

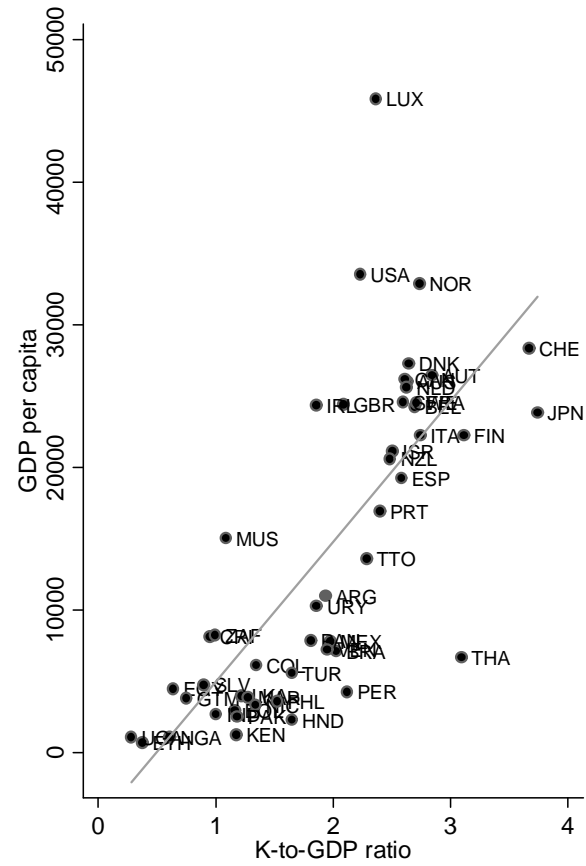
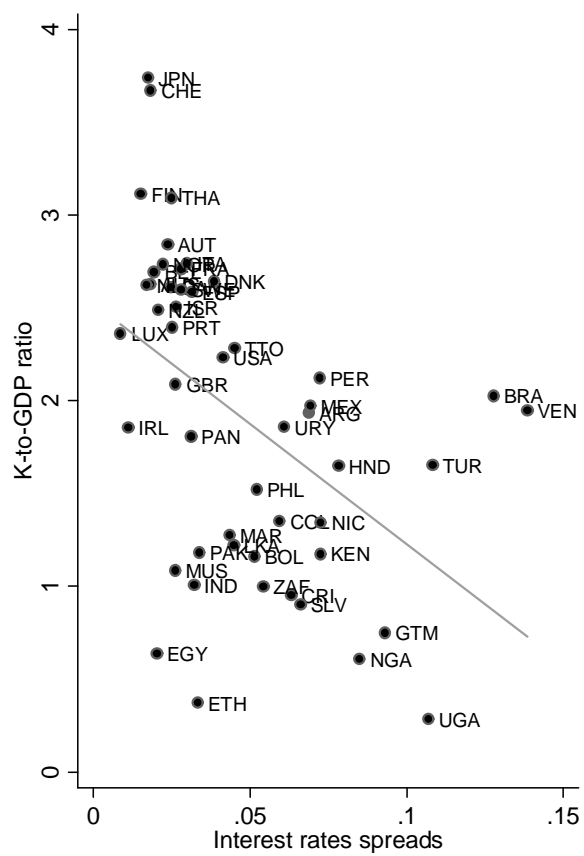
Quantifying the Impact of Financial Development on Economic Development

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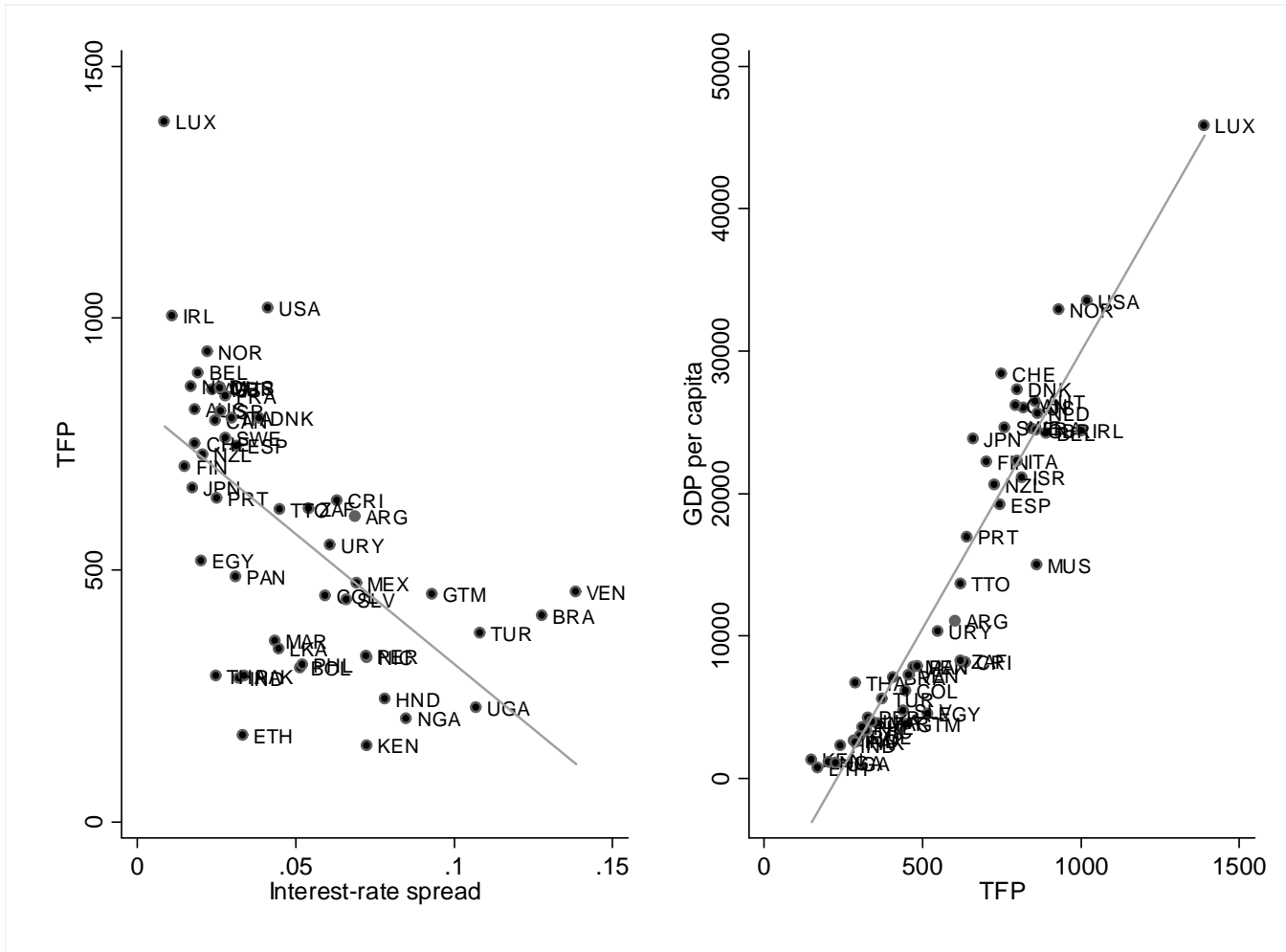
October 2010

