Internet Appendix: Not for Publication

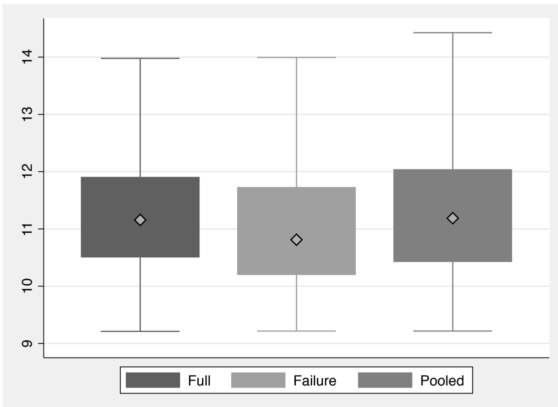
A. Further Details on Pre-Estimation

A.1 Distributional Characteristics of Pooled Sample

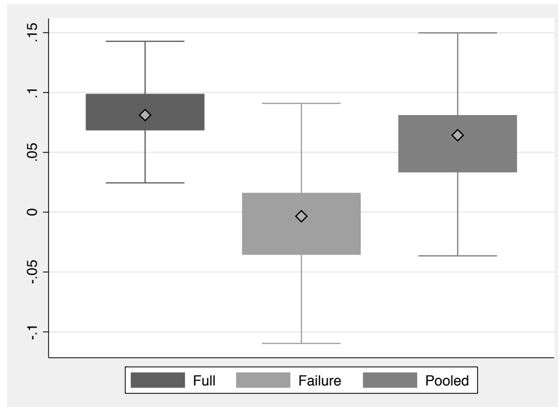
Relative to the failure-only estimates used in most previous studies (e.g. James 1991; Schaeck 2008), the Tobit estimates are a significant improvement in correcting the obvious bias in the predicted costs. Figure IA.1 presents box plots of the distribution of the bank specific closure cost determinants for both the failure-only sample and the pooled failure and merger sample against the full estimation sample. Failed banks have significantly lower capitalization and net income ratios and significantly higher non-performing loan and real estate ownership ratios than the full sample. The pooled sample is far more representative, with the mean and intraquartile range of each variable being quite close to the full sample in most cases. While we recognize that this does not completely solve the problem of conditionality, we believe that our approach provides a good approximation of the likely monetary closure costs.

A.2 Model Fit

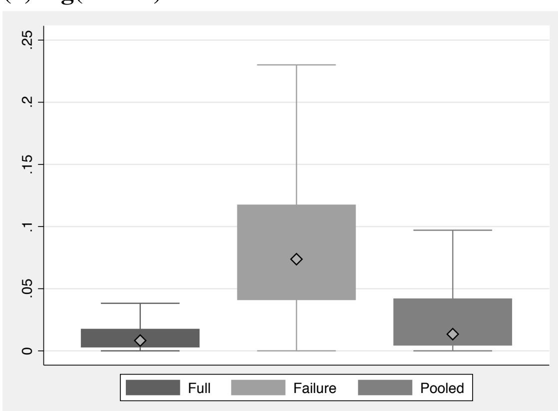
To further illustrate the fit, we plot the period ahead predicted value of each of the six transitioning variables in Figure IA.2. These graphs show the average fit of the regression prediction for banks which did fail in the 20 quarters up to failure.



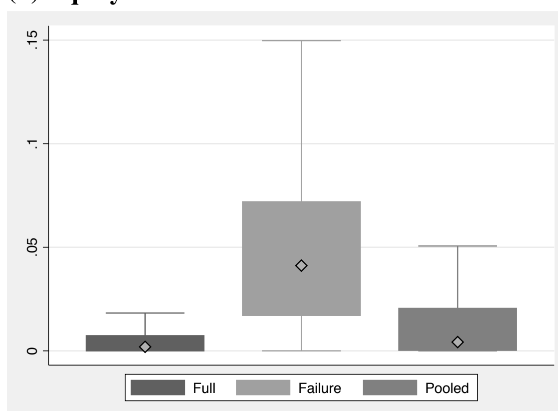
(a) log(Assets)



