

Internet Banking: An Exploration in Technology

Diffusion and Impact

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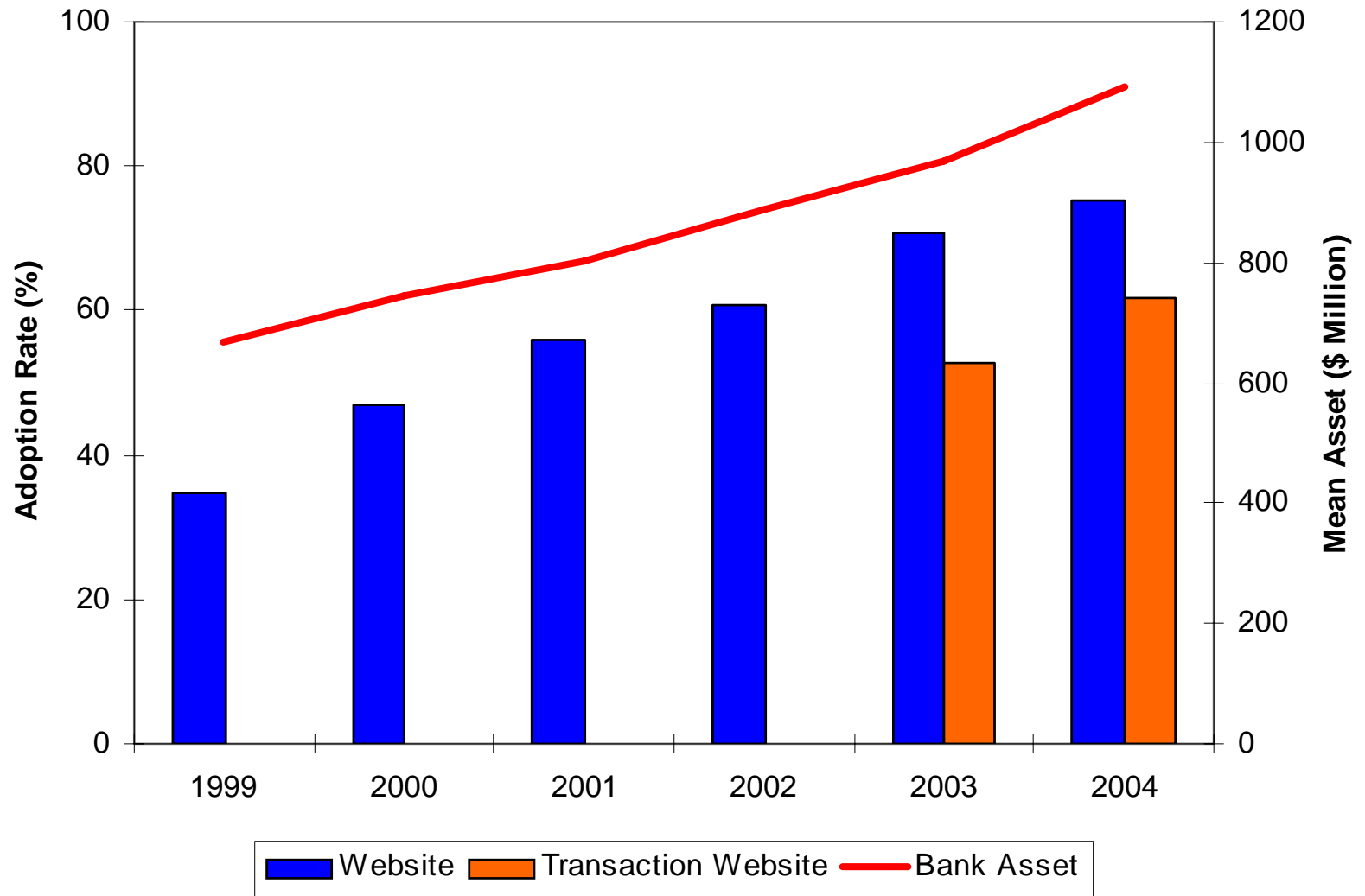