1 Introduction

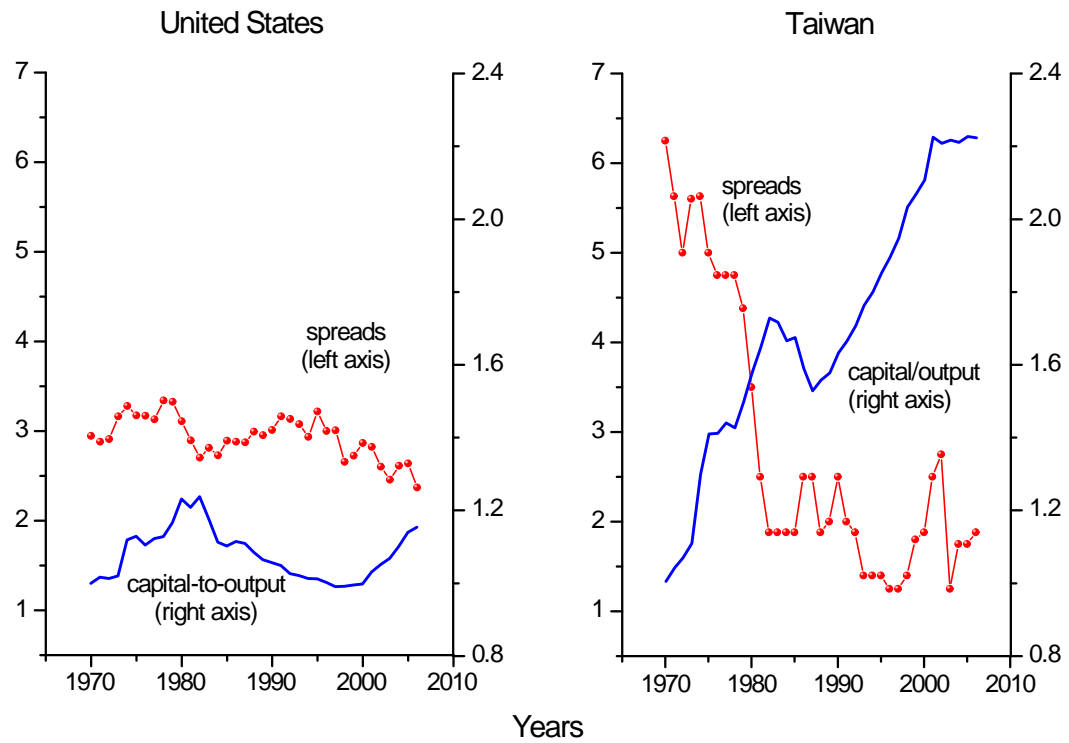
- The efficiency of financial intermediation affects economic development through *capital deepening* and the *reallocation* of labor and capital.
- Illustrated by the cross-country relationship between
 - interest-rate spreads
 - capital-to-output ratios and TFPs



Capital Deepening



1.1 U.S. and Taiwan



Interest-Rate Spreads and Capital/Output Ratios

1.2 Theory

- Costly State Verification Model–Townsend (1979) and Williamson (1986)
 - Efficiency of Monitoring
 - * Depends upon resources devoted to it
 - * Depends upon efficiency in financial sector
 - Ex ante firm heterogeneity in risk and return
- Financial theory of firm size emerges

- Technological progress in the financial sector leads to capital *deepening* and *reallocation*
 - Balanced growth
 - Unbalanced growth

1.3 Quantitative Analysis

- Model calibrated to U.S. data
 - Firm-size distribution, output, interest-rate spreads
- U.S. and Taiwan
 - $1/3$ of U.S. growth
 - $1/2$ of Taiwanese growth

- Cross-Country Analysis—45 countries
 - Uganda
 - * financial best practice could raise output by 145% and TFP by 30%
 - World
 - * financial best practice could raise output by 65%
 - Bulk of variation in world output (64%) is *not* explained by financial factors

2 The Model

2.1 Firms

- Produce output,

$$o = x\theta k^\alpha l^{1-\alpha}$$

- x , aggregate TFP
- $\theta \in \tau \equiv \{\theta_1, \theta_2\}$, with $\theta_2 > \theta_1$
- $\pi_1 = \Pr(\theta = \theta_1)$ and $\pi_2 = 1 - \pi_1 = \Pr(\theta = \theta_2)$
- realization is private information

2.2 Intermediaries

Borrow from consumers and lend to firms.