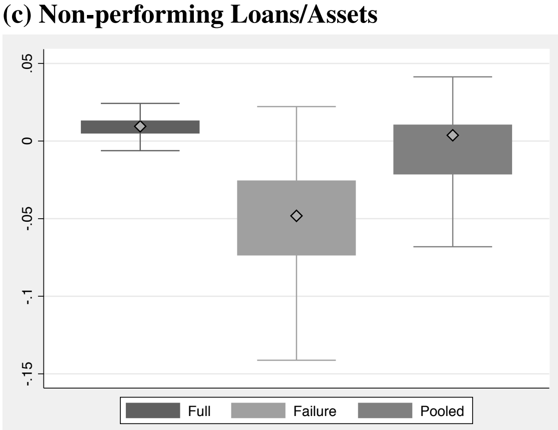
(b) Equity/Assets



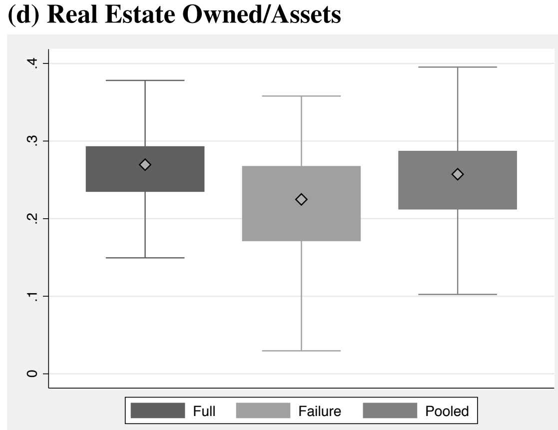
(c) Non-performing Loans/Assets



(d) Real Estate Owned/Assets

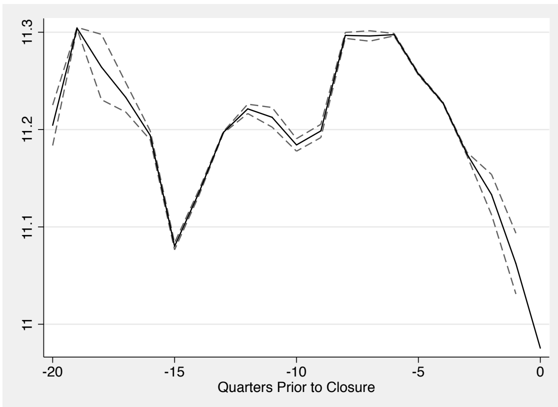


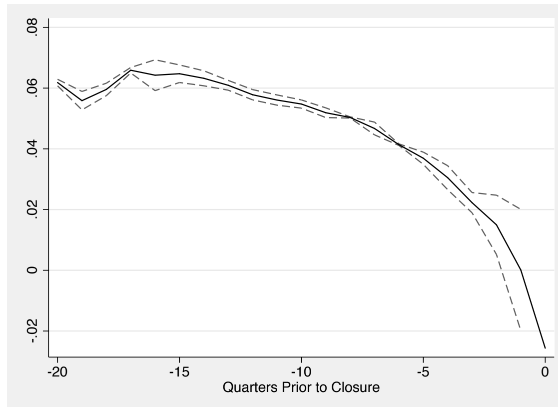
(e) Net Income/Assets



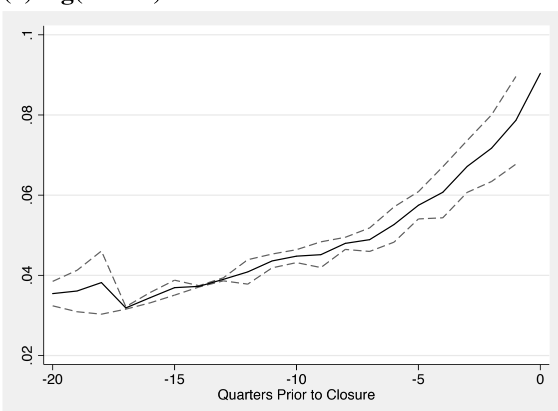
(f) Core Deposits/Assets

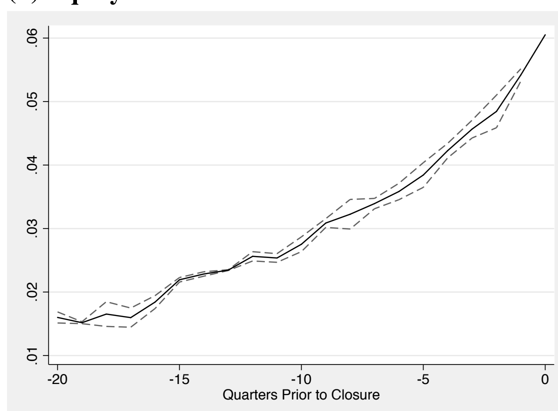
Figure 1
Distributional box plots of the major cost determinants for the full estimation sample, the "failure" sample and the pooled sample of mergers and failures for the 1980s and 1990s. The full sample represents all observations used in the quarter ahead prediction sample for the full model. The "failure" sample represents only the observations for banks which failed and resolved the quarter of their failure. The pooled sample represents observations of both failures and unassisted mergers.