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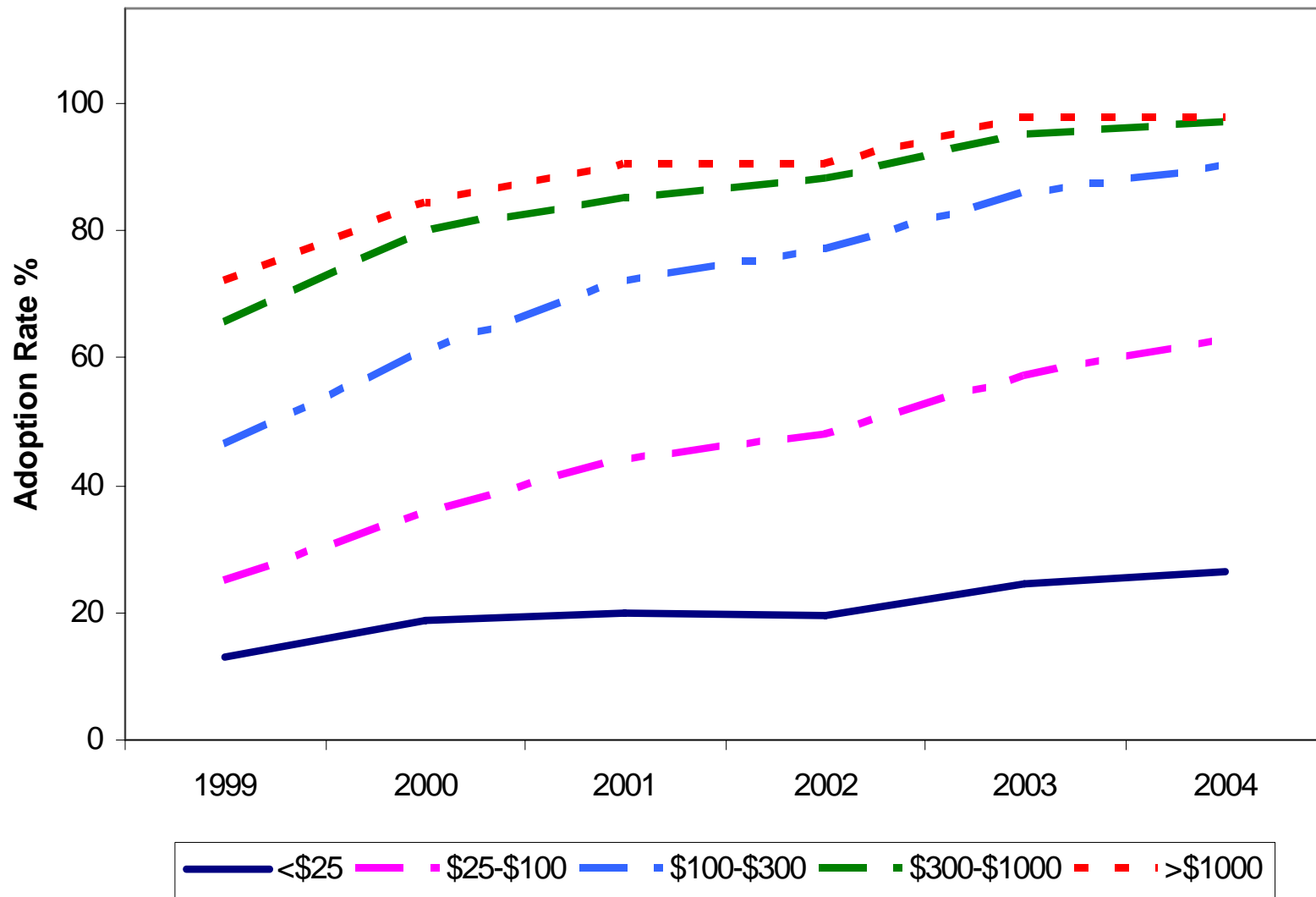
Questions on Technology Diffusion

