Internet Appendix for "Information versus Investment"

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A. Model appendix

This appendix provides more detail on our theoretical model. We define a stationary general equilibrium on a balanced growth path, characterize normalized stationary versions of value functions, the cross-sectional distribution, the earnings-based pricing function, and the variety growth rate in this equilibrium, demonstrate that all aggregates grow at an identical rate equal to the growth rate of aggregate varieties, characterize household bond returns and welfare in closed form, provide an expression for the realized household equity return as an aggregate across stationary firm outcomes, and describe the numerical solution method we employ.

A.1 Equilibrium definition

A stationary general equilibrium on a balanced growth path (balanced growth path) is a collection of:

- intermediate goods prices, p_{jt},
- intermediate goods quantities, x_{jt},
- land prices, P_t^L,
- land quantities demanded, L_t
- a manager value function, $V^m(z_{kt}, \nu_{kt}, B_{kt-1}, M_{kt}, Q_t)$, an intangible investment policy, $W(z_{kt}, \nu_{kt}, B_{kt-1}, M_{kt}, Q_t)$, a bias policy, $B(z_{kt}, \nu_{kt}, M_{kt}, Q_t)$,
- a fundamental firm value function, $V^f(z_{kt}, \nu_{kt}, B_{kt-1}, M_{kt}, Q_t)$,
- aggregate output, Y_t,
- intangible investment, W_t,
- intermediate goods production, X_t,
- consumption, C_t,
- aggregate newly innovated variety levels, M_t,
- aggregate total variety levels, Q_t,
- household bond savings, S_t,
- household equity investments, E_t,

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- a household bond return, R^f,
- a household equity return, $\tilde{R}^h$,
- a firm average equity return, R^f,
- a profit target, $\bar{\pi}$,
- an aggregate growth rate, g,
- and a stationary distribution, $F(z, \nu, b_{-1}, m)$.

Together these objects satisfy the following conditions:

- taking as given demand from the final goods producer, intermediate goods prices, p_{jt}, for newly innovated on-patent goods are set optimally by intermediate goods firms under monopolistic competition to maximize their static profits,
- taking as given the marginal cost of production, intermediate goods prices, p_{jt}, for previously innovated off-patent goods are optimally set equal to marginal cost by intermediate goods firms under perfect competition to maximize their static profits,
- taking as given the intermediate goods prices, p_{jt}, the final goods producer optimally chooses intermediate goods quantities, x_{jt}, to maximize their static profits,
- taking as given the land price, P_t^L, the final goods producer optimally chooses the quantity of land demanded, L_t, to maximize their static profits,
- taking as given the firm average equity return, R^f, and the profit target, $\bar{\pi}$, firm managers choose policies for intangible investment, $W(z_{kt}, \nu_{kt}, B_{kt-1}, M_{kt}, Q_t)$, and bias, $B(z_{kt}, \nu_{kt}, B_{kt-1}, M_{kt}, Q_t)$, in order to optimize the expected present discounted value of their payoffs, D_{kt}^m, given by the manager value function, $V^m(z_{kt}, \nu_{kt}, B_{kt-1}, M_{kt}, Q_t)$,
- fundamental firm value, $V^f(z_{kt}, \nu_{kt}, B_{kt-1}, M_{kt}, Q_t)$, is equal to the present discounted value of firm cash flows, D_{kt}^f, taking as given the firm cost of capital, R^f, as well as manager optimal policies for intangible investment, $W(z_{kt}, \nu_{kt}, B_{kt-1}, M_{kt}, Q_t)$, and bias, $B(z_{kt}, \nu_{kt}, B_{kt-1}, M_{kt}, Q_t)$,
- taking as given the bond return, R^f, the household optimally chooses bond savings, S_{t+1}, to maximize their welfare,
- taking as given the equity return, $\tilde{R}^h$, the household optimally chooses equity savings, E_{t+1}, to maximize their welfare,
- taking as given manager intangible investment, $W(z_{kt}, \nu_{kt}, B_{kt-1}, M_{kt}, Q_t)$, and bias, $B(z_{kt}, \nu_{kt}, B_{kt-1}, M_{kt}, Q_t)$, policies as well as fundamental ex-dividend firm value functions, $\tilde{V}^f(z_{kt}, \nu_{kt}, B_{kt-1}, M_{kt}, Q_t)$, which imply an earnings-based firm pricing function, $\mathbb{E}\left(\tilde{V}_{kt}^f | \Pi_{kt}\right)$, household realized equity returns, $\tilde{R}^h$, reflect intermediary information rents causing overpayment for purchases and underpayment for sales by the fraction τ for every firm k