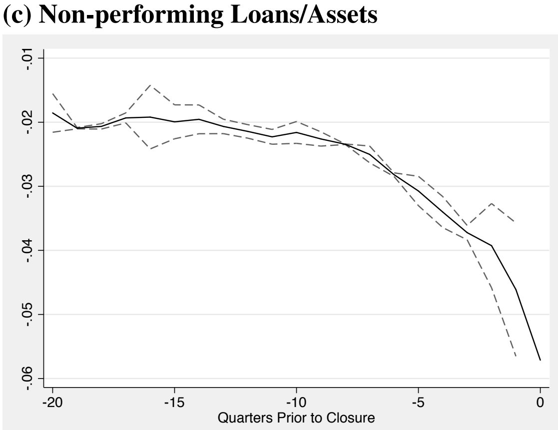


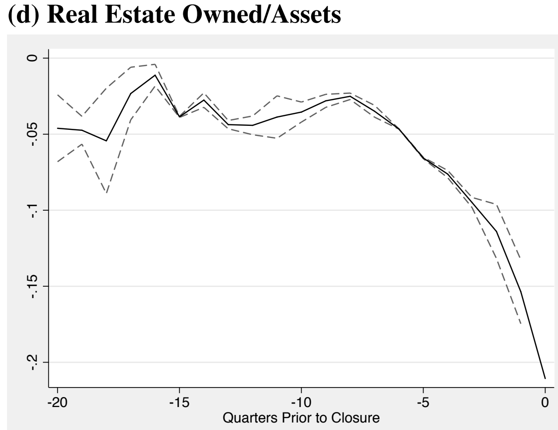
(a) log(Assets) **(b) Equity/Assets**





(c) Non-performing Loans/Assets **(d) Real Estate Owned/Assets**





(e) Net Income/Assets **(f) Asset Growth**

Figure 2
This figure shows the mean quarter ahead predicted values of the transition variables for the sample of banks which were eventually closed by the FDIC in the 1980s and 1990s. The solid line represents the predicted value and the dashed line represents the range around the estimate given by the Root Mean Squared Error. Note that since the final quarter ahead prediction is unrealized, the error cannot be calculated and there is no error band for the final observation.

B. Derivation of CCP Estimator

Define $\nu_j(x_{it}) \equiv V_j(x_{it}) - \varepsilon_{jit}$ for $j \in \{0,1\}$. Then equation (2) can be rewritten as

$$\begin{aligned} V_0(x_{it}) &= \varepsilon_{0it} + \beta E[p_0^{(1)}(x_{0it})(\nu_0^{(1)}(x_{0it}) + \varepsilon_{0it+1}) + p_1^{(1)}(x_{0it})(\nu_1^{(1)}(x_{0it}) + \varepsilon_{1it+1})] \\ &= \varepsilon_{0it} + \beta E[p_0^{(1)}(x_{0it})\varepsilon_{0it+1} + p_1^{(1)}(x_{0it})\varepsilon_{1it+1} \\ &+ p_0^{(1)}(x_{0it})(\nu_0^{(1)}(x_{0it}) - \nu_1^{(1)}(x_{0it})) + \nu_1^{(1)}(x_{0it})] \end{aligned} \tag{17}$$

where the second equality exploits the fact that $p_1^{(1)}(x_{0it}) = 1 - p_0^{(1)}(x_{0it})$.

The next step, which applies Proposition 1 from Hotz and Miller (1993), eliminates the difference between value functions from the previous expression. Specifically, with the extreme value distribution, the difference $\nu_0 - \nu_1$ is equal to $\sigma \ln \frac{p_0}{p_1}$. Intuitively, the value of each choice depends on the current payoff to each choice and the value going forward available following each choice. Only the difference between the values is relevant. Differences in values imply differences in the likelihood of selecting one action over the other. Since there is a one-to-one correspondence between the value function difference and the probabilities of choosing actions, as shown in Proposition 1 in Hotz and Miller (1993), it is possible to replace this value difference with a function of the probabilities of taking one or the other action. The distribution of the choice specific error term makes the expression particularly simple. In principle, it is possible to estimate the model with different error distributions but in practice it is standard, and certainly most convenient, to assume an extreme value distribution. It is also necessary at this stage to exploit the existence of an absorbing state, specifically bank closure. Thus, $\nu_1^{(1)}(x_{0it}) = -c^{(1)}(x_{0it})$; closing the bank generates the value associated with paying the costs to close now, with no further payoffs in the future.[25] Note that this correspondence also exploits Assumption 1, since there is no risk of transitioning into the disorderly closure states.