- ❖ Why does it take time for new technology to diffuse?
- ❖ Who are the early adopters?
- ❖ What factors determine the diffusion rates?
- ❖ What feedbacks does the diffusion have on the environment?

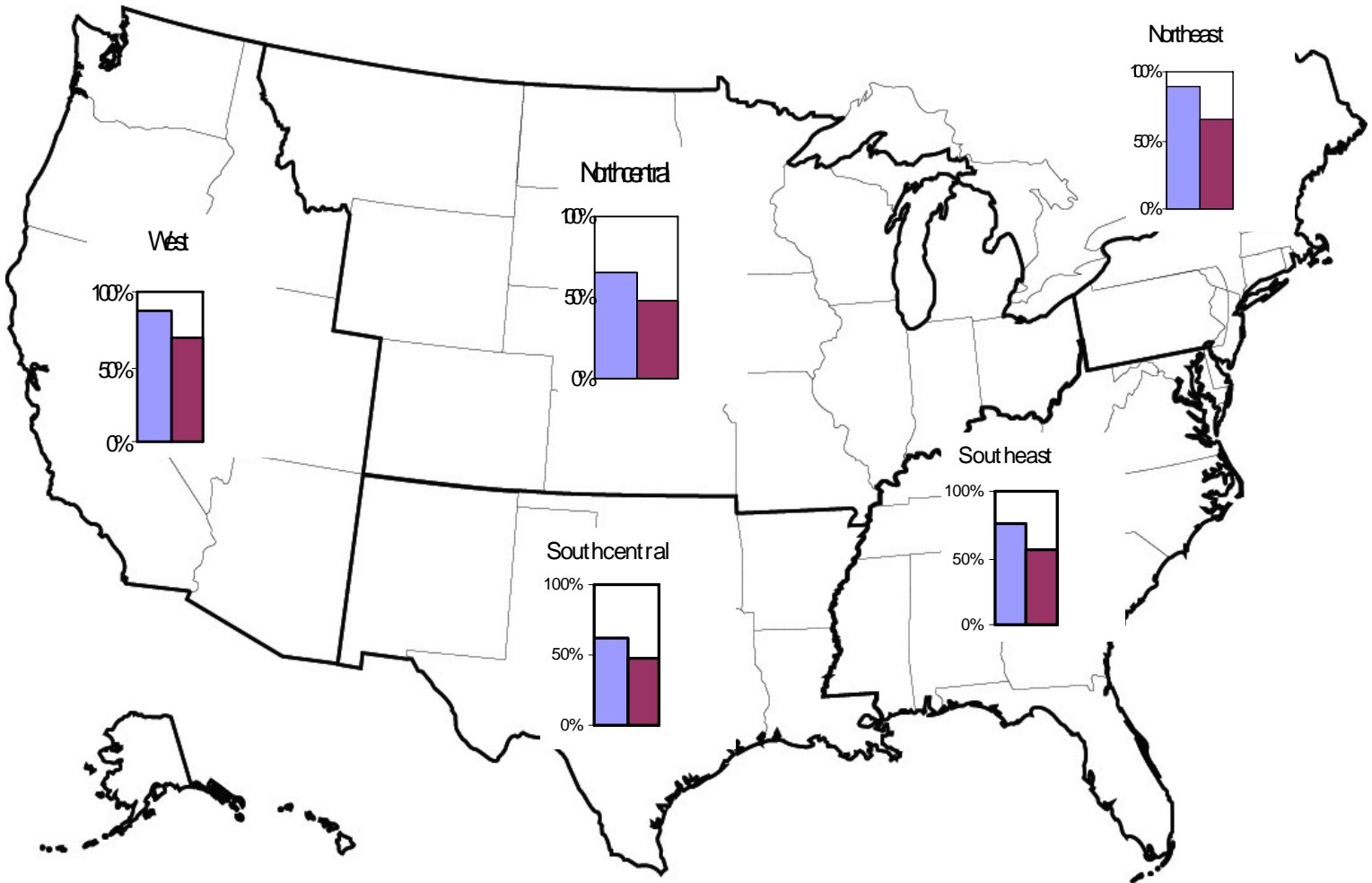
Diffusion of Internet Banking and Growth of Average Bank Size



Diffusion of Web Sites by Bank Assets (Million)



Regional Adoption for Internet Banking (2003)



