

The Trilemma, International Currencies, Capital Controls and Financial Development

Menzie D. Chinn

University of Wisconsin, Madison
and NBER

Central German Doctoral Program
Economics

Leipzig Universität

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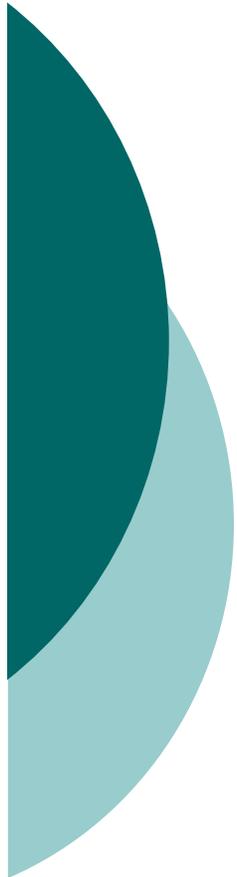
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Outline of Week

1. Trilemma
2. Trilemma vs. Dilemma/Capital Controls
3. ***Capital Controls/Financial Development/Int'l Currencies***
4. International Currencies



Capital Controls: Efficacy (2)



What is the definition of “working”?

- Insulation from external influences – *yes, for interest rates*
- Reduce capital inflows/outflows – *yes, for walls*
- Reduce capital inflows/outflows at specific times – *maybe*
- Alter composition of capital inflows/outflows – *yes, in some cross section analyses*
- **But what about costs?**

Modern Capital Controls: Chile

Table 1
Main changes in the URR administration

Jun-1991		20% URR introduced for all new credit Holding period (months) = $\min \langle \max \langle \text{credit maturity}, 3 \rangle, 12 \rangle$ Holding currency = same as credit Investors can waive the URR by paying a fix fee (through a repo agreement at discount in favor of the central bank) Repo discount = US\$ libor
Jan-1992	1	20% URR extended to foreign currency deposits with proportional HP
May-1992	2	Holding period (months) = 12 URR increased to 30% for bank credit lines
Aug-1992		URR increased to 30% Repo discount = US\$ libor + 2.5%
Oct-1992		Repo discount = US\$ libor + 4.0%
Jan-1995	3	Holding currency = US\$ only
Jul-1995	4	URR extended to secondary ADR
Sep-1995	5	Period to liquidate US\$ from Secondary ADR tightened
Dec-1995		Foreign borrowing to be used externally is exempt of URR
Oct-1996	6	FDI committee considers for approval productive projects only
Dec-1996		Foreign borrowing < US\$ 200,000 (500,000 in a year) exempt of URR
Mar-1997	7	Foreign borrowing < US\$ 100,000 (100,000 in a year) exempt of URR
Jun-1998		URR set to 10%
Sep-1998		URR set to zero

Sources: Le Fort and Sanhueza (1997) and Laurens and Cardoso (1998).
The numbers identify a change we consider in constructing the power index.

Source: De Gregorio, Edwards, Valdes (2000)



Tax equivalent of URR (short)

For $k < h$ (h months held at CB)

$$i_k \equiv i^* + \mu_k. \quad (1)$$

1. At $t = 0$ the investor has available the remaining after depositing the reserve requirement. That is, he invests $(1 - u)$ at i_k .
2. At $t = k$ the loan has to be paid. The cash flow is: $-(1 + i^*)^{k/12}$.
3. At $t = h$ the reserve requirement is returned, and hence, the cash flow is u .

Therefore, the annual rate i_k , at which the investor is indifferent between investing at home and abroad (computing all values as of time h , when u is returned) is:

$$(1 - u)(1 + i_k)^{k/12}(1 + i^*)^{(h-k)/12} + u = (1 + i^*)^{h/12}. \quad (2)$$

Solving for i_k we find the tax-equivalent of the URR:

$$(1 + i_k)^{k/12} = \frac{(1 + i^*)^{k/12} - u(1 + i^*)^{(k-h)/12}}{1 - u} \equiv (1 + i^* + \mu_k)^{k/12}. \quad (3)$$

6



Tax equivalent of URR (long)

The tax equivalence of the URR is somewhat more complicated when the investment horizon exceeds one year (the required URR period). In this case, the investor has to decide whether, at the end of the year, to maintain the 30% corresponding to the URR in Chile, or to deposit it outside the country. For simplicity we first assume that this decision is made in $t = 0$. If the returned reserves are deposited at i^* , then the no-arbitrage condition is the same as in the case of $k < h$ (given by Eq. (3)). However, if the returned reserves are deposited domestically at a rate i_k , then the implied interest rate-equivalent cost is smaller.

$$\tilde{\mu}_k = i^* \frac{u}{1-u} \frac{h}{k}. \quad (7)$$

Tax equivalents

Table 2
Tax equivalents of the URR

Maturity	$\bar{\mu}_k$	$\bar{\mu}_{k'}$	μ_k	$\tilde{\mu}_k$
1	23.38	45.53	22.85	30.86
3	7.95	11.42	7.13	10.29
6	3.95	4.66	3.51	5.14
9	2.77	2.93	2.32	3.43
12	2.18	2.18	1.74	2.57
18	1.60	1.51	1.16	1.71
24	1.30	1.20	0.87	1.29
36	1.01	0.91	0.58	0.86

Taxes
abroad
included

Taxes abroad
included,
payment
repatriated

No taxes
abroad
included

Simplified
Formula,
taxes abroad



Empirical specification

$$F_t = \beta_0 + \beta_1(i_t - i_t^* - \hat{e}_t^e - \mu_t) + \beta_3 Z_t.$$

- F is a type of flow (short, total)
 - Z a vector of exogenous variables, e.g. RANK, CA, etc.
- \hat{e}_t^e proxied by ex post, or by ARMA

Effect on Flows

$$F_t = \beta_0 + \beta_1(i_t - i_t^* - \hat{e}_t^e - \mu_t) + \beta_3 Z_t. \quad (10)$$

$$F_t = \beta_0 + \beta_1(i_t - i_t^* - \hat{e}_t^e) + \beta_2 \mu_t + \beta_3 Z_t. \quad (11)$$

URR, Short-term, and total capital flows

Dep. var.:	Short-term inflows/GDP			
	4.1	4.2	4.3	4.4
	μ	μ	μ	$p \times \mu$
\hat{e}^e : effective UF/dollar depreciation				
$i - i^* - \hat{e}^e$	0.25 (3.57)	0.24 (3.18)	0.10 (1.43)	0.19 (2.97)
μ or $p \times \mu$	-6.56 (-3.53)	-4.37 (-3.23)	-2.48 (-2.56)	-7.84 (-3.40)
Curr. acc./GDP	-0.67 (-3.76)	-0.74 (-2.49)		-0.67 (-2.06)
GDP growth	1.03 (3.76)	1.05 (3.56)		1.03 (3.64)
RANK				-0.23 (-2.01)
R^2	0.23	0.15	0.13	0.22
N Obs.	40	40	40	40
F -stat	3.15	5.04	5.06	3.09
D.W.	2.10	1.94	1.95	2.31

Effect on Flows

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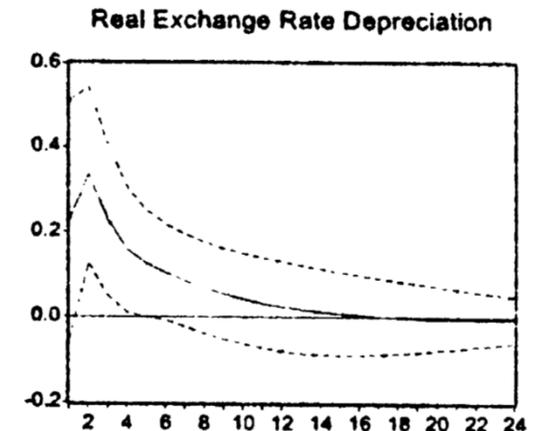
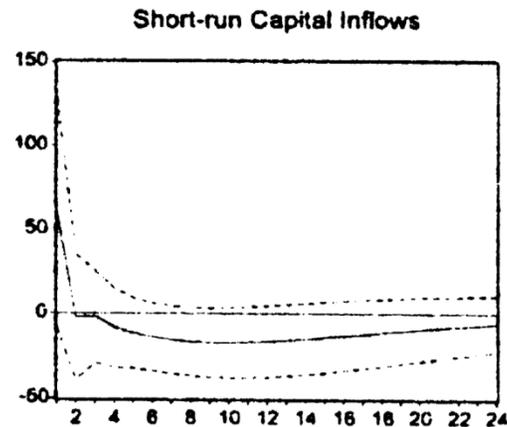
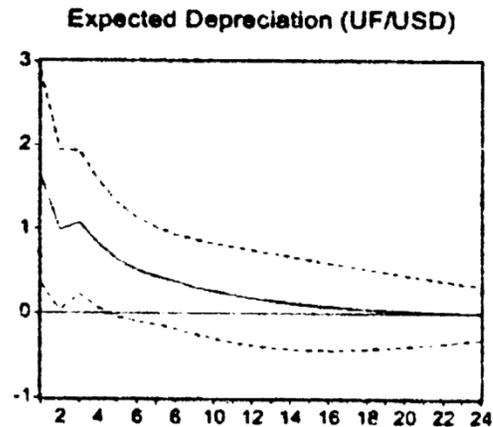
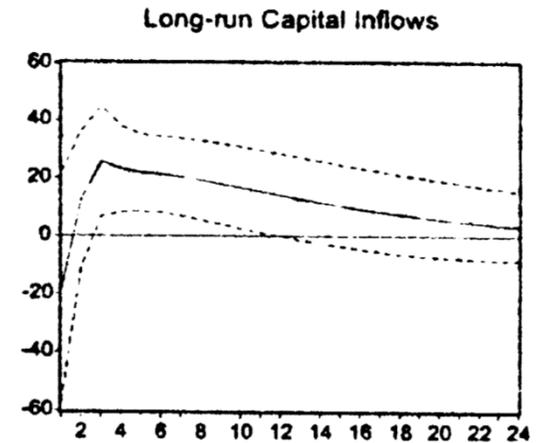
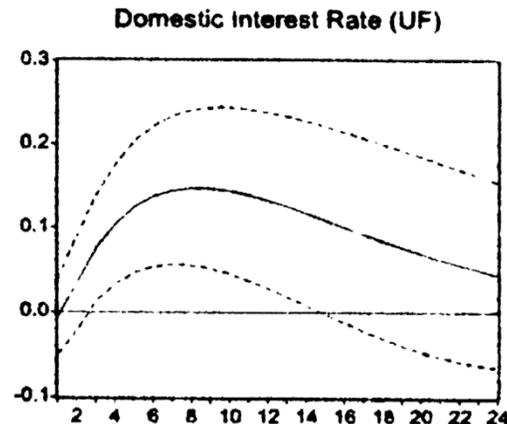
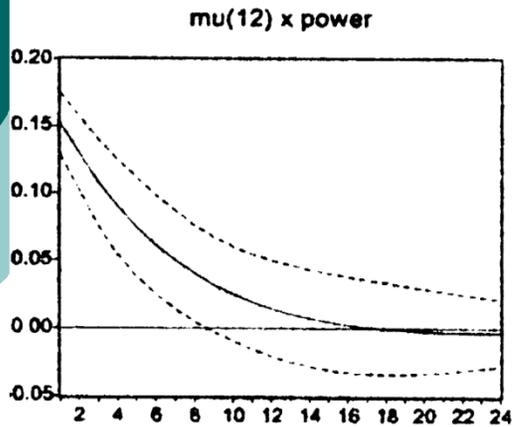
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Total inflows/GDP