- k , size of loan to firm (capital)
- θ_j , state reported by firm
- θ_i , true state realized by firm
- l_{mj} , labor devoted to monitoring a claim of state j

2.2.1 Monitoring Technology

- $P_{ij}(l_{mj}, k, z)$, probability that the firm is caught *cheating* (for $i \neq j$) when:
 - true realization of productivity is θ_i
 - firm makes a *false* report of $\theta_j \neq \theta_i$
 - z , financial sector productivity
 - P_{ij} is increasing in l_{mj} and z , decreasing in k
 - Odd *not* caught cheating

$$1 - P_{ij}(m_j/k) = \frac{1}{\epsilon(z/k)^\psi (l_{mj})^\gamma}, \text{ with } 0 < \psi < 1.$$

2.3 Contracting Problem

2.3.1 Notation

- \tilde{r} , cost of capital for the intermediary
 - return to savers plus capital consumption
- r_i , *internal* return on firm's capital in state i
- w , equilibrium wage rate

$$r_i = R(\theta_i, w)k \equiv \max_{l_i} \{x\theta_i k^\alpha l_i^{1-\alpha} - wl_i\}$$

2.3.2 Problem

$$v \equiv \max_{k, l_{m1}} \underbrace{\{\pi_2[1 - P_{21}(l_{m1}, k, z)][r_2(\tau) - r_1(\tau)]k\}}_{\text{firm's rents}},$$

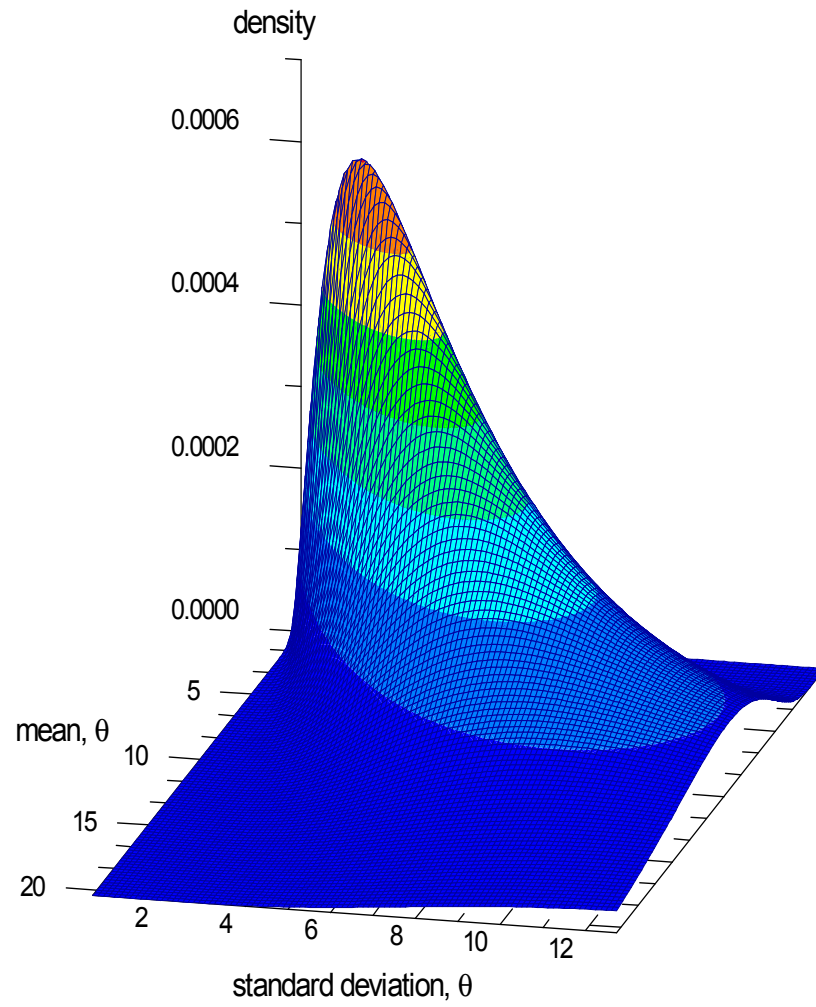
subject to:

- Intermediary's zero-profit condition

$$\underbrace{[\pi_1 r_1(\tau) + \pi_2 r_2(\tau)]k}_{\text{Expected return}} - \underbrace{\pi_2[1 - P_{21}(l_{m1}, k, z)][r_2(\tau) - r_1(\tau)]k}_{\text{firm's rents}} - \underbrace{\pi_1 w l_{m1}}_{\text{monitoring cost}} = \underbrace{\tilde{r}k}_{\text{cost of capital}}$$

2.4 Equilibrium

- Firms differ by publicly observable type, $\tau = (\theta_1, \theta_2)$
- \mathcal{T} , space of firm types.
- $\tau \sim F : \mathcal{T} \rightarrow [0, 1]$



The F distribution – in mean/variance space

- A necessary and sufficient condition for a type- τ firm to be active or funded is

$$\tau \in \underbrace{\mathcal{A}(w)}_{\text{set of funded projects}} = \left\{ \tau : \underbrace{\pi_1 r_1 + \pi_2 r_2}_{\text{expected return}} - \tilde{r} > 0 \right\}$$

- Labor market must clear
 - determines equilibrium wage rate

$$\int_{\mathcal{A}(w)} [\pi_1 l_1(\theta_1, \theta_2) + \pi_2 l_2(\theta_1, \theta_2) + \pi_1 l_{m1}(\theta_1, \theta_2)] dF(\theta_1, \theta_2) = 1$$