Thus, equation (17) becomes, applying the law of iterated expectations:

$$\begin{aligned} V_0(x_{it}) &= \varepsilon_{0it} + \beta E[p_0^{(1)}(x_{0it})\varepsilon_{0it+1} + p_1^{(1)}(x_{0it})\varepsilon_{1it+1} + p_0^{(1)}(x_{0it})\sigma \ln \frac{p_0^{(1)}(x_{0it})}{p_1^{(1)}(x_{0it})} - c^{(1)}(x_{0it})] \\ &= \varepsilon_{0it} + \beta E_x E[p_0^{(1)}(x_{0it})\varepsilon_{0it+1} + p_1^{(1)}(x_{0it})\varepsilon_{1it+1} + p_0^{(1)}(x_{0it})\sigma \ln \frac{p_0^{(1)}(x_{0it})}{p_1^{(1)}(x_{0it})} - c^{(1)}(x_{0it})|x_{0it}^{(1)}]. \end{aligned}$$

[25] In fact, there can be a continued stream of payoffs of some form, as long as there are no choices that are relevant for these payoffs that can be taken after the terminal action is chosen. In this case, further payoffs are normalized to 0.

Note that this expression has current and one period ahead components without any other future component even though it is an equivalent expression for the maximum of equation (1), which includes all future payoffs. This is the result of having a terminating action or absorbing state.

Using the assumed distribution of the choice specific errors, it can be shown that $E(\varepsilon_{jit+1}|x_{0it}^{(1)}) = \mu + \sigma\gamma - \sigma \ln p_j^{(1)}(x_{0it})$ for $j \in \{0, 1\}$ where γ is Euler constant (≈ 0.577). Therefore, after some algebra, the previous expression becomes

$$V_0(x_{it}) = \varepsilon_{0it} + \beta E_x[\mu + \sigma(\gamma - \ln p_1^{(1)}(x_{0it})) - c^{(1)}(x_{0it})],$$

or

$$\begin{aligned} \nu_0(x_{it}) &= \beta E_x[\mu + \sigma(\gamma - \ln p_1^{(1)}(x_{0it})) - c^{(1)}(x_{0it})] \\ \nu_1(x_{it}) &= -c(x_{it}). \end{aligned}$$

Again applying Proposition 1 from Hotz and Miller (1993) yields

$$\begin{aligned} \sigma \ln \frac{p_0(x_{it})}{p_1(x_{it})} &= \nu_0(x_{it}) - \nu_1(x_{it}) \\ &= \beta E_x[\mu + \sigma\gamma - \sigma \ln p_1^{(1)}(x_{0it}) - c^{(1)}(x_{0it})] + c(x_{it}) \end{aligned}$$

where the second equality provides the moment equation used in the estimation of the model. By the normalization in Assumption 3, $\mu + \gamma\sigma = 0$ since the mean of the choice specific error term is zero. This gives the expression in the text.

C. Robustness Checks and Alternative Models

C.1 Time Varying Conditional Choice Probabilities

For the primary model we study, and in the exposition of the model, we have assumed that the environment facing the FDIC is time invariant. That is, the state of the bank and the aggregate state of the economy is assumed to be sufficient to describe all current and future payoffs to the FDIC. This assumption is not necessarily valid in our context. Specifically, the FDIC may anticipate that at some point in the future it could completely or partially lose control over the decision to close banks. Here, we have in mind the possibility that Congress would intervene to force closures. In fact, with the passage of the FDIC Improvement Act, Congress would arguably have been prepared to intervene to enforce prompt corrective action. This risk of outside interference provides a secondary rationale for paying the cost to close a bank rather than allowing it to continue to operate. That is, the FDIC may close a bank not because it fears that the bank will descend into disorderly failure but instead because it expects that at some point in the future it may be forced to close the bank by Congress, involuntarily incurring both the monetary and non-monetary costs.

Accommodating this consideration into our estimation framework is surprisingly straightforward. As long as we allow the estimated conditional choice probabilities to depend on time, our estimation can nest this type of model, again assuming that this regime shift does not occur with positive probability in our sample or one period ahead of any realization in our sample period. The reason is simple; any such anticipated regime shift will affect the expected value of the future payoffs associated with leaving a bank open. This difference will be reflected in the value function difference between leaving a bank open and closing a bank. By allowing the conditional choice probabilities to be time specific, we account for the possibility that the value function difference changes over time, which fully accounts for beliefs that the regime change has come closer in time. Ideally, we would like to estimate choice probabilities on a quarter-by-quarter basis, but as we have only a limited number of closures to work with we instead include a time trend in the logit in the specifications in which we account for the possibility of an anticipated regime shift. Even numbered models (II and IV) include the time trend in the choice probability estimation and thus can account for the possibility of an anticipated policy shift.