4.5 μ	4.6 μ	4.7 μ	4.8 $p \times \mu$
0.23 (3.32)	0.21 (3.05)	0.12 (2.27)	0.20 (3.33)
-2.43 (-0.93)	-0.70 (-0.59)	1.25 (1.22)	-0.57 (-0.44)
-0.99 (-3.72)	-0.95 (-3.98)		-0.85 (-2.92)
0.07 (0.17)			
-0.15 (-1.82)			
0.12	0.12	0.09	0.16
40	40	40	40
2.57	4.36	1.88	3.69
1.84	1.77	1.76	1.76

VAR Analysis: shock to μ x power

Response Functions ± 2 S.E.



- (1) Exogenous variables: - 6-month labor in dollars
 - JP Morgan Emerging Market Bond Indicator
- (2) Monthly data, 1991.1-1998.6.
- (3) VAR estimation with 1 lag.



Conclusions

point estimates indicate the following numerical effects of the Chilean 30% URR (according to the VARs reported that include short- and long-term flows). The domestic interest rate increases between 130 and 150 basis points. Short-term flows decrease by around USD750 millions, long-term inflows increase around USD 1300 millions, whereas the overall inflow is practically unaffected. The real exchange rate effect, on the other hand, is rather small. A 30% URR results in a depreciation of the RER of approximately 2.5%.

The increase in the domestic cost of capital associated with higher interest rates is, of course, an important cost of the URR. Why must firms borrow with a tax if the world is willing to lend cheaper? Additionally, since the URR penalizes more short-term credit, the yield curve tends to be inverted. Small firms, that cannot issue long-term bonds in international capital markets, have to borrow at a differential interest rates higher than similar firms in other countries. In other words there is a bias against firms that cannot borrow long, which are usually small business and firms that are starting operations.

Costs and Micro Effects

(Forbes, 2007)

- Do capital controls exacerbate the collateral constraints on firms?
- Use Chilean , Worldscope data:

$$\left(\frac{I}{K}\right)_{it} = \theta_0 + \theta_1 \left(\frac{I}{K}\right)_{i,t-1} + \theta_2 \left(\frac{\text{Sales}}{K}\right)_{it} + \theta_3 \left(\frac{\text{Cash}}{K}\right)_{it} + \theta_4 \left(\frac{\text{Cash}}{K} * \text{Size}\right)_{it} + f_i + d_t + \varepsilon_{it}. \quad (13)$$

Question: Does this coefficient vary with regime?

Empirics

Table 6
Base results: cash stock interacted with firm size

	Full period: 1988–2001	Pre- <i>encaje</i> : 1988–1991	<i>Encaje</i> period: 1992–1997	Post- <i>encaje</i> : 1998–2001
	(1)	(2)	(3)	(4)
<i>Interaction with large firm dummy</i>				
Investment _{<i>t</i>-1}	0.135** (0.033)	-0.088 (0.041)	0.128 (0.148)	0.145** (0.032)
Sales	0.180** (0.015)	0.050 (0.092)	0.343** (0.124)	0.170** (0.018)
Cash	0.027 (0.034)	-0.149 (0.179)	0.797** (0.300)	-0.008 (0.015)
Cash* size dummy	-0.022 (0.046)	-0.357** (0.087)	-0.713** (0.282)	0.023 (0.038)
Period dummies ¹	14.1	5.4	3.4	7.1
# observations	594	38	262	294
# firms	114	20	61	113
Sargan test ²	75.2	12.4	50.6	66.2
Serial correlation ³	-2.4**	0.4	-0.7	-2.1**

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<i>Interaction with ln(Assets)</i>				
Investment _{<i>t</i>-1}	0.135** (0.035)	-0.010 (0.088)	0.120 (0.127)	0.141** (0.034)
Sales	0.180* (0.016)	0.089 (0.086)	0.285** (0.115)	0.169** (0.018)
Cash	-0.021 (0.184)	0.841 (3.429)	5.851** (2.780)	-0.098 (0.154)
Cash* size	0.004 (0.016)	-0.095 (0.303)	-0.444** (0.217)	0.008 (0.014)
Period dummies ¹	13.9	2.7	5.3	7.1
# observations	594	38	262	294
# firms	114	20	61	113
Sargan test ²	78.5	14.6	54.4	62.9
Serial correlation ³	-2.4**	0.4	-0.8	-2.1**

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Spillover Effects: Brazil

(Forbes, Fratzscher, Kostka, Straub, 2011)

Examines impact on portfolios of tax on financial transactions, *Imposto de Operações Financeiras* (IOF)

Date	Description
03/2008	Introduced IOF of 1.5% on fixed income
10/2008	IOF on fixed income reduced to 0%
10/2009	Introduced IOF of 2% on portfolio inflows of fixed income and equities; also implemented 1.5% tax when foreign investors converted ADRs into receipts for shares issued locally
10/2010	Increased IOF to 4% on fixed income; then increased IOF to 6% on fixed income and over next two months adopted a number of restrictions to close loopholes that were used to avoid the tax ¹⁸ ; Finance Minister Mantega also announced that other measures were under consideration



Empirics

Based on which uses a model that assumes that each fund allocates its portfolio across countries based on the country's weight in the fund's benchmark, a fund fixed effect, And an error term. Uses EPFR data set

$$\omega_{i,j,t} = \alpha_{i,j} + \beta \cdot \omega_{i,t}^{benchmark,j} + \varepsilon_{it} \quad , \quad (1)$$

where $\omega_{i,j,t}$ is the share of the portfolio allocated to country i for fund group j at time t ; $\alpha_{i,j}$ is the country-fund group fixed effect; $\omega_{i,t}^{benchmark,j}$ is the weight of country i in the relevant benchmark for fund group j at time t ; and ε_{it} is the error term.

$$\omega_{i,j,t} = \alpha_{i,j} + \gamma_D Control_t^{Brazil} + \gamma_S Control_t^{ExBrazil} + \beta \cdot \omega_{i,t}^{benchmark,j} + \delta \chi_{it} + \varepsilon_{it} \quad , \quad (2)$$

$$\Delta \omega_{i,j,t} = \gamma_D \Delta Control_t^{Brazil} + \gamma_S \Delta Control_t^{ExBrazil} + \beta \cdot \Delta \omega_{i,t}^{benchmark,j} + \delta \Delta \chi_{it} + \mu_{it} \quad (3)$$



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Empirics

Table 5: Regression Results—Effect of Capital Controls

	Base		Levels	Different Timing for Effects of Controls		
	Base	Base		Prior	Immediate	Additional Lag
$Control^{Brazil}$	-0.0363** (0.0169)	-0.0356** (0.0173)	-0.1006* (0.0577)	-0.0357** (0.0173)		-0.0355** (0.0174)
$Control^{Ex-Brazil}$	0.0032 (0.0043)	0.0038 (0.0051)	-0.0024 (0.0364)	0.0037 (0.0051)		0.0039 (0.0051)
$\omega^{benchmark}$	0.6933*** (0.0463)	0.6979*** (0.0460)	0.8076*** (0.0478)	0.6970*** (0.0469)	0.6978*** (0.0456)	0.6981*** (0.0457)
$TED\ spread$		0.0046 (0.0178)	-0.0004 (0.0005)	0.0050 (0.0179)	0.0043 (0.0178)	0.0046 (0.0178)
VIX		-0.0250 (0.1735)	0.0009 (0.0074)	-0.0410 (0.1682)	-0.0279 (0.1696)	-0.0245 (0.1736)
$FX\ return$		-0.0059 (0.0791)	-0.0109*** (0.0030)	-0.0033 (0.0778)	-0.0033 (0.0759)	-0.0046 (0.0789)
$Interest\ rate$		0.1157 (0.3307)	0.0200 (0.0137)	0.1000 (0.3306)	0.1156 (0.3319)	0.1189 (0.3296)
Observations	4,288	3,723	3,775	3,723	3,723	3,723
R-squared	0.433	0.445	0.739	0.445	0.444	0.445