3 Discussion

- *Rents*

- Excess profits

$$r_1(\tau) + \pi_2 r_2(\tau) > \tilde{r}$$

- Undeserving firms get funded

$$\mathcal{B}(w) \equiv \{\tau : \max_{\tau \in \mathcal{I}} [\pi_1 r_1(\tau) + \pi_2 r_2(\tau)]\} \subseteq \mathcal{A}(w)$$

- *Loan Size*

- Increasing in expected return, $r_1(\tau) + \pi_2 r_2(\tau)$

– Decreasing in risk, $\propto r_2(\tau) - r_1(\tau)$

- Balanced Growth

– x grows over time at the constant rate $g^{1/\alpha}$

– z grows at rate g

– Interest-rate spread, capital-to-output ratio, and firm size are constant

- Unbalanced Growth

– Growth in z exceeds growth in x .

– $\mathcal{A}(w) \longrightarrow \mathcal{B}(w) \equiv \{\tau : \max_{\tau \in \mathcal{T}} [\pi_1 r_1(\tau) + \pi_2 r_2(\tau)]\}$

– Interest-rate spread narrows

$$* \max_{\tau} [\pi_1 r_1(\tau) + \pi_2 r_2(\tau)] \longrightarrow \tilde{r}$$

– Capital-to-output ratio rises

4 Calibration

- Model fit to U.S. economy
- Standard parameters given standard values
- Other parameters picked to minimize the distance between model and some data targets
- Data Targets, 1974 and 2004
 1. Establishments size distribution for firms
 2. Interest-rate spread, s , and output, o

4.1 Minimization Routine

$p = (\epsilon, \psi, \gamma, \mu_{\theta_2}, \sigma_{\theta_1}^2, \sigma_{\theta_2}^2, \rho)$, parameter vector

$$\min_p \left\{ \underbrace{\sum_j \frac{w_j}{2} \left[\overbrace{e_{j,74}^{US}}^{\text{Data}} - \overbrace{M_j(x_{74}^{US}, z_{74}^{US}, p)}^{\text{Model}} \right]^2 + \sum_j \frac{w_j}{2} [e_{j,04}^{US} - M_j(x_{04}^{US}, z_{04}^{US}, p)]^2}_{\text{Firm-Size Distribution-deviations, data and model}} \right\},$$

subject to

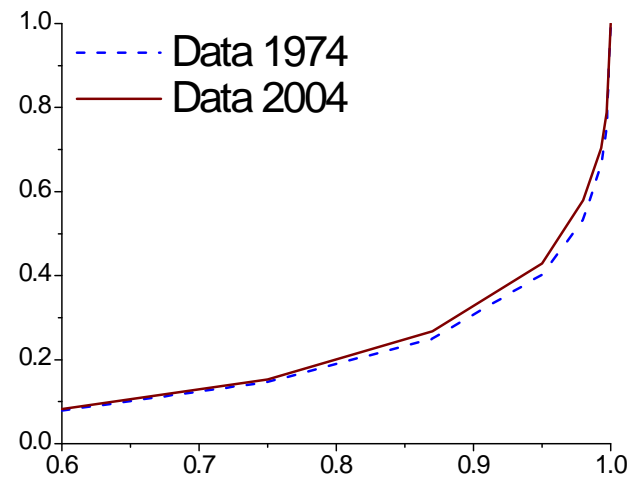
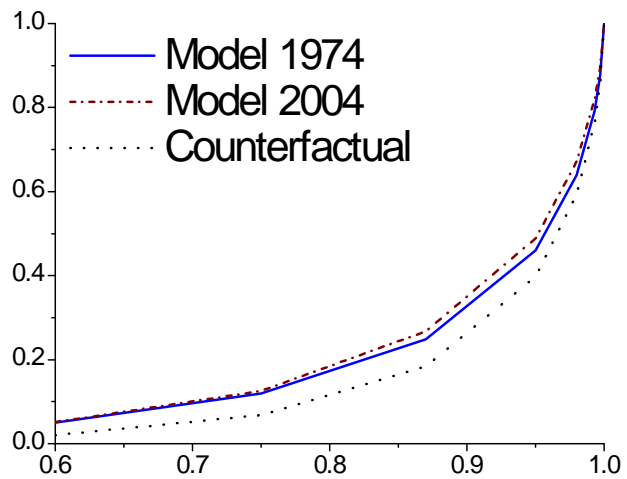
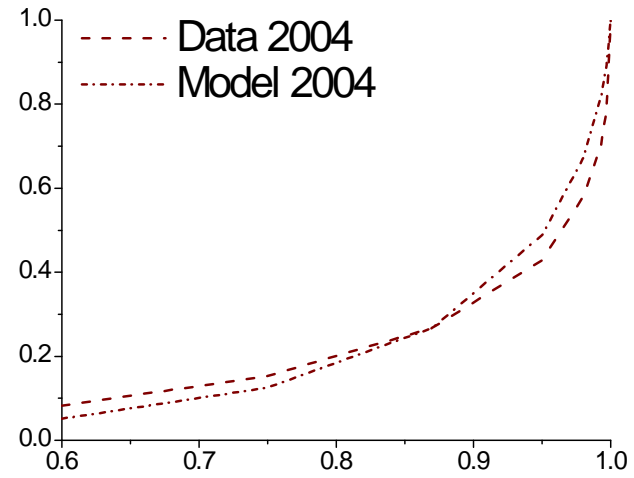
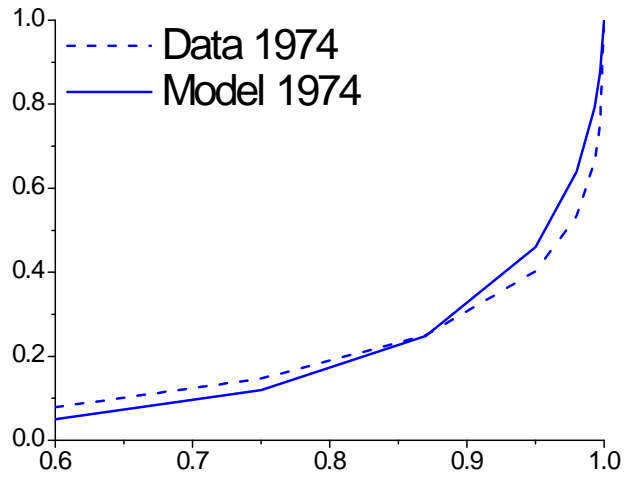
- Match observed output and interest-rate spreads