$$\tilde{R}^h = \int \frac{D_{kt+1}^f + \tilde{V}_{kt+1}^f - \tau\left[\tilde{V}_{kt+1}^f - \mathbb{E}\left(\tilde{V}_{kt+1}^f | \Pi_{kt+1}\right)\right]^+}{\tilde{V}_{kt}^f + \tau\left[\mathbb{E}\left(\tilde{V}_{kt}^f | \Pi_{kt}\right) - \tilde{V}_{kt}^f\right]^+} dk,$$

- aggregate output, Y_t, is given by the final goods producer technology as a function of the land, L_t, and intermediate goods, x_{jt}, inputs,
- aggregate final goods used in intermediate goods production, X_t, is equal to the total demand across all intermediate varieties j adjusted for marginal cost

$$X_t = \int \psi x_{jt} dj,$$

- aggregate intangible investment, W_t, is equal to the total intangible investment across all firms k

$$W_t = \int w_{kt} dk,$$

- the mass of newly innovated varieties is given by the total newly innovated varieties across all firms k

$$M_{t+1} = \int M_{kt+1} dk,$$

- the market for final goods clears, i.e., the resource constraint

$$Y_t = C_t + X_t + W_t$$

  is satisfied,
- the zero net supply bond market clears with savings, $S_t = 0$,
- the land market clears with the land demand, L_t, equal to the inelastic supply 1 in each period,
- the average profit target, $\bar{\pi}$, is equal to the average scaled profit level across firms, i.e.,

$$\bar{\pi} = \mathbb{E}\left(\frac{\Pi_{kt}}{Q_t}\right),$$

- total aggregate variety levels respect the accumulation equation

$$Q_{t+1} = M_{t+1} + Q_t,$$

- growth of the total variety level is constant and given by g, i.e.,

$$g = \frac{M_{t+1}}{Q_t},$$

- aggregate quantities C_t, Y_t, X_t, and W_t all grow at the constant rate g,
- and the constant stationary distribution of scaled firm state variables in each period is $F(z_t, \nu_t, b_{t-1}, m_t)$, where $b_{t-1} = B_{t-1}/Q_t$, $m_t = M_t/Q_t$, and $F(\cdot)$ respects manager optimal intangible investment and bias policies together with the exogenous stochastic processes for z_t and ν_t.

A.2 Stationary optimization, cross-sectional distributions, earnings-based pricing functions, and the variety growth rate

First, note that from this point forward we often drop the k and t notation, replacing it with state vectors and $_{-1}$, prime notation when it is possible to do so without loss of clarity. Also note that the value functions V^f and V^m above have unbounded, nonstationary inputs because Q grows without bound on a balanced growth path. This nonstationarity makes numerical dynamic programming difficult in practice, so we exploit the fact that the firm and manager flow payoffs are homogeneous in Q to write the value functions and nonstationary inputs in stationary, normalized form.

$$V^m(z,\nu,B_{-1},M,Q) =$$

$$\max_{W,B}\begin{bmatrix} \mathbb{I}(B=0)\left(D^m+\frac{1}{R^f}\mathbb{E}\left[V^m(z',\nu',0,M',Q')|z\right]\right) \\ \mathbb{I}(B\neq 0)(1-\lambda)\left(D^m+\frac{1}{R^f}\mathbb{E}\left[V^m(z',\nu',B,M',Q')|z\right]\right) \\ \mathbb{I}(B\neq 0)\lambda\left(D^m|_{B=0}-MC(B,Q)+\frac{1}{R^f}\mathbb{E}\left[V^m(z',\nu',0,M',Q')|z\right]\right) \end{bmatrix}$$

$$= Q\max_{w,b}\begin{bmatrix} \mathbb{I}(b=0)\left(d^m+\frac{1}{R^f}\frac{1}{Q}\mathbb{E}\left[V^m(z',\nu',0,M',Q')|z\right]\right) \\ \mathbb{I}(b\neq 0)(1-\lambda)\left(d^m+\frac{1}{R^f}\frac{1}{Q}\mathbb{E}\left[V^m(z',\nu',B,M',Q')|z\right]\right) \\ \mathbb{I}(b\neq 0)\lambda\left(d^m|_{b=0}-MC(b,1)+\frac{1}{R^f}\frac{1}{Q}\mathbb{E}\left[V^m(z',\nu',0,M',Q')|z\right]\right) \end{bmatrix}$$