Empirics

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Empirics: Disaggregated

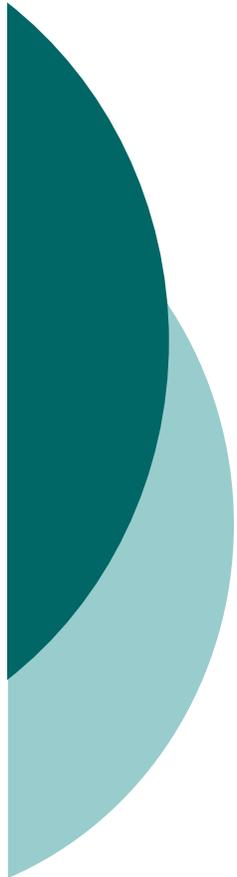
Table 6
Effect of Capital Controls on Different Fund Groups

	Full Sample	Equity	Debt	Global Emerging Market Equity	Latin America Equity
<i>Control</i> ^{Brazil}	-0.0356** (0.0173)	-0.0526*** (0.0168)	-0.0263*** (0.0037)	-0.0294*** (0.0026)	-0.0773*** (0.0089)
<i>Control</i> ^{Ex-Brazil}	0.0038 (0.0051)	0.0034 (0.0080)	0.0037 (0.0062)	0.0004 (0.0068)	0.0175 (0.0321)
ω ^{benchmark}	0.6979*** (0.0460)	0.7723*** (0.0295)	0.2185*** (0.0750)	0.7628*** (0.0618)	0.7789*** (0.0238)
<i>TED spread</i>	0.0046 (0.0178)	0.0029 (0.0107)	0.0005 (0.0336)	0.0120 (0.0088)	-0.0413 (0.0420)
<i>VIX</i>	-0.0250 (0.1735)	-0.0424 (0.1653)	-0.0258 (0.3164)	0.0043 (0.1331)	-0.3084 (0.6949)
<i>FX return</i>	-0.0059 (0.0791)	0.0909 (0.1256)	-0.1304 (0.0953)	-0.0026 (0.0991)	0.4506 (0.5486)
<i>Interest rate</i>	0.1157 (0.3307)	-0.0701 (0.3212)	-0.3447 (0.3847)	0.0042 (0.3873)	-0.4998 (0.2945)
Observations	3,723	2,227	1,496	1,762	465
R-squared	0.445	0.685	0.024	0.630	0.735

Empirics: Disaggregated

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<i>VIX</i>	-0.0250 (0.1735)	-0.0424 (0.1653)	-0.0258 (0.3164)	0.0043 (0.1331)	-0.3084 (0.6949)
<i>FX return</i>	-0.0059 (0.0791)	0.0909 (0.1256)	-0.1304 (0.0953)	-0.0026 (0.0991)	0.4506 (0.5486)
<i>Interest rate</i>	0.1157 (0.3307)	-0.0701 (0.3212)	-0.3447 (0.3847)	0.0042 (0.3873)	-0.4998 (0.2945)
Observations	3,723	2,227	1,496	1,762	465
R-squared	0.445	0.685	0.024	0.630	0.735



Financial Development/Sequencing



Financial Development and Financial Openness

- Question: Is financial openness a key determinant of financial development,
- And what is financial development anyways?
- Credit/GDP; stock market cap., traded value, turnover (no bonds)

$$\begin{aligned} \text{FD}_t^i - \text{FD}_{t-5}^i = & \gamma_0 + \rho \text{FD}_{t-5}^i + \gamma_1 \text{KAOPEN}_{t-5}^i + \gamma_2 L^i + \gamma_3 (L^i \times \text{KAOPEN}_{t-5}^i) \\ & + \mathbf{X}_{t-5}^i \Gamma + u_t^i, \end{aligned} \tag{1}$$

By Group, by Type

Table 2-1

Financial development, financial openness, and legal/institutional development (LEGAL1: General Legal/Institutional Development) FULL, LDC, and EMG: 5-year panels, 1980–2000

	Pred sign	FULL				LDC				EMG			
		Private credit	Stock market capitalization	Stock market total value	Stock market turnover	Private credit	Stock market capitalization	Stock market total value	Stock market turnover	Private credit	Stock market capitalization	Stock market total value	Stock market turnover
		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
<i>Legal/inst. variable: LEGAL1</i>													
Financial openness	(+)	0.0027	-0.0009	-0.0036	-0.0041	0.0004	0.0050	0.0070	0.0096	0.0028	0.0097	0.0081	0.0013
[t-5]		[0.0011]**	[0.0041]	[0.0031]	[0.0097]	[0.0013]	[0.0078]	[0.0042]*	[0.0123]	[0.0024]	[0.0070]	[0.0044]*	[0.0179]
LEVEL: LEGAL1	(+)	0.0014	-0.0025	-0.004	-0.0047	0.0011	0.0126	0.0091	0.0046	0.0077	0.0177	0.0117	0.0098
		[0.0010]	[0.0057]	[0.0051]	[0.0127]	[0.0014]	[0.0081] ^{12%}	[0.0053]*	[0.0186]	[0.0032]**	[0.0098]*	[0.0082]	[0.0277]
INTERACTION: LEGAL1 × Fin. open. [t-5]	(+)	0.0005	0.0035	0.0037	0.0045	-0.0009	0.0037	0.0103	0.0212	0.0024	0.0072	0.0118	0.0190
		[0.0005]	[0.0019]*	[0.0015]**	[0.0039]	[0.0010]	[0.0043]	[0.0035]**	[0.0109]**	[0.0025]	[0.0042]*	[0.0033]**	[0.0102]*
Financial deepening	(-)	-0.017	-0.0335	0.1445	-0.0358	0.0001	-0.0493	0.0795	-0.0033	-0.0117	-0.0349	0.0926	0.0014
[t-5]		[0.0085]**	[0.0307]	[0.0936]	[0.0344]	[0.0119]	[0.0380]	[0.1187]	[0.0536]	[0.0139]	[0.0382]	[0.1208]	[0.0683]
Per capita income	(+)	0.0037	0.0164	0.016	0.0053	0.0031	0.0187	0.0128	-0.0023	-0.0031	0.0018	0.0049	-0.0134
[t-5]		[0.0015]**	[0.0106]	[0.0104]	[0.0227]	[0.0015]**	[0.0126]	[0.0123]	[0.0273]	[0.0030]	[0.0125]	[0.0159]	[0.0448]
Inflation [t-5]	(-)	-0.0112	-0.0548	-0.0318	-0.0561	-0.0047	-0.0497	-0.0221	-0.0815	-0.0248	-0.0334	-0.0164	-0.1095
		[0.0074]	[0.0208]**	[0.0266]	[0.0919]	[0.0074]	[0.0303]*	[0.0317]	[0.1166]	[0.0104]**	[0.0293]	[0.0414]	[0.1863]
Trade openness	(+)	0.0000	0.0002	-0.0001	-0.0003	0.0000	0.0001	-0.0003	-0.0006	0.0000	0.0000	-0.0003	-0.0006
[t-5]		[0.0000]*	[0.0001]**	[0.0001]	[0.0001]**	[0.0000]	[0.0001]	[0.0002]*	[0.0003]*	[0.0001]	[0.0001]	[0.0002]**	[0.0003]**
N		408	175	206	172	289	101	115	98	138	87	97	85
Adjusted R ²		0.15	0.11	0.28	0.03	0.09	0.2	0.16	-0.01	0.16	0.19	0.18	0.01

By Group, By Type w/Institutions

Table 2-2
Financial development, financial openness, and legal/institutional development (Components of LEGAL1: Corruption, Law and Order, and Bureaucracy Quality) FULL, LDC, and EMG: 5-year panels, 1980–2000

	Pred sign	FULL				LDC				EMG			
		Private credit	Stock market capitalization	Stock market total value	Stock market turnover	Private credit	Stock market capitalization	Stock market total value	Stock market turnover	Private credit	Stock market capitalization	Stock market total value	Stock market turnover
		[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
<i>Legal/inst. variable: Corrupt (Corruption)</i>													
Financial openness [$t-5$]	(+)	-0.0009	-0.0129	-0.0195	-0.0309	0.0009	-0.0112	-0.0313	-0.0610	-0.006	-0.0193	-0.0362	-0.0634
		[0.0027]	[0.0099]	[0.0071]***	[0.0261]	[0.0038]	[0.0134]	[0.0110]***	[0.0409]	[0.0091]	[0.0146]	[0.0124]***	[0.0460]
LEVEL: CORRUPT	(+)	0.0001	0.0003	-0.0002	-0.0012	0.0000	0.0014	0.0004	-0.0012	0.0004	0.0016	0.0005	-0.0012
		[0.0001]	[0.0005]	[0.0003]	[0.0008]	[0.0001]	[0.0007]**	[0.0004]	[0.0011]	[0.0002]*	[0.0007]**	[0.0006]	[0.0016]
INTERACTION: Corrupt × Fin. opn. [$t-5$]	(+)	0.0001	0.0002	0.0003	0.0004	0.0000	0.0003	0.0006	0.001	0.0001	0.0005	0.0007	0.0009
		[0.0000]	[0.0001]	[0.0001]**	[0.0003]	[0.0001]	[0.0003]	[0.0002]***	[0.0006]*	[0.0002]	[0.0003]*	[0.0002]***	[0.0006]*
<i>N</i>		408	175	206	172	289	101	115	98	138	87	97	85
Adjusted R^2		0.15	0.12	0.28	0.03	0.09	0.23	0.16	-0.01	0.14	0.24	0.18	0.00