$$(o_{74}^{US}, s_{74}^{US}) = O(x_{74}^{US}, z_{74}^{US}; p),$$

and

$$(\mathbf{o}_{04}^{US}, \mathbf{s}_{04}^{US}) = O(x_{04}^{US}, z_{04}^{US}; p).$$

Employment, Cumulative Share



Establishments, Percentile

5 U.S. and Taiwan

5.1 U.S.–Balanced Growth

- Balanced Growth between 1974 and 2004
 - Firm-size distribution, small change.
 - Interest-rate spread, modest decline.
 - Capital/output ratio, small increase.

- Technological Improvement in the financial sector
 - Model, 2.6 percent a year
 - Data, 2.2 percent a year (Berger, 2003)
 - Contribution to growth, 1/3
 - * Economy in 2004 with ≈ 1974

The U.S. Economy

	<i>Data</i>	<i>Model</i>
<i>1974</i>		
Spread, s	3.07%	3.07%
GDP (per capita), o	\$22,352	\$22,352
capital-to-output ratio (indexed), k/o	1.00	1.00
TFP		6.63
<i>2004</i>		
Spread, s	2.62%	2.62%
GDP (per capita), o	\$41,208	\$41,208
capital-to-output ratio (indexed), k/o	1.02	1.10
TFP		9.54
<i>2004 Counterfactual, $z_{2004}^{US} = z_{1974}^{US}$</i>		
Spread, s	2.62	3.87
GDP (per capita), o	\$41,208	\$33,656
capital-to-output ratio (indexed), k/o	1.02	0.86
TFP		9.12
Yearly growth in financial productivity		2.59%

5.2 Taiwan–Unbalanced Growth

- Unbalanced growth between 1974 and 2004
 - Interest-rate spread, large drop
 - Capital/output ratio, large increase
- Technological Improvement in the financial sector
 - Model, 9.9 percent a year
 - Contribution to growth, 1/2

The Taiwan Economy

	<i>Data</i>	<i>Model</i>
<i>1974</i>		
Spread, s	5.41%	5.41%
GDP (per capita), o	\$2,211	\$2,211
capital-to-output(indexed), k/o	1.00	1.00
TFP		1.68
<i>2004</i>		
Spread, s	1.96%	1.96%
GDP (per capita), o	\$13,924	\$13,924
capital-to-output(indexed), k/o	1.847	1.905
TFP		4.46
<i>2004 Counterfactual, $z_{2004}^T = z_{1974}^T$</i>		
Spread, s	1.96%	9.66%
GDP (per capita), o	\$13,924	\$5,676
capital-to-output(indexed), k/o	1.847	0.630
TFP		3.66
Yearly growth in financial productivity		9.89%

6 Cross-Country Analysis

- Take model calibrated to the U.S. economy.
- Make an inference about x and z given an observation on \mathbf{o} and \mathbf{s} , using