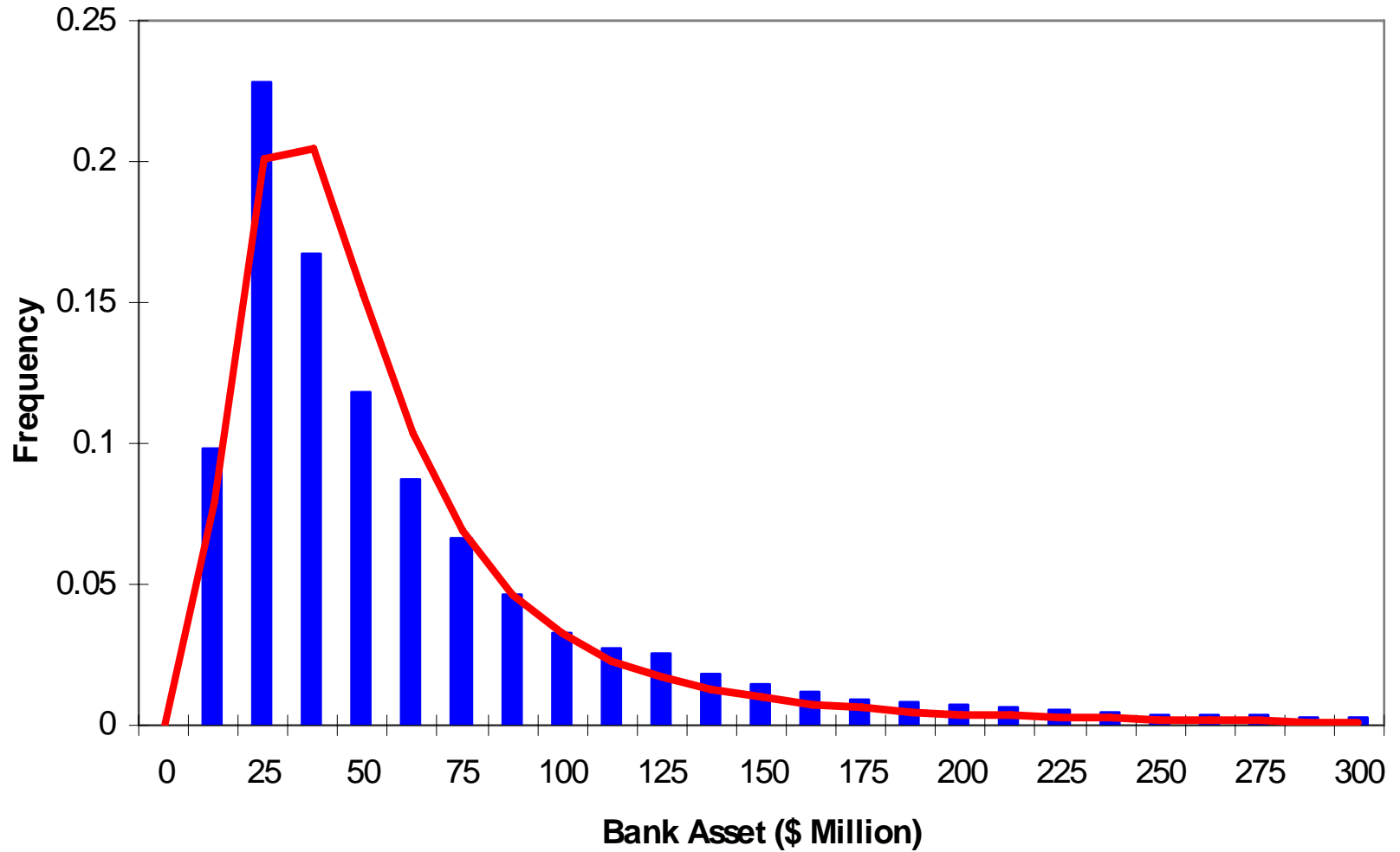
The Hypothesis:

Bank Size Distribution \Leftrightarrow Internet Banking Diffusion

Key Elements:

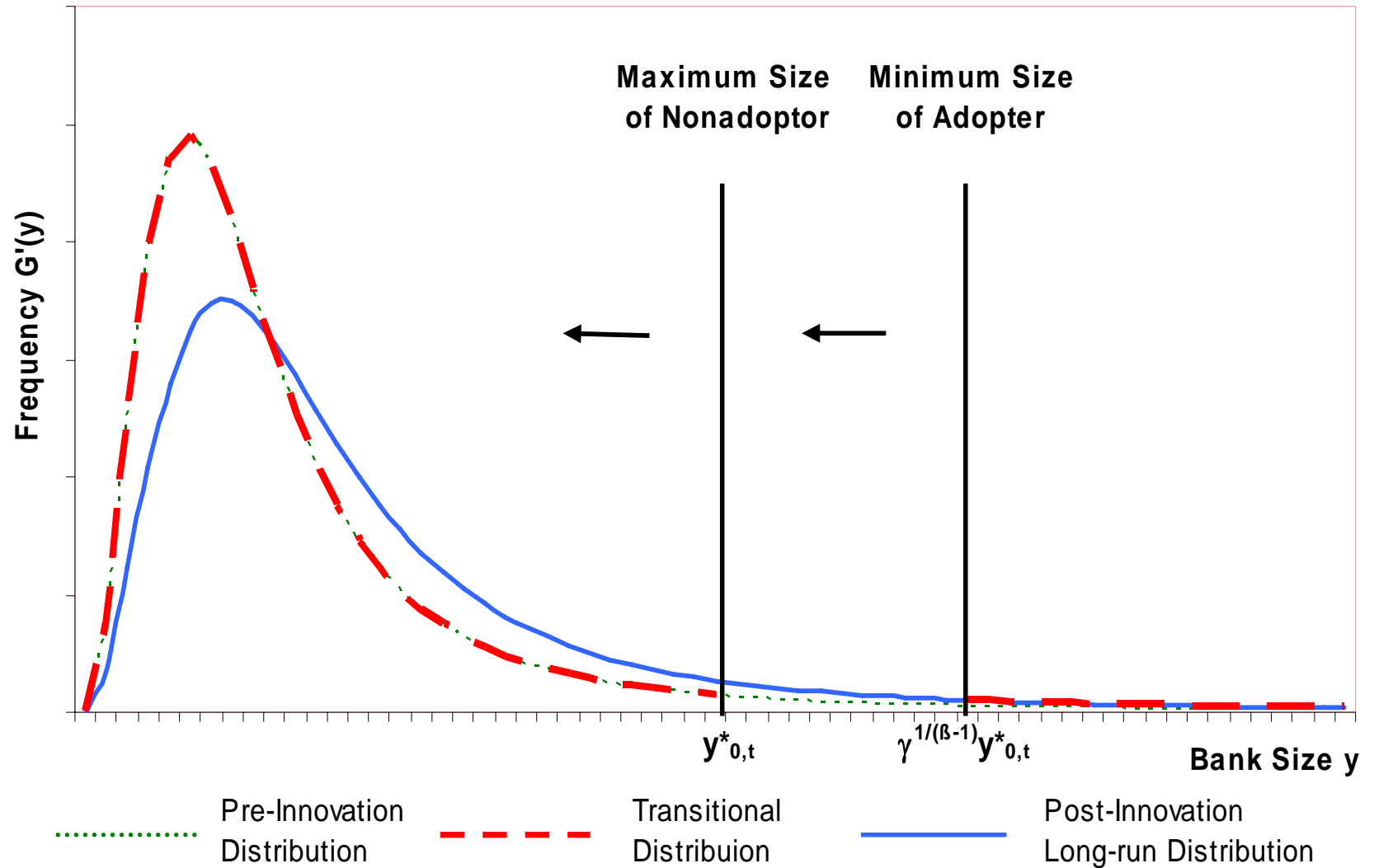
- (1) Considering explicitly the heterogeneity of banks' productivity and deriving empirically plausible bank size distribution;
- (2) Characterizing the endogenous diffusion of Internet banking and its reverse impact on the average bank size;
- (3) Bring the theory to data to explain the diffusion of Internet banking across 50 US states.

Bank Size Distribution (State-Chartered Banks, 1990)



■ Histogram — Log-logistic Distribution

Illustration of the Industry Dynamics



Empirical Study: Simultaneous Equations

Adoption:
$$F = \frac{1}{1 + (\eta y_0^* / E(y_0))^{1/g}}$$

Mean Size :
$$E(y) = E(y_0) \{1 + [\gamma^{1/(\beta-1)} - 1][1 - B(1 + g, 1 - g; 1 - F)]\}$$

Linearization:
$$g \ln\left(\frac{1-F}{F}\right) = a_0 + a_1 \ln E(y) + a_2 \ln(\gamma^{\frac{1}{\beta-1}} - 1) + a_3 (\ln P - \ln k)$$

$$\ln E(y) = b_0 + b_1 \left[g \ln\left(\frac{1-F}{F}\right) \right] + b_2 \ln(\gamma^{1/(\beta-1)} - 1) + b_3 \ln P + \ln E(\alpha^{1/(1-\beta)})$$