Financial Development, again (PCGDP + SMKC), Ito & Chinn '09

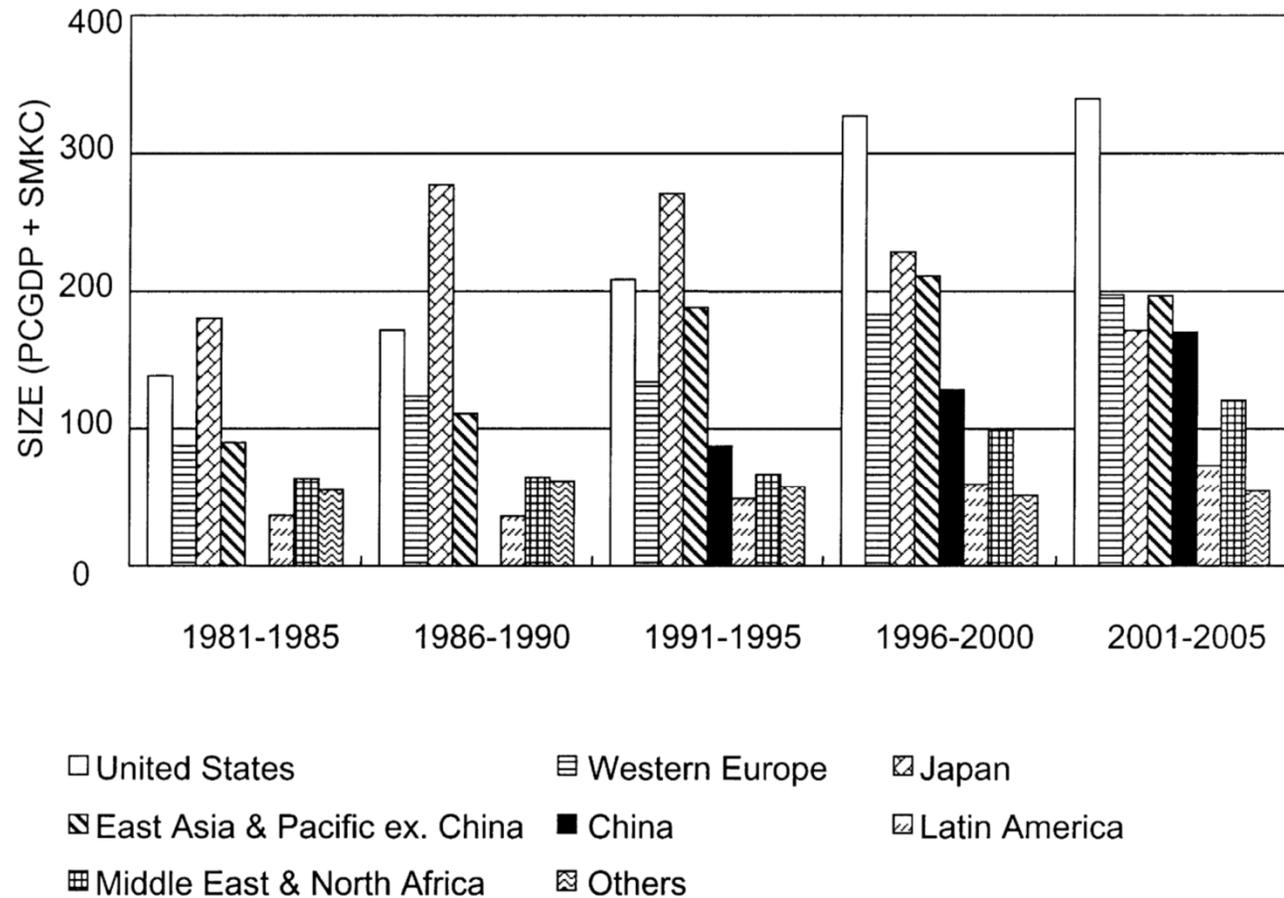


Fig. 4.2 Financial market development (size)

Financial Development plus activity indicators

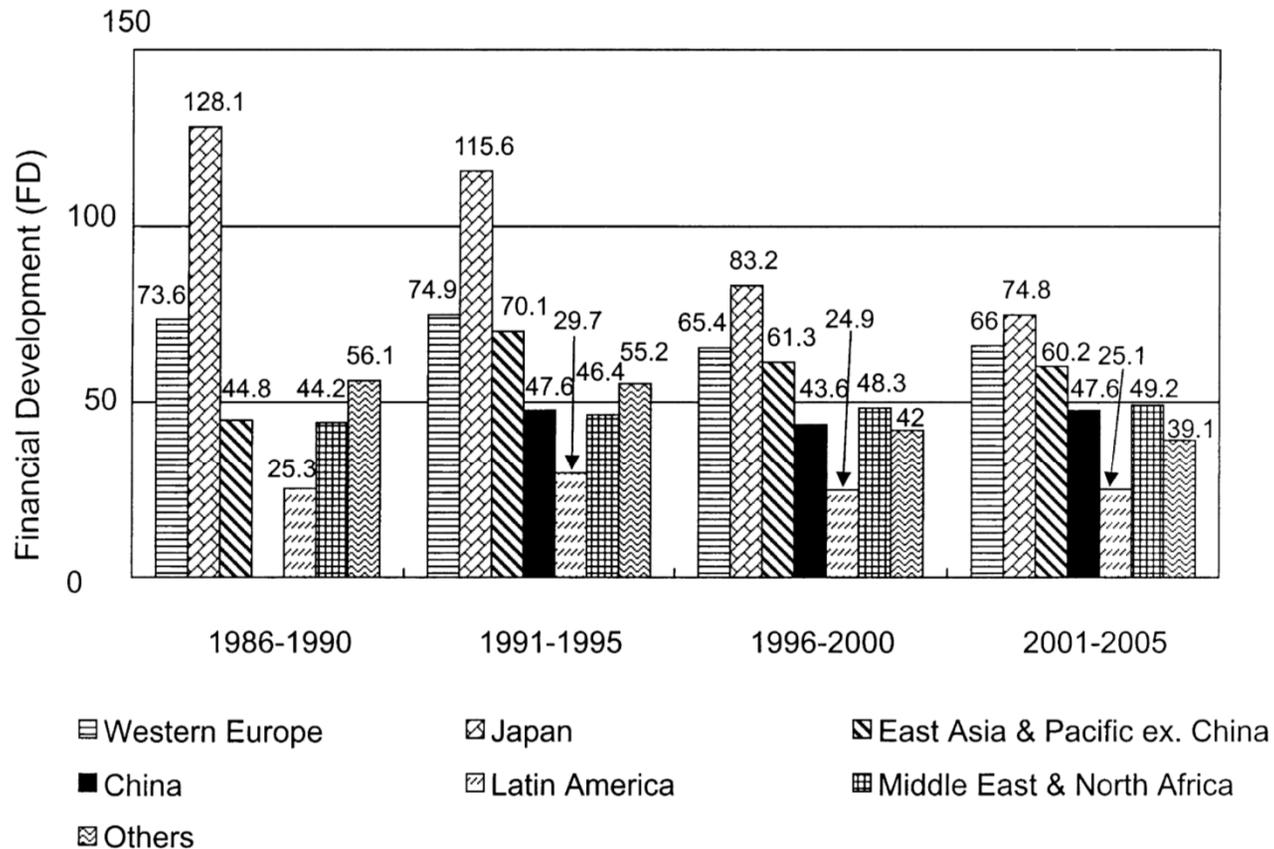


Fig. 4.8 Comparison by “financial development index”

Financial Development plus activity indicators (China adjusted)