$$(x, z) = O^{-1}(\mathbf{o}, \mathbf{s}).$$

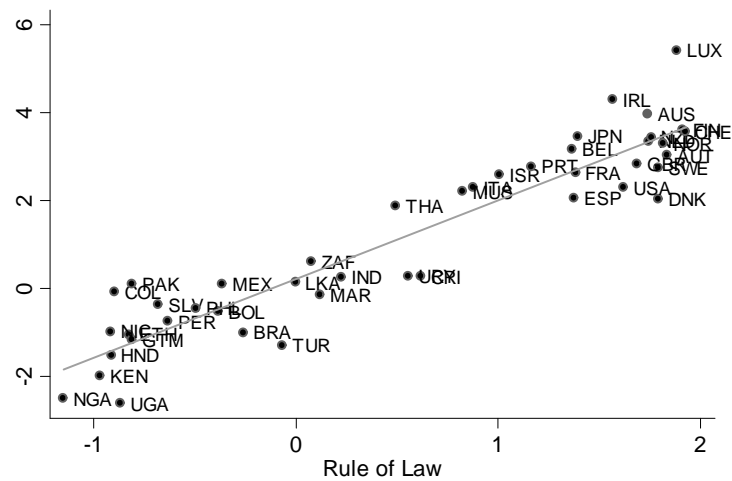
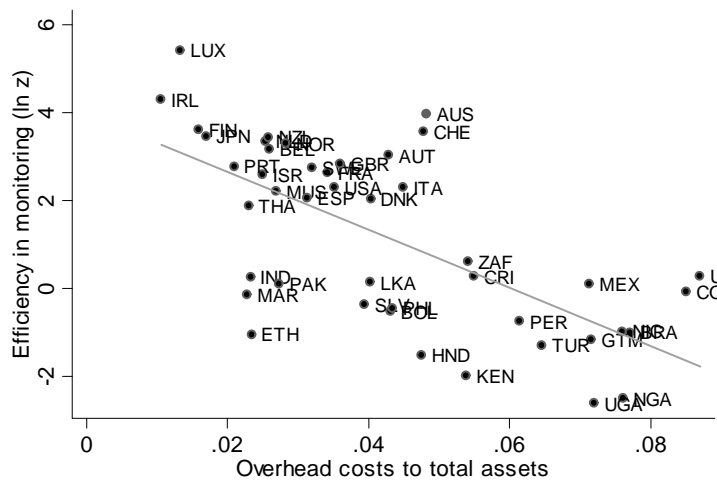
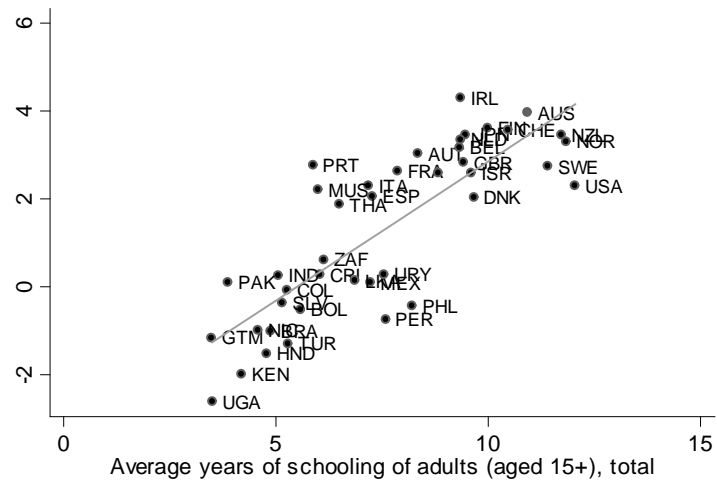
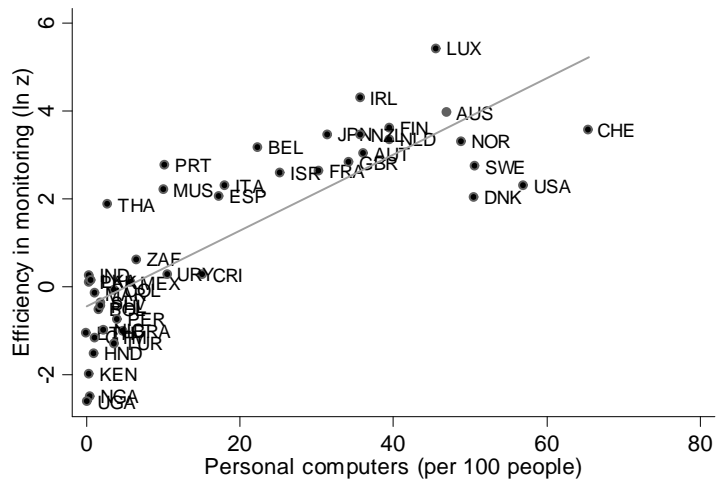
- Do this for a sample of 45 countries.

6.1 How Reasonable is z ?

- In z correlates well with the Beck et al measure of efficiency in the financial sector

Cross-Country Evidence	
In z with Beck et al (2000, 2001)	
<i>Corr(model, data)</i>	0.81

- In z correlates well with measures of IT use, overhead costs, human capital and rule of law



6.2 Financial Development and Firm Size

- Firms should be larger in countries with better developed financial systems
 - Beck, Demirgüç-Kunt, and Maksimovic (2006)
 - Run regression of firm size on spreads

$$\ln(\text{size}) = \text{constant} + \eta \times \text{spread} + \iota \times \text{controls}.$$

Cross-Country Firm-Size Regressions

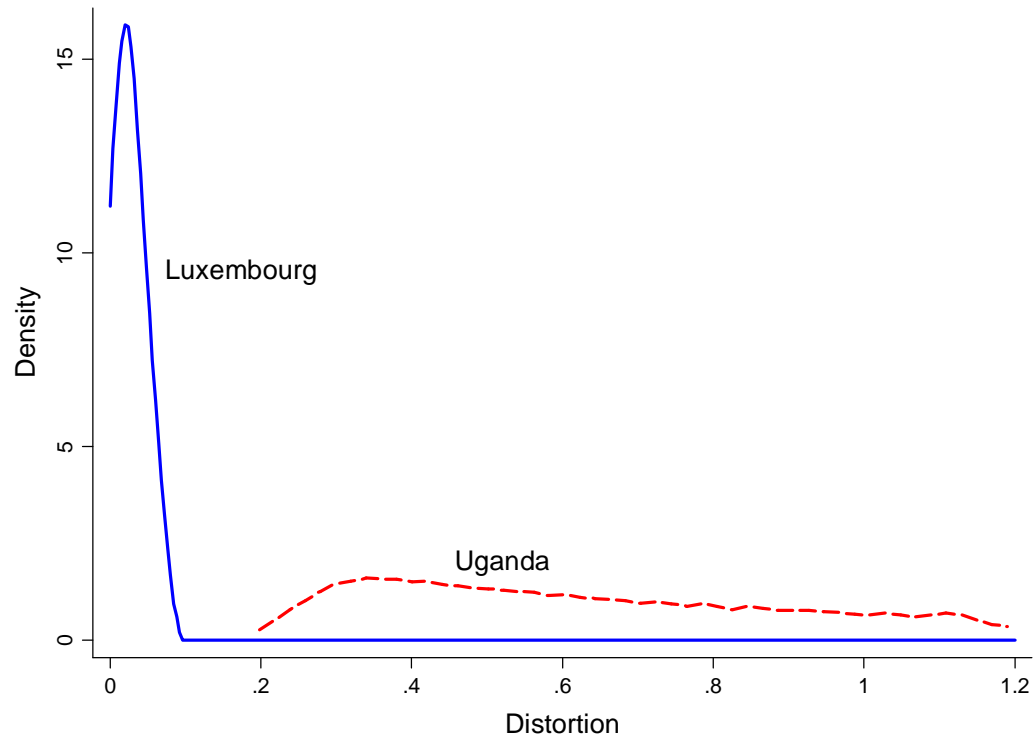
	<i>Data</i>	<i>Model</i>
Interest-rate spread coefficient, η	-0.16	-0.19
Standard error for η	0.07	0.03
Number of country observations	29	29
R^2	0.51	0.93