where lowercase variables are the same as uppercase variables scaled by Q, i.e.,

$$m=\frac{M}{Q}, w=\frac{W}{Q}, b=\frac{B}{Q}$$

$$d^m=\frac{D^m}{Q}=\theta^d d^f+\theta_\pi\mathbb{I}(\pi\geq\bar{\pi})-\theta_q(\pi-\bar{\pi})^2, d^f=\frac{D}{Q}=\pi_m(z)m-w$$

$$mc(b)=\frac{MC(B,Q)}{Q}=\kappa_f+\kappa_q b^2, \pi=\frac{\Pi}{Q}=\pi_m(z)m-w+\nu+b-b_{-1}$$

$$v^m(z,\nu,b_{-1},m)=\frac{V^m(z,\nu,B_{-1},M,Q)}{Q}.$$

We obtain that

$$v^m(z,\nu,b_{-1},m)Q = Q\max_{w,b}\begin{bmatrix} \mathbb{I}(b=0)\left(d^m + \frac{1}{R^f}\frac{Q'}{Q}\mathbb{E}\left[v^m(z',\nu',0,m')|z\right]\right) \\ \mathbb{I}(b\neq 0)(1-\lambda)\left(d^m + \frac{1}{R^f}\frac{Q'}{Q}\mathbb{E}\left[v^m(z',\nu',b,m')|z\right]\right) \\ \mathbb{I}(b\neq 0)\lambda\left(d^m|_{b=0} - mc(b) + \frac{1}{R^f}\frac{Q'}{Q}\mathbb{E}\left[v^m(z',\nu',0,m')|z\right]\right) \end{bmatrix}$$

$$v^m(z,\nu,b_{-1},m) = \max_{w,b}\begin{bmatrix} \mathbb{I}(b=0)\left(d^m + \frac{1+g}{R^f}\mathbb{E}\left[v^m(z',\nu',0,m')|z\right]\right) \\ \mathbb{I}(b\neq 0)(1-\lambda)\left(d^m + \frac{1+g}{R^f}\mathbb{E}\left[v^m(z',\nu',b,m')|z\right]\right) \\ \mathbb{I}(b\neq 0)\lambda\left(d^m|_{b=0} - mc(b) + \frac{1+g}{R^f}\mathbb{E}\left[v^m(z',\nu',0,m')|z\right]\right) \end{bmatrix}$$

where g is the growth rate of varieties Q. Similarly, we can write fundamental firm value in normalized form as

$$v^f(z,\nu,b_{-1},m) = \begin{bmatrix} \mathbb{I}(b=0)\left(d + \frac{1+g}{R^f}\mathbb{E}\left[v^f(z',\nu',0,m')|z\right]\right) \\ \mathbb{I}(b\neq 0)(1-\lambda)\left(d + \frac{1+g}{R^f}\mathbb{E}\left[v^f(z',\nu',b,m')|z\right]\right) \\ \mathbb{I}(b\neq 0)\lambda\left(d + \frac{1+g}{R^f}\mathbb{E}\left[v^f(z',\nu',0,m')|z\right]\right) \end{bmatrix},$$

where we substitute in the optimal policies from the manager's problem, v^m, and where $v^f Q = V^f$. Given values for the aggregate growth rate, g, the profit target, $\bar{\pi}$, and the firm cost of capital, R^f, the normalized or stationary Bellman equations above are computable using standard numerical dynamic programming techniques.

Note that given this stationary formulation of the manager dynamic optimization problem, the stationary cross-sectional distribution, $F(z,\nu,b_{-1},m)$, is simply a function of the implied investment and bias policies, together with the exogenous stochastic processes for z and ν.