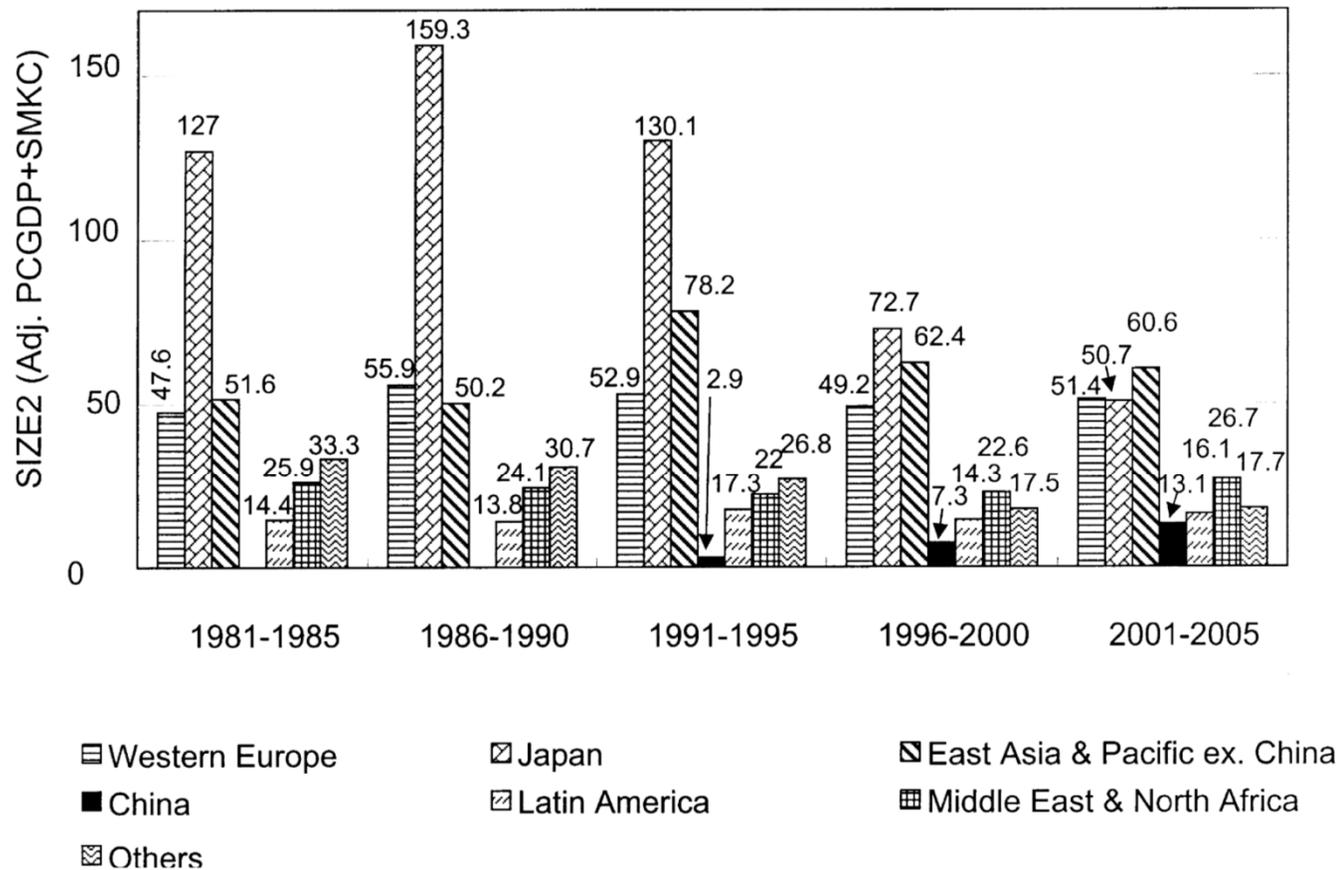
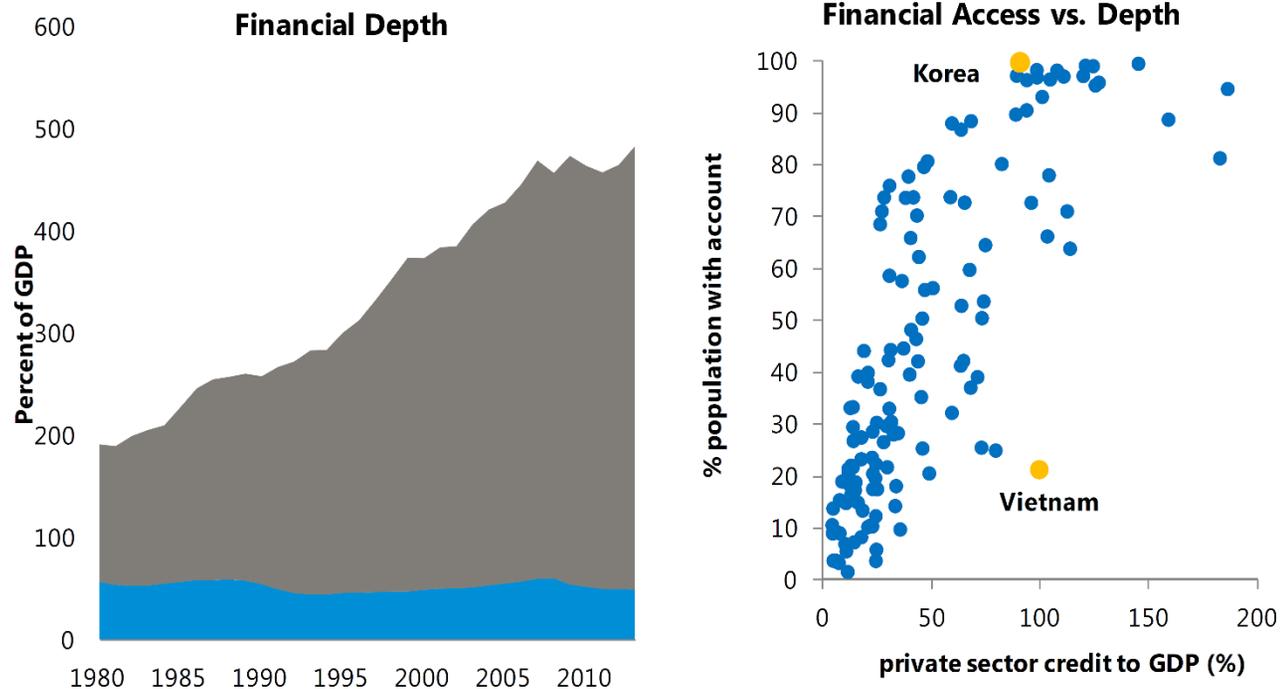


Fig. 4.9 “Adjusted” financial market size

Toward Better Measures of Financial Deepening

Figure 2. Bank Credit Can be a Misleading Measure of Financial Depth and Access

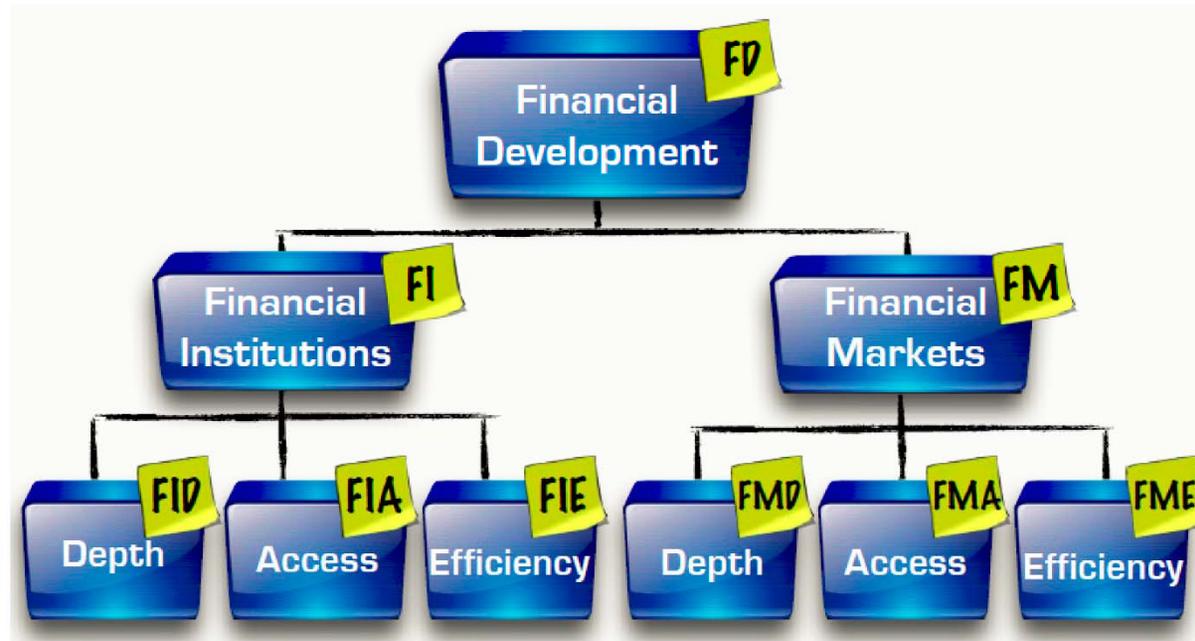


Sources: Global Financial Development Database; Global Findex; and IMF staff estimates

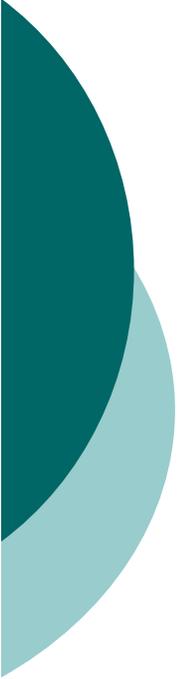
Note: In the left panel, the blue area is private-sector credit to GDP. The gray area is the shadow banking size relative to GDP. In the right panel, the vertical axis is the percentage of adults with at least one account in a financial institution at end-2011.

How to Measure FD

Figure 3. Financial Development Index

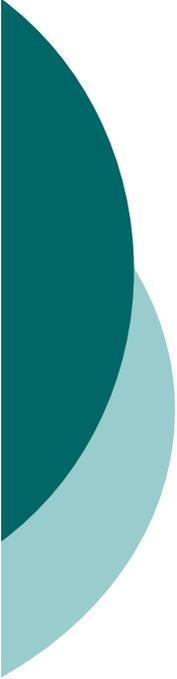


Source: IMF staff, based on Čihák and others (2012).



Creating the Index (1)

- A list of indicators is chosen to measure each sub-index at the bottom of the pyramid in Figure 3, that is, FID, FIA, FIE, FMD, FMA, and FME, with the letters D, A, and E denoting depth, access, and efficiency, respectively, and I and M denoting institutions and markets, respectively.



Creating the Index (2)

Each indicator is normalized between 0 and 1. Thus, the highest (lowest) value of a given variable across time and countries is equal to one (zero) and all other values are measured relative to these maximum (minimum) values. To avoid pitfalls arising from extreme observations, the data are winsorized with the 5th and 95th percentiles as the cutoff levels. The indicators are defined so that higher values indicate greater financial development.



Creating the Index (3)

Indicators are then aggregated into the six sub-indices at the bottom of the pyramid. The aggregation is a weighted average of the underlying series, where the weights are obtained from principal component analysis, reflecting the contribution of each underlying series to the variation in the specific sub-index.

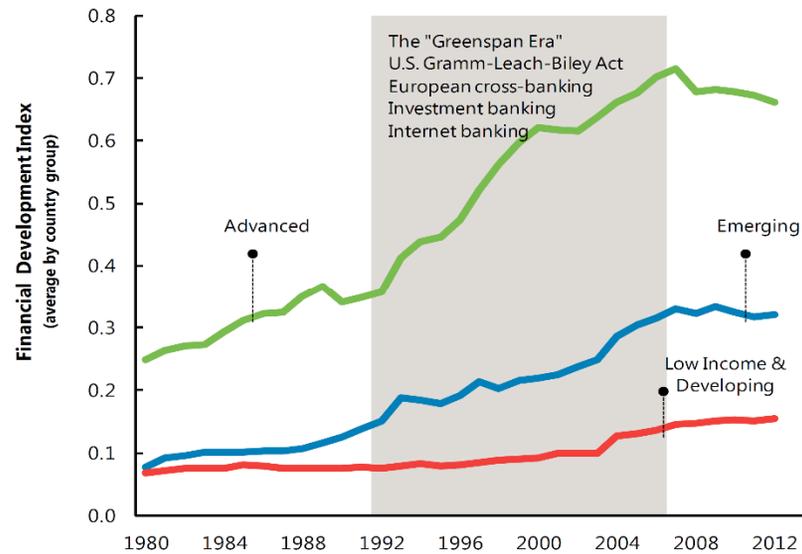


Creating the Index (4)

Finally, sub-indices are aggregated into higher-level indices using the same procedure as above, culminating at the most aggregated level in the FD index.