6.3 Idiosyncratic Distortions

- Restuccia and Rogerson (2008)
 - Idiosyncratic distortions across firms can generate large TFP differences (30 to 50 percent)
 - Information frictions put a distortion, d , in investment decision

$$d = \pi_1 r_1 + \pi_2 r_2 - \tilde{r}$$

- Mean variance of the distortion are much larger in countries with less developed financial system



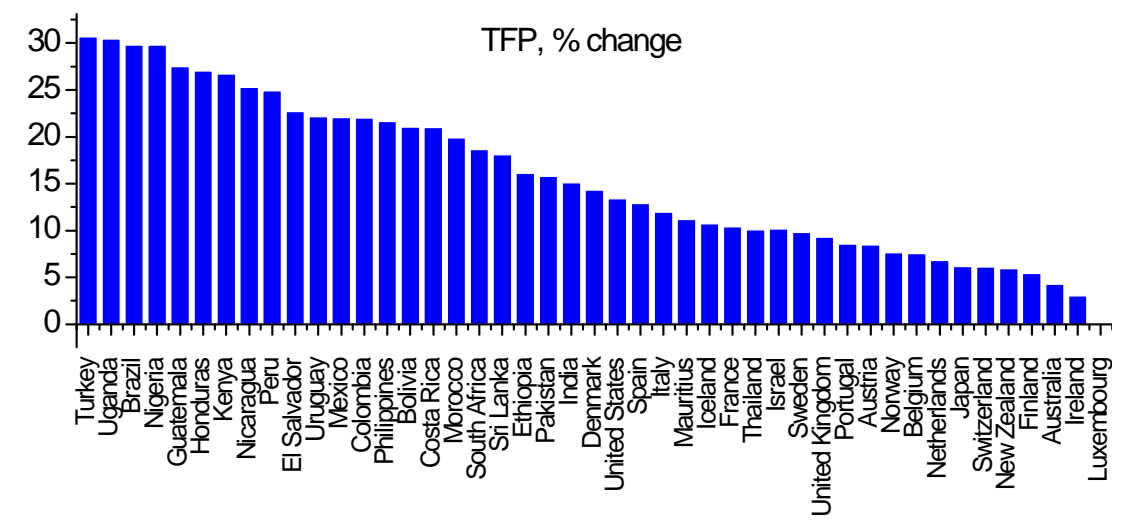
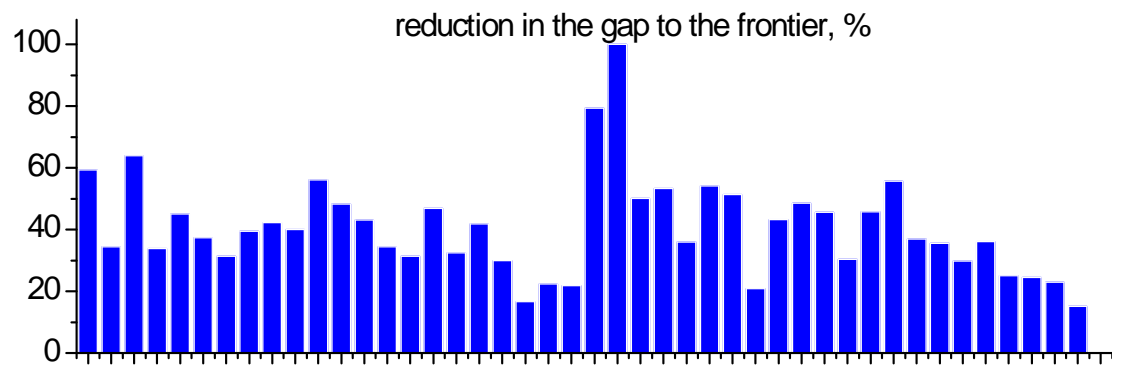
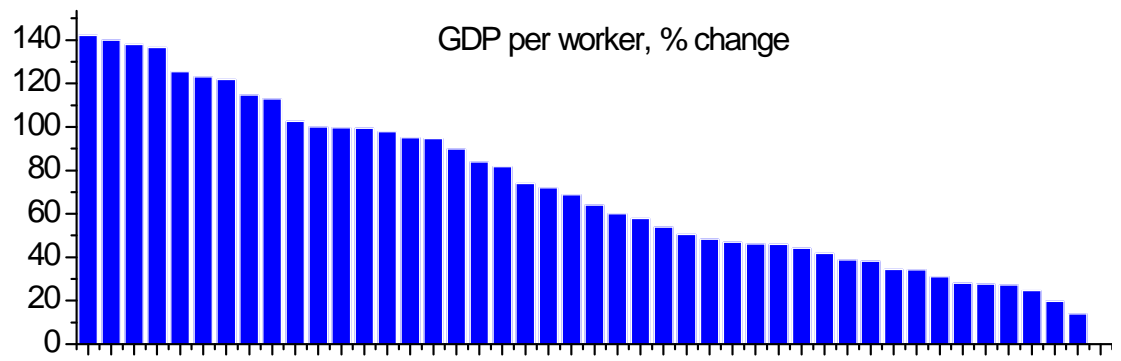
The distribution of distortions across establishments for the Luxembourg and Uganda—the model