Also note that the nonstationary earnings-based firm valuation or pricing function, $\mathbb{E}(\tilde{V}^f_{kt}|\Pi_{kt}) = \mathbb{E}(\tilde{v}^f_{kt}Q_t|\pi_{kt}Q_t)$, is implied by the stationary earnings-based firm valuation function, $\mathbb{E}(\tilde{v}^f|\pi)$, given common knowledge of the nonstochastic aggregate variety level Q_t. In addition, the normalized firm pricing function is a function of computable stationary objects through the formula

$$\mathbb{E}(\tilde{v}^f|x) = \frac{\int \mathbb{I}(\pi(z,\nu,b_{-1},m)=x)\tilde{v}^f(z,\nu,b_{-1},m)dF(z,\nu,b_{-1},m)}{\int \mathbb{I}(\pi(z,\nu,b_{-1},m)=x)dF(z,\nu,b_{-1},m)}.$$

Finally, to characterize the variety growth rate, note that the total mass of varieties satisfies the accumulation equation

$$Q_{t+1} = \int M_{kt+1}dk + Q_t$$

$$Q_{t+1} = \int m'(z,\nu,b_{-1},m)Q_t dF(z,\nu,b_{-1},m) + Q_t$$

$$g = \frac{Q_{t+1}-Q_t}{Q_t} = \int m'(z,\nu,b_{-1},m)dF(z,\nu,b_{-1},m)$$

$$g = \int \bar{\xi}\left(w(z,\nu,b_{-1},m)\right)^{\gamma} dF(z,\nu,b_{-1},m),$$

Also, note that since the growth rate is constant in any period we also have

$$g = \int m dF(z,\nu,b_{-1},m) = \frac{Q_t - Q_{t-1}}{Q_{t-1}},$$

a formula that is sometimes easier to compute.

A.3 Balanced growth at rate g

In the background, we assume that there are lump-sum transfers from intermediaries and managers to the household that are chosen to ensure that, on aggregate, neither intermediaries nor managers consume positive amounts of resources. This assumption implies that neither manager consumption nor intermediaries' consumption enter the resource constraint or final goods clearing condition. Therefore, the final goods market-clearing condition is given as noted above by

$$Y_t = C_t + X_t + W_t.$$

We now show that each of these terms is proportional to Q_t, which implies common or balanced growth of all aggregate quantities at the rate g.

Note that output consumed in the production of intermediate varieties, X_t, satisfies

$$X_t = \int_{Q_{t-1}}^{Q_t} \psi x_{jt} dj + \psi \int_0^{Q_{t-1}} x_{jt} dj = M_t \int \psi x_m(z) dF(z,\nu,b_{-1},m) + Q_{t-1}\psi x_c$$

$$= \frac{g}{1+g} Q_t \int \psi x_m(z) dF(z,\nu,b_{-1},m) + \frac{1}{1+g} Q_t \psi x_c \propto Q_t$$

Aggregate investmen,t W_t, satisfies

$$W_t = \int_0^1 W_{kt} dk = \int_0^1 w_{kt} Q_t dk = Q_t \int w(z,\nu,b_{-1},m) dF(z,\nu,b_{-1},m) \propto Q_t.$$

Total output, Y_t, satisfies

$$Y_t = L_t^{1-\alpha} \int_0^{Q_t} z_{jt}^{1-\alpha} x_{jt}^{\alpha} dj = M_t \int z^{1-\alpha} x_m(z)^{\alpha} dF(z,\nu,b_{-1},m) + Q_{t-1} x_c^{\alpha}$$

$$= \frac{g}{1+g} Q_t \int z^{1-\alpha} x_m(z)^{\alpha} dF(z,\nu,b_{-1},m) + \frac{1}{1+g} Q_t x_c^{\alpha} \propto Q_t.$$

Since $C_t = Y_t - X_t - W_t$, we also conclude that $C_t \propto Q_t$. Given that Q_t grows at the constant rate g, we obtain common or balanced growth at rate g.

A.4 Household risk-free bond returns

The household optimality condition for savings, S_{t+1}, on a risk-free bond is given by

$$C_t^{-\eta} = \beta R^h C_{t+1}^{-\eta}.$$

But because C_t grows at the constant rate g, we have $\frac{C_{t+1}}{C_t} = 1 + g$, and therefore we can write the household return on risk-free bonds in closed form as

$$R^h = \frac{1}{\beta}(1+g)^{\eta}.$$

Next, because the household faces no aggregate uncertainty, the household must be indifferent between saving in the bond and equity investment E_{t+1}. This indifference requires that the household return on equity, $\tilde{R}^h = R^h$, is the same as the bond return.