Financial Deepening over Time

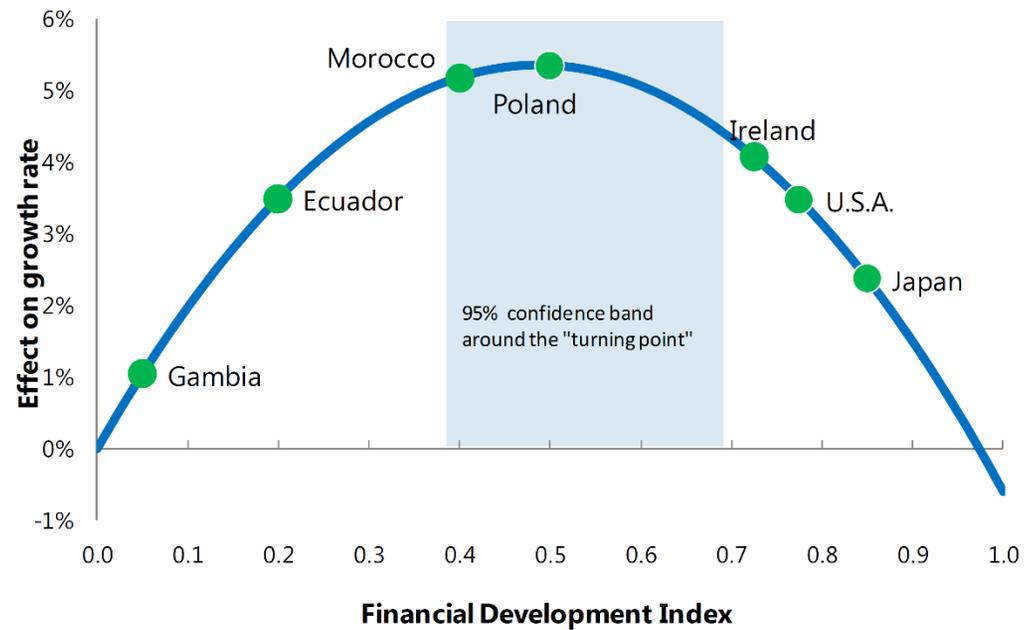
Figure 4. Financial Development Through Time



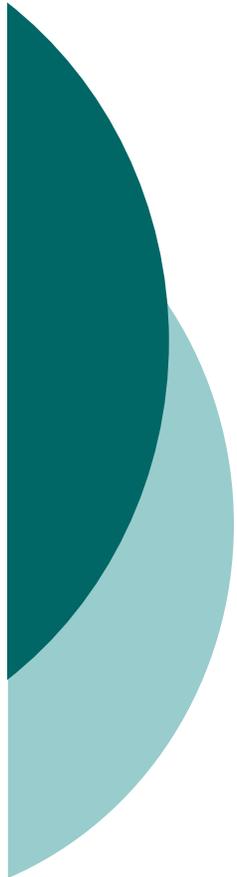
Source: IMF staff estimates.

Financial Development and Growth

Figure 7. Financial Development Effect on Growth



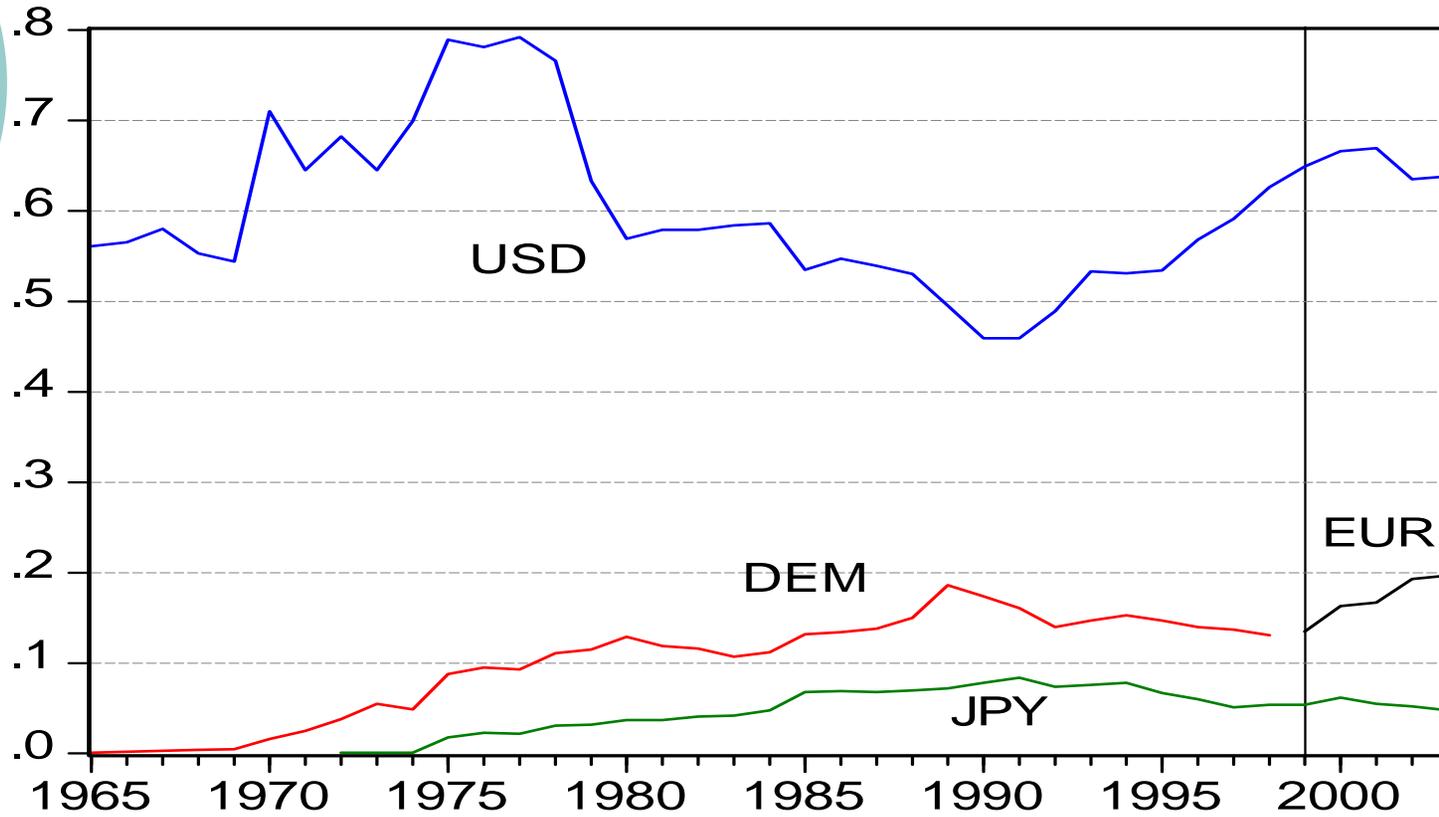
Source: IMF staff estimates.



International & Reserve Currencies

Shares of Major Int'l Currencies in Reserve Holdings

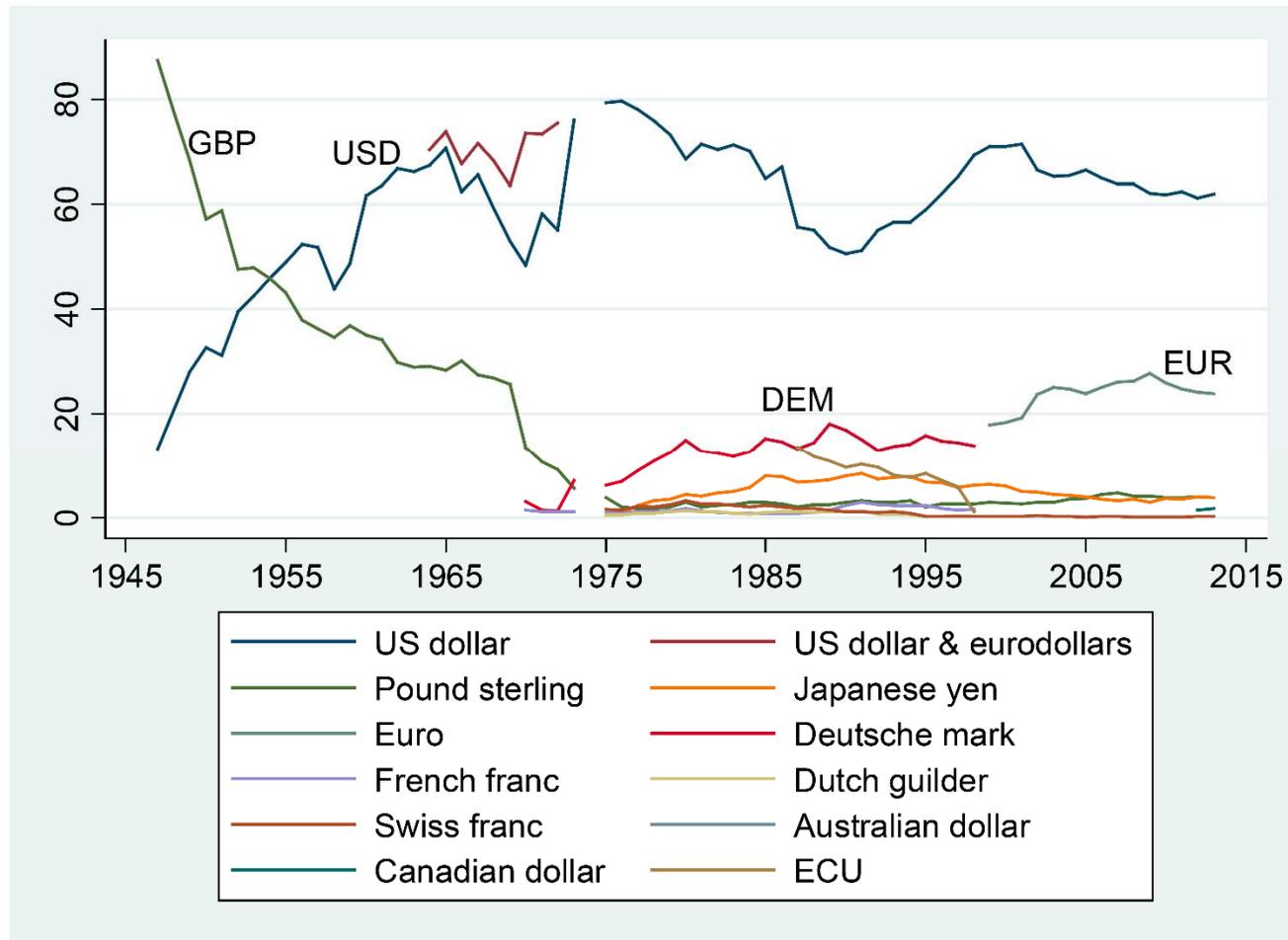
revised IMF data spliced into old data after 1979, up to 2004 IMF AR



Source: Chinn and Frankel (2007)

The Longest Span of Data

Figure 1: Currency composition of globally disclosed foreign exchange reserves (1947-2013, %)



Source: Eichengreen, Chitu, Mehl (2014)

Roles of an International Currency

Table 1:

<i>Function of money</i>	Governments	Private actors
<i>Store of value</i>	International reserve holdings	Currency substitution (private dollarization)
<i>Medium of exchange</i>	Vehicle currency for foreign exchange intervention	Invoicing trade and financial transactions
<i>Unit of account</i>	Anchor for pegging local currency	Denominating trade and financial transactions

Source: Kenen (1983)



Why should we care?

