economies. Further reform of the industry sector will possibly promote the emergence of more prominent industry effects.<sup>26</sup>

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<sup>26</sup>The Indian experience, studied in Bhattacharjee and Majumdar (2007), indicate that the role of industry in determining firm performance emerges a reasonable time after active industrial policies are implemented.

## 6 Conclusions

In this paper, we examined the relationship between financial distress on the one hand, and firm-level characteristics and the macroeconomic cycle on the other, focusing on listed Chinese companies. The period of analysis, 1995-2006, has seen massive regulatory and institutional changes in China, and evidenced substantial variation in the business cycle and instability. State protection in China ensures that there are only very few business exits. Therefore, we conduct our analysis based on a synthetic measure of financial distress. Conditioned on the above institutional setting, we develop a simple economic model of financial distress. Using hazard regression analysis, we find important effects of firm-level characteristics such as age of the firm, size, gearing and cash flow. In addition, we find an important effect of instability in the interest rate, as well as important institutional effects. The results are robust to unobserved heterogeneity at the firm level, as well as those shared by firms in similar macroeconomic founding conditions.

Our results underscore the importance of smooth macroeconomic management in an emerging market context. Further, they offer interesting points of comparison with related studies in western economies, and highlight several policy implications. In particular, the important role for developing appropriate markets is emphasized, and so too are reforms in industrial policy and the rule of law.

Several lines of further research emerge from our work. First, the links between the process of macroeconomic, industrial and legislative reforms in China and corporate distress hypothesized in this paper need to be further examined. Second, the finding of a decreasing baseline hazard rate is unusual in the literature. Robustness of this finding needs to be studied and explanations sought in the specifics of industrial dynamics in China. Third, implications of our work for credit scoring, and more generally credit management under the Basel II framework, requires further examination. Finally, while we identify new evidence on the determinants of financial distress in Chinese industry, similar work for other emerging market economies is required for obtaining a more precise understanding of these issues.



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