A.5 Household welfare

Substituting the common growth rate g into the household welfare objective, and summing the implied geometric series, we have that welfare is given at time t by

$$\frac{C_t^{1-\eta}}{1-\eta}\frac{1}{1-\beta(1+g)^{1-\eta}}.$$

The first term represents static elements of welfare, and the second term represents dynamic components. Further note that under the innocuous normalizing assumption, $Q_t = 1$, we have from the derivations above that on a balanced growth path, C_t is given by the computable formulas

$$C_t = Y_t - X_t - W_t$$

$$Y_t = \left(\frac{g}{1+g}\int z^{1-\alpha} x_m(z)^{\alpha} dF(z,\nu,b_{-1},m) + \frac{1}{1+g}x_c^{\alpha}\right)$$

$$X_t = \left(\frac{g}{1+g}\int \psi x_m(z) dF(z,\nu,b_{-1},m) + \frac{1}{1+g}\psi x_c\right)$$

$$W_t = \left(\int w(z,\nu,b_{-1},m) dF(z,\nu,b_{-1},m)\right).$$

A.6 Household realized equity returns

The household's implied diversified equity return, $\tilde{R}^h$, accounting for information costs is given in computable stationary form by

$$\tilde{R}^h = (1+g)\int \frac{d^{f'} + \tilde{v}^{f'} - \tau\left[\tilde{v}^{f'} - \mathbb{E}\left(\tilde{v}^{f'}|\pi'\right)\right]^+}{\tilde{v}^f + \tau\left[\mathbb{E}\left(\tilde{v}^f|\pi\right) - \tilde{v}^f\right]^+} dG(z',\nu',b,m',z,\nu,b_{-1},m),$$

where $\tilde{v}^f = v^f - d^f$ and $G(\cdot)$ is the joint stationary distribution of outcomes in one period and the next.

A.7 Computational strategy

When numerically solving and estimating the model described above, we impose the following fixed points to guarantee consistency between model and empirical growth rates and firm returns:

- Average investment productivity, $\bar{\xi}$, is chosen so that $g = \hat{g}$, where the target growth rate, $\hat{g}$, is average real GDP growth in the data.
- The information rent parameter, τ, is chosen so that the firm's cost of capital is equal to the target empirical value, $\hat{R}^f$, i.e.,

$$R^f = \hat{R}^f.$$

With these targets in place, stationary general equilibrium along a balanced growth path involves only three aggregate fixed points that require numerical calculation, all of which are a function of the aggregate triplet, $(\tau, \bar{\xi}, \bar{\pi})$. The first fixed point requires that

$$g(\tau, \bar{\xi}, \bar{\pi}) = \hat{g},$$

i.e., that the growth rate implied by the model is equal to the target growth rate. So we must have that

$$\hat{g} = \int \bar{\xi}\,(w)^{\gamma}\, dF(z, \nu, b_{-1}, m).$$

The second fixed point is

$$\tilde{R}^h(\tau, \bar{\xi}, \bar{\pi}) = R^h = \frac{1}{\beta}(1+\hat{g})^{\eta},$$

i.e., we must have that the household's implied diversified equity return accounting for information costs is equal to the analytically tractable formula for R^h. Given the normalized formulation for the households implied return on equity above, we can rewrite this second fixed point in a more computationally useful fashion as

$$\frac{1}{\beta}(1+\hat{g})^{\eta} = (1+\hat{g}) \int \frac{d^{f'} + \tilde{v}^{f'} - \tau\left[\tilde{v}^{f'} - \mathbb{E}\left(\tilde{v}^{f'}|\pi'\right)\right]^{+}}{\tilde{v}^{f} + \tau\left[\mathbb{E}\left(\tilde{v}^{f}|\pi\right) - \tilde{v}^{f}\right]^{+}} dG(z', \nu', b, m', z, \nu, b_{-1}, m)$$

The third fixed point is that average profits appearing in firm incentives are indeed average profits observed at firms, i.e.,

$$\bar{\pi} = \int \pi(z, \nu, b_{-1}, m) dF(z, \nu, b_{-1}, m).$$

We are now in a position to explicitly describe our algorithm for solving the GE model for estimation purposes:

1. Guess a triplet of the investment productivity shifter, $\bar{\xi}$, the information rent parameter, τ, and the average profit level $\bar{\pi}$.
   (a) Solve the manager problem, v^m, assuming the discounter, $R^f = \hat{R}^f$, from the data.
   (b) Compute the implied firm value, v^f, assuming the discounter, $R^f = \hat{R}^f$, from the data.
   (c) Compute the stationary distribution, F, (and the two-period equivalent, G).
   (d) Compute the inferred earnings-based pricing schedule, $\mathbb{E}\left(\tilde{v}^f|\pi\right)$.
2. Evaluate the three fixed point equations above. If they are all solved to some numerical tolerance, stop. If not, update the guesses for the values of the triplet and return to top.