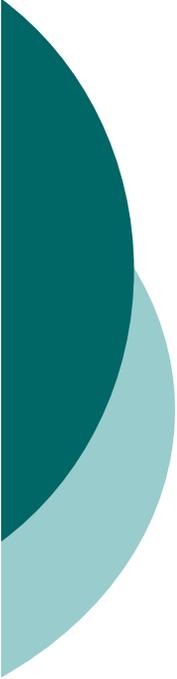
~~FOUR ADVANTAGES TO A COUNTRY OF HAVING ITS CURRENCY PLAY A LARGE ROLE IN THE WORLD.~~

- (1) *Convenience* for its residents.
- (2) *Business* for its banks & other financial institutions.
- (3) *Seignorage*
 - narrowly defined as willingness to hold \$ as high-powered money (esp. fx reserves held by central banks) or
 - more broadly as willingness of private investors to hold \$-denominated assets: America's "exorbitant privilege"
- (4) *Political power and prestige.*



A Cautionary Tale

- UK loss of international currency paralleled loss of its economic pre-eminence, military hegemony, colonies & other trappings of international power.
 - Suez crisis of 1956 is often recalled as occasion on which Britain was forced under US pressure to abandon imperial designs.
 - Often forgotten: A run on the £ was the mechanism.



From the literature on reserve currencies

Determinant

1. Size
2. Depth of Fin.mkt.
3. Rate of return

Proxy:

GDP

FX turnover

inflation,
LR depreciation
ex.rate variance



From the literature, continued

Network externalities

= > *Tipping*

captured by:

1) Inertia

lags

2) Nonlinearity

In determinants

logistic
functional form

or

dummy for
leader GDP



EU GDP > US GDP

	2006 (e)
US	\$13.2 tr.
Euro-zone (12 countries)	\$9.9 tr.
EU pre-5/1/04 (15 countries)	\$12.8 tr.
EU post-5/1/4 (25 countries)	\$13.5 tr.

Source: IMF, World Economic Outlook, April 2006.



Research strategy

- Estimate parameters from historical data on reserve currency shares, 1973-1998.
- Simple post-sample test on data from first years of euro, 1999-2004
- Use estimates to simulate possible future path of \$, € & other currencies in the future, 2005-2040, under alternate scenarios

Figure 7: Reserves held by central banks as shares of total – major currencies

(revised IMF data spliced into old data after 1979) 5/2/05

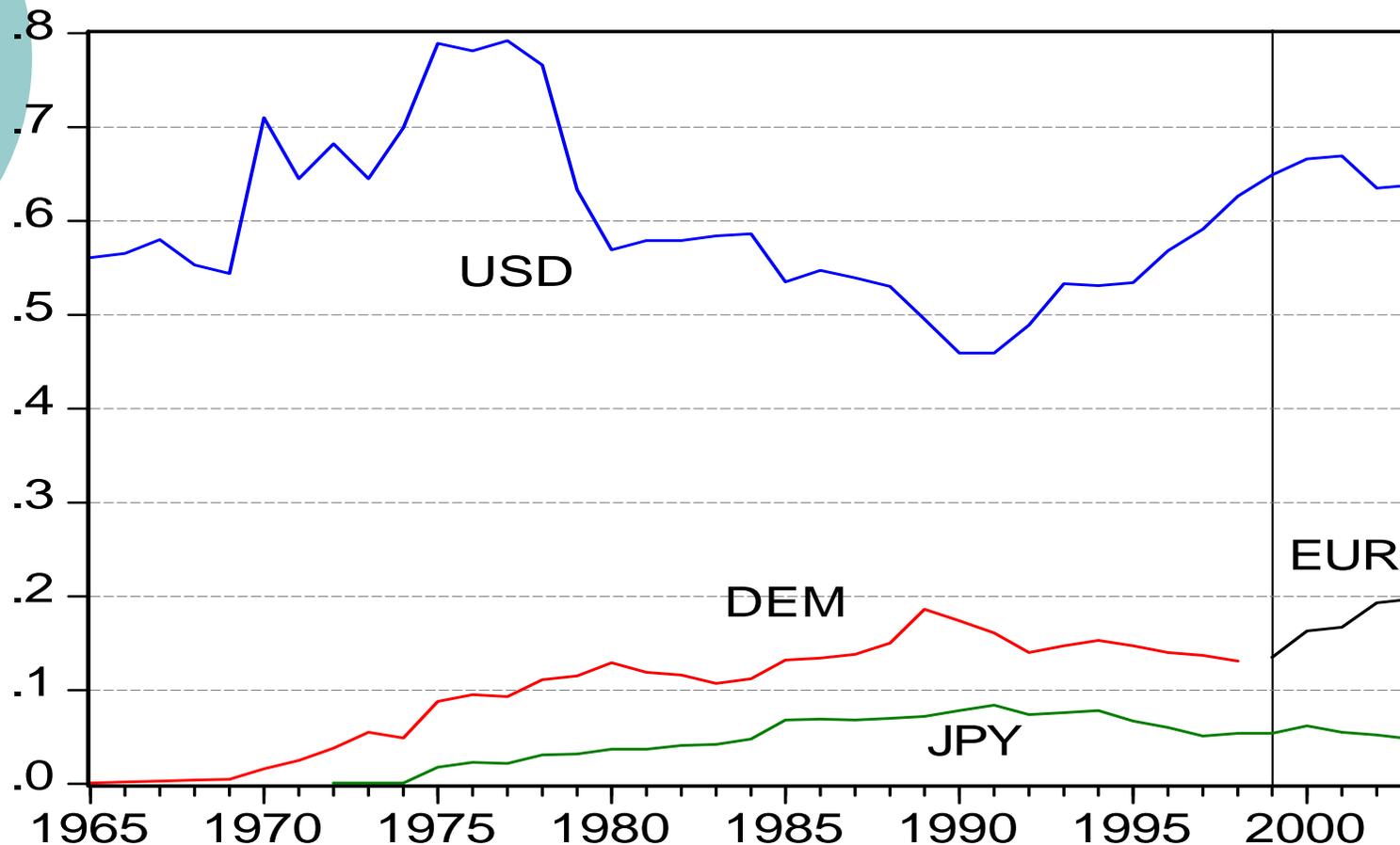
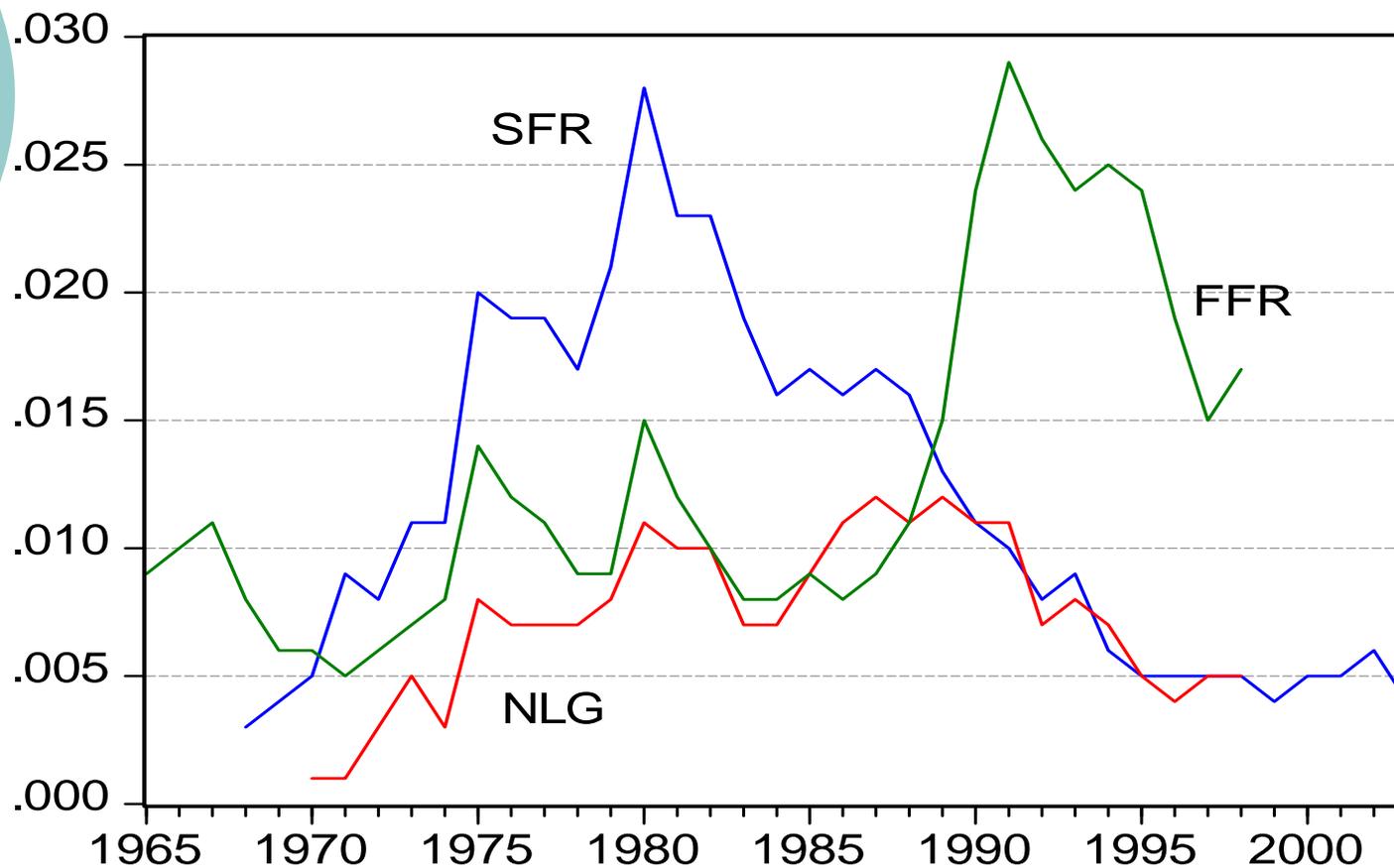