6.4 How much does Financial Development Matter?

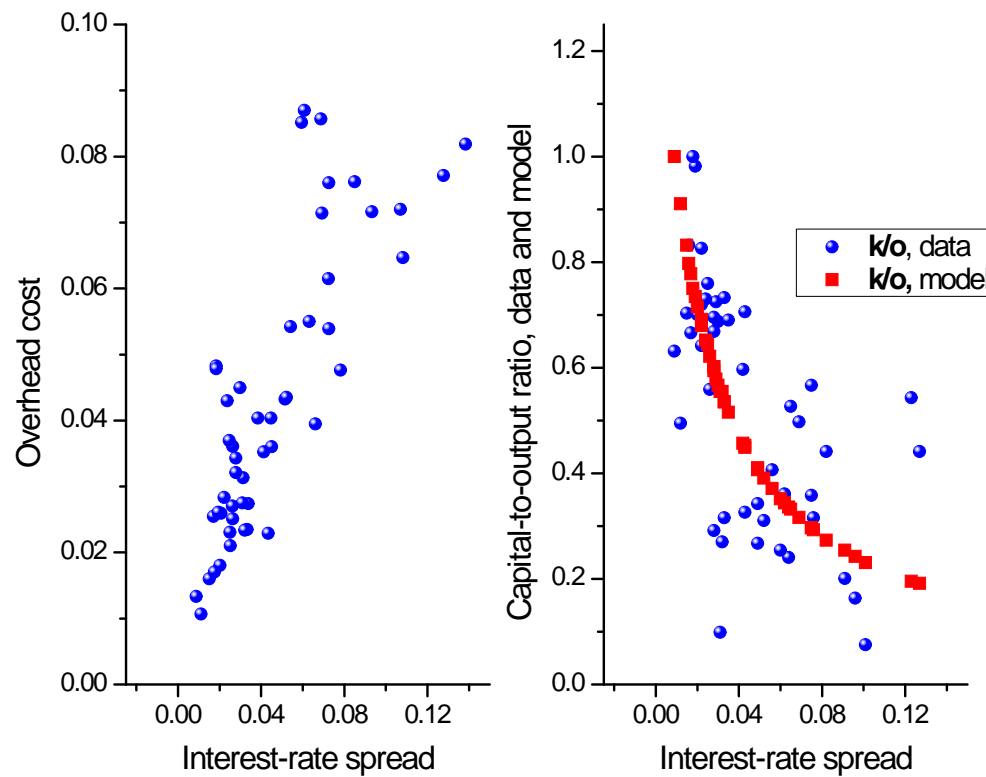
- Best financial practice, $\bar{z} = \max\{z_i\}$.
- Best industrial practice, $\bar{x} = \max\{x_i\}$.
- Country i 's output (per worker), $\mathbf{O}(x_i, z_i)$.
- Country i 's output with best financial practice, $\mathbf{O}(x_i, \bar{z})$.
- Output with best practice in both sectors, $\mathbf{O}(\bar{x}, \bar{z})$.
- Gap in output, $\mathbf{O}(\bar{x}, \bar{z}) - \mathbf{O}(x_i, z_i)$.

World-Wide Move to Best Financial Practice, \bar{z}

Increase in world output (per worker)	65%
Reduction in output gap	35.6%
Increase in world TFP	17.4%
Fall in dispersion of $\ln(\text{output})$	27.2 perc pts
Fall in mean of distortion	20.8 perc pts
Fall in mean dispersion of distortion	13.5 perc pts



6.5 Robustness Analysis—Alternative Matching Strategies



World-Wide Move to Best Financial Practice, \bar{z}

	<i>Matching Methodology</i>		
	s	k/o	ϕ
Increase in world output	65%	51.6%	72.7%
Reduction in output gap	35.6%	29.9%	44.4%
Increase in world TFP	17.4%	14.2%	16.1%
Fall in dispersion of $\ln(\text{output})$	27.2%	45.1%	20.5%

6.5.1 Intangible Investments and Capital's Share of Income

- Corrado, Hulten, and Sichel (2007)–investment in intangibles is important
 - GDP should be 12 percent higher
 - Capital's share of income should be

$$\alpha = 1 - \frac{\text{GDP}}{\text{o}} \times \text{LSI} = 1 - \frac{1}{1.12} 0.67 = 0.41$$

World-Wide move to best financial practice, \bar{z}

$\alpha = 0.41$ (intangible capital)

Increase in world output	88.2%
Reduction in output gap	43.5%
Increase in world TFP	33.1%
Fall in dispersion of $\ln(\text{output})$	34.4% ($\simeq 111.4\% - 77.0\%$)

7 Conclusions

- Explore the link between financial intermediation and economic development
- Embed a costly-state-verification paradigm into the standard growth model
- Firm-size distribution depends on financial development
- Balanced growth path
 - Interest-rate spread, capital-to-output, and firm size constant

- Unbalanced growth
 - Rents get squeezed
 - Interest-rate spreads narrow
 - Reallocation of funds toward the most profitable firms
 - Capital/output ratios and TFP rise

- Mechanism has quantitative significance
 - Relationship between firm size and financial development is similar in the model and data
 - Wedges created by financial frictions resemble idiosyncratic distortions in Restuccia and Rogerson (2008)

- Improvements in intermediation are important for growth in the US and Taiwan

- Differences in financial development are important across countries
 - Move to best practice
 - * Uganda–financial best practice could raise output by 145% and TFP by 30%

 - * Ireland–financial best practice could rise output by 14% and TFP by 3%

 - * World TFP would increase by 18 to 33 percent

 - * World output would increase by 65 to 88 percent