In practice, we implement this solution algorithm with a (joint) dampened fixed point iteration on the triplet, $(\tau, \bar{\xi}, \bar{\pi})$.

For counterfactuals rather than estimation, the values of $\bar{\xi}$ and τ are taken as given from the estimated model while g and R^f must now be endogenously determined. In that case, the household's return is given by

$$R^h = \frac{1}{\beta}(1+g)^{\eta},$$

where g is not fixed to an outside benchmark. General equilibrium numerically reduces to a system of three fixed points in the triplet, $(g, R^f, \bar{\pi})$. The first fixed point is that equilibrium growth must be generated by optimal policies

$$g = \int \bar{\xi}\,(w)^{\gamma}\, dF(z, \nu, b_{-1}, m).$$

The second fixed point is that the household's realized diversified equity return must be equal to their analytically tractable risk-free bond return, i.e.,

$$\frac{1}{\beta}(1+g)^{\eta} = (1+g)\int \frac{d^{f'} + \tilde{v}^{f'} - \tau\left[\tilde{v}^{f'} - \mathbb{E}\left(\tilde{v}^{f'}|\pi'\right)\right]^{+}}{\tilde{v}^{f} + \tau\left[\mathbb{E}\left(\tilde{v}^{f}|\pi\right) - \tilde{v}^{f}\right]^{+}} dG(z', \nu', b, m', z, \nu, b_{-1}, m).$$

The third fixed point is the same as above, i.e., that $\bar{\pi}$ is equal to the average level of normalized earnings, π, across the stationary distribution, F. For these counterfactual exercises, we modify the explicit numerical algorithm above in the obvious way.

B. Model specification with variable detection probability

In this Appendix, we present results from a robustness check in which we consider the possibility that the probability of detection is a function of bias. First, we estimate logistic regressions for the probability of detection for both the pre-SOX and post-SOX periods, as

well as for both less and more serious restatements. The results are in Table IA.1. In these regressions, the outcome variable is an indicator variable for detection. Defining this variable requires care because restatements of financial statements typically correct financial results for several years. We set this indicator variable equal to one in the last year of a restatement span and zero in the prior years of a restatement span. In other words, if a restatement spans just one year, this indicator variable is set to one in that year. If a restatement spans multiple years, this indicator variable equals a sequence of zeros that ends with one. Note that if certain years are not restated, one cannot conclude whether these years were manipulated or not because detection is not perfect. For this reason, the sample in Table IA.1 is restricted to restated years only.

Interestingly, Table IA.1 shows that the probability of detection does not increase with the magnitude of manipulation in either of the periods or for either type of restatement. While the coefficient on the absolute value of bias is positive (but statistically insignificant) for the pre-SOX period, it is *negative* (again, statistically insignificant) for the post-SOX period. Thus, there is no evidence that the probability of detection increases in the magnitude of bias.

One drawback of this analysis is the rare nature of restatements and thus a relatively small sample of restated years in Table IA.1. Because of the associated low power, we take a second approach to understanding the effect of the magnitude of bias on the probability of detection by completely reestimating the structural model for the less serious restatements (our main specification) for the pre-SOX period by letting the probability of detection be a logistic function of bias in which we set the value of the slope coefficient to 0.595, which is the value from Table IA.1. Similar to our main analysis for the pre-SOX period, we re-estimate κ_f, κ_q, as well as a new parameter λ_0, which is the intercept in the logistic function for the probability of detection.

These results are reported in Table IA.2. Briefly, the average implied detection probabilities are similar in our baseline pre-SOX estimation and this expended estimation. The point estimate for the detection probability in our baseline pre-SOX estimation is 0.016, while for the estimation of this augmented model, the average detection probability is:

$$\frac{1}{1+e^{-\lambda_0-\lambda_1|b/y|}}\Big|_{\lambda_0=-4.698,\ \lambda_1=0.595,\ |b/y|=0.172} = 0.010.$$

Table IA.1: Probability of detection as a function of bias

This table presents estimates of the probability of detection as a logistic function of the absolute value of bias in book value scaled by sales. The sample contains firm-year observations in which financial statements were, restated. The outcome variable is an indicator for detection that equals one in the last restated year and zero in prior restated years.