Empirical Specification

$$g_{j,t} \ln\left(\frac{1-F_{j,t}}{F_{j,t}}\right) = a_0 + a_1 \ln(E(y)_{j,t}) + \sum_i a_i \ln(X_{i,j,t}) + \sum_j a_3 (\ln I_{l,j,t}) + \varepsilon_{j,t} \quad (\text{Adoption})$$

$$\ln(E(y)_{j,t}) = b_0 + b_1 \left[g_{j,t} \ln\left(\frac{1-F_{j,t}}{F_{j,t}}\right) \right] + \sum_i b_i \ln(X_{i,j,t}) + \sum_l b_l \ln(S_{l,j,t}) + \mu_{j,t} \quad (\text{Size})$$

- $g \ln(1/F-1)$ -- Gini-adjusted state-level IB adoption odds ratio;
- $E(y)$ -- a measure of state-level average bank size;
- X -- shared in both equations, e.g. variables affecting P and γ ;
- I -- only in Adoption equation, e.g. variables affecting k only;
- S -- only in size equation, e.g. variables affecting α only.

Data for Dependent Variables

(with averages for 50 states)

Variable	2003	2004
TRANSAVE	0.573	0.671
TRANODDS	0.898	0.592
WEBAVE	0.757	0.813
WEBODDS	0.391	0.282
GINIASST	0.618	0.620
ASSTAVE (millions)	\$837.9	\$799.5

Explanatory variables used in both equations

(with averages for 50 states)

Variable	2003	2004
AGEAVE	56.6	56.7
METROAVE	0.759	0.763
LNSPAVE	0.365	0.355
PCY (000s)	\$14.8	\$15.2
POPDEN	187	188
INETADPT	58.0	64.0

Explanatory variables used as instruments

(with averages for 50 states)

Adoption equation				
Variable		2003		2004
IMITATE		6.700		7.700
WAGERATIO		3.024		3.058

Asset size equation				
Variable		2003		2004
INTRAREG		0.240		0.240
ASST90 (\$ millions)		\$292.0		\$292.0
BHCAVE		0.772		0.780
DEPINST		0.278		0.328

Adoption of transactional Websites and average bank assets

Simultaneous equation model

Dependent variable:	lnTRANODDS-GINIAVE	lnASSTAVE
lnASSTAVE	-0.1445*	
lnTRANODDS-GINIAVE		-0.3662
lnIMITATE	-0.4852**	
lnWAGERATIO	0.1127	
INTRAREG		0.0235
lnASST90		0.6761***
lnBHCAVE		0.9286
lnDEPINST		-0.1628
lnMETROAVE	-0.1904	0.1074
lnLNSPAWE	-0.3419*	-0.7074*
lnAGEAVE	0.4183***	0.6718**
lnPCY	0.3348	1.9618**
lnPOPDEN	0.1314*	0.3156**
lnINETADPT	-1.6319***	-3.3892**
R-square	0.72	0.78

Equations include year and dummies for regions

Mean Values of Variables Across Regions (2003)

Variable:	Effects on IB	Far West	Plains	New England
OBS.		6	7	6
TRANSAVE		0.768	0.399	0.695
WEBAVE		0.882	0.539	0.967
GINIASST		0.561	0.567	0.536
ASSTAVE	+	\$1,336.7	\$106.7	\$1,562.9
LNSPAVE	-	0.208	0.287	0.430
PCY	+	\$15,523	\$14,694	\$16,734
IMITATE	+	5.83	6.71	6.33
INETADPT	+	63.48	58.77	62.87
BHCAVE	+	0.780	0.867	0.599
ASST90	+	\$579.2	\$42.6	\$324.9
DEPINST	-	0.319	0.164	0.294
POPDEN	-	95.7	39.2	470.4
AGEAVE	-	34.91	80.18	57.46

Estimation strategy and robustness checks

- Assets and deposits to measure size
- OLS on separate structural equations
- Structural estimation
 - Instrumental variables
 - Random effects model using GLS
- Robust standard errors for OLS and IV