	Less serious restatements		More serious restatements	
	Pre-SOX	Post-SOX	Pre-SOX	Post-SOX
(Intercept)	-1.490^{***}	-0.651^{***}	-1.568^{***}	-0.727^{***}
	(0.111)	(0.058)	(0.135)	(0.070)
Bias in book value to sales, abs()	0.595	−0.109	0.488	−0.221
	(0.497)	(0.223)	(0.531)	(0.250)
AIC	585.299	1985.486	402.784	1389.168
BIC	594.087	1996.172	410.893	1399.184
Log Likelihood	−290.650	−990.743	−199.392	−692.584
Deviance	581.299	1981.486	398.784	1385.168
Num. obs.	598	1545	426	1105

Table IA.2: Pre-SOX period: probability of detection as a function of bias

The estimation is done with a simulated minimum distance estimator, which chooses structural model parameters by matching the moments or functions of moments from a simulated panel of firms to the corresponding moments or functions of moments from the data. The sample is the SG&A sample for the pre-SOX period. All parameters describing firm fundamentals are set to our baseline parameters from Table 3. Panel A reports the simulated and actual moments and the t-statistics for the differences between the corresponding moments. Panel B reports the estimated structural parameters with standard errors in parentheses. κ_q is the quadratic cost of manipulation. κ_f is the fixed cost of manipulation. λ is the probability of manipulation detection. λ_0 is the intercept in the logistic function used for the probability of manipulation detection. The standard errors are clustered by firm.

A. Moments

	Constant prob. of detection			Prob. of detection as a function of bias		
	Data moments	Simulated moments	t-stat	Data moments	Simulated moments	t-stat
Mean ratio of investment to sales	0.387	0.392	0.58	0.387	0.390	0.37
Incidence of detection	0.010	0.008	-1.98	0.010	0.006	-3.49
Mean absolute bias relative to sales, given detection	0.086	0.202	5.54	0.086	0.172	3.15
Variance of cash flow growth	1.407	1.357	-2.64	1.407	1.354	-2.92
Covariance of cash flow and earnings growth	0.253	0.334	5.03	0.253	0.288	1.77
Covariance of cash flow and investment growth	-0.027	-0.065	-9.25	-0.027	-0.032	-1.28
Variance of earnings growth	1.035	1.230	11.32	1.035	1.088	1.47
Covariance of earnings and investment growth	-0.030	0.008	10.07	-0.030	0.021	14.57
Variance of investment growth	0.088	0.089	0.09	0.088	0.076	-2.90
Variance of cash flow growth, given detection	1.457	1.249	-1.32	1.457	1.272	-0.97
Covariance of cash flow and earnings growth, given detection	0.307	0.090	-1.60	0.307	0.317	0.03
Covariance of cash flow and investment growth, given detection	-0.001	-0.048	-1.13	-0.001	-0.045	-1.07
Covariance of cash flow and earnings bias growth, given detection	-0.098	-0.170	-0.45	-0.098	-0.063	0.20
Variance of earnings growth, given detection	1.186	2.196	7.08	1.186	1.988	3.79
Covariance of earnings and investment growth, given detection	-0.050	0.077	4.68	-0.050	0.015	2.25
Covariance of earnings and earnings bias growth, given detection	0.219	-0.508	-4.72	0.219	-0.261	-3.17
Variance of investment growth, given detection	0.084	0.083	-0.06	0.084	0.061	-0.88
Covariance of investment growth and earnings bias growth, given detection	-0.009	0.036	1.07	-0.009	0.002	0.26
Variance of earnings bias growth, given detection	1.916	3.005	5.78	1.916	2.270	1.35
Variance of absolute bias, given detection	0.049	0.005	-1.36	0.049	0.011	-1.16
Skewness of absolute bias, given detection	6.304	1.014	-5.13	6.304	2.546	-3.30

B. Parameter estimates

κ_q	κ_f	λ	λ_0
Constant prob. of detection			
2.310	0.009	0.016	
(0.325)	(0.132)	(0.234)	
Prob. of detection as a function of bias			
2.405	0.046		-4.698
(0.149)	(0.051)		(0.019)