Figure 8: Reserves held by central banks as shares of total – smaller currencies

revised IMF data spliced into old data after 1979)



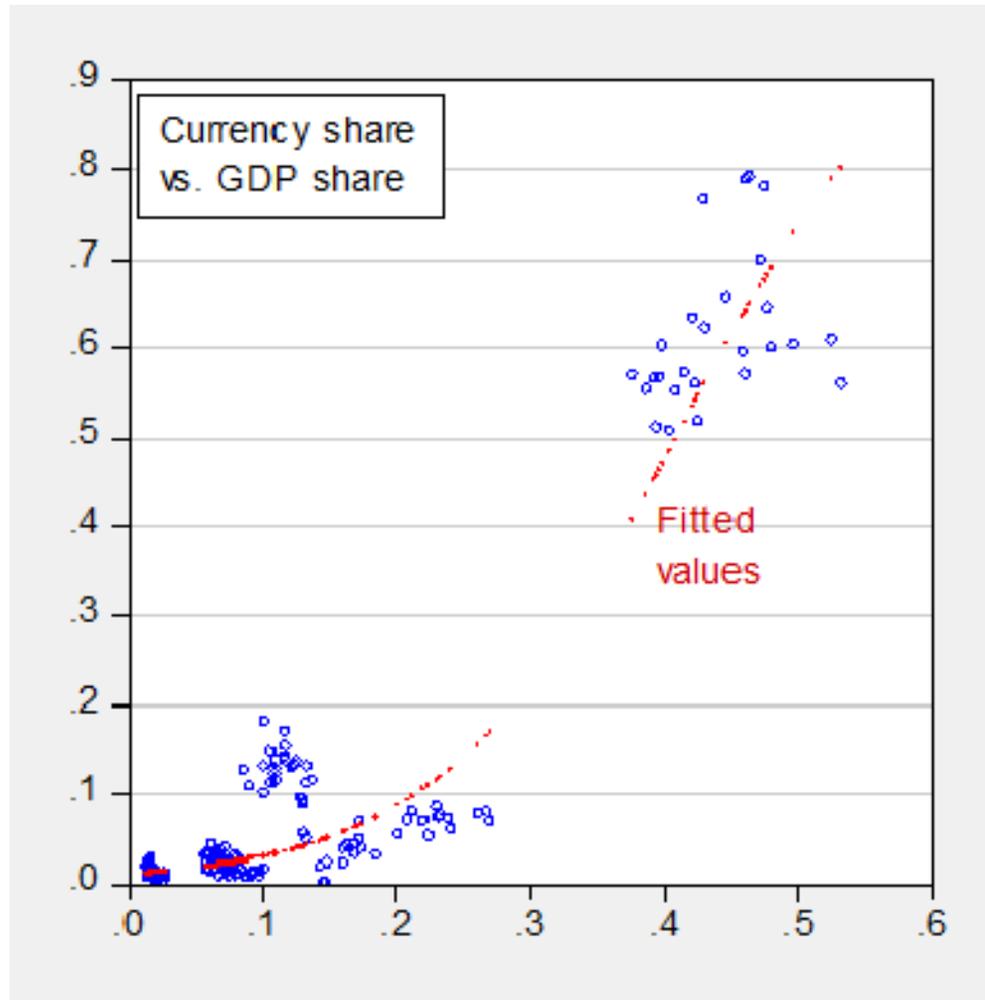


Working with logistics transformations

- The problem with working with shares as a dependent variable is that predicted values are not bounded between $[0, 1]$
- Hence we transform the variable into one bounded.

$$z = \ln\left(\frac{share}{1 - share}\right)$$

A Logistic Transform - Graphical



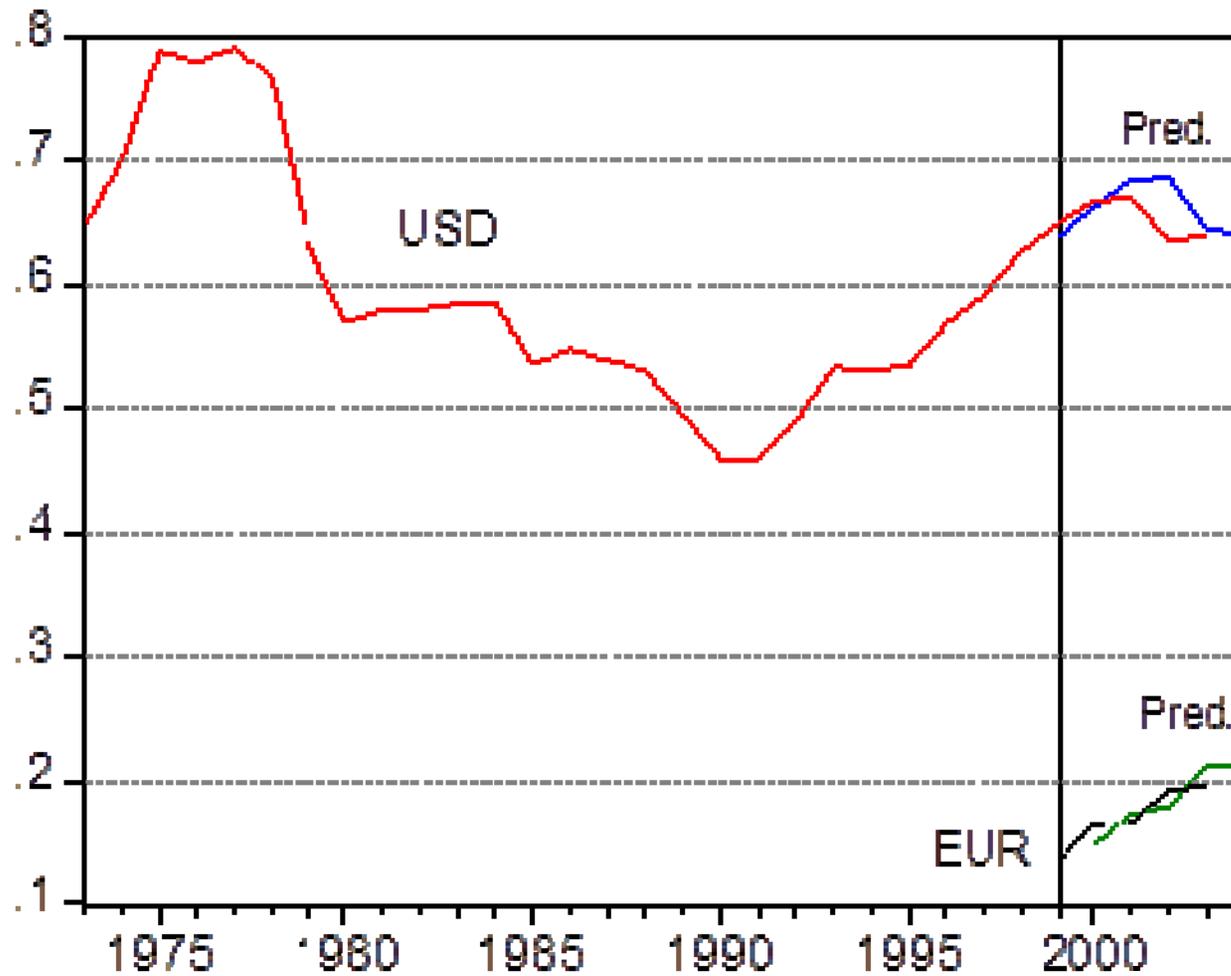
Explaining currency logit transformed shares, pre-euro

	[2]	[4]	[7]
GDPratio (<i>y</i>)	2.768 [0.643]	3.69 [0.923]	1.04 [0.288]
Inflationdiff (<i>π</i>)	-2.639 [1.156]	-2.86 [1.164]	
Depreciation (<i>Δs</i>)			-1.095 [0.594]
Exratevar (<i>σ</i>)	-0.981 [0.573]	-1.395 [0.644]	-1.251 [0.341]
Fxturnoverratio (<i>to</i>)	0.446 [0.289]	0.576 [0.303]	0.427 [0.145]
GDPlleader (<i>leader</i>)		-0.217 [0.156]	
laglogit <i>log(sh_{t-1}/1- sh_{t-1})</i>	0.851 [0.031]	0.846 [0.031]	0.957 [0.014]

Explaining two-currency system of logit shares, pre-euro

GDPratio	0.762	1.015	0.974 <i>a/</i>
(<i>y</i>)	[0.247]	[0.773]	[0.688]
Inflationdiff	-0.554	-0.844	
(π)	[1.247]	[1.259]	
Depreciation			-4.524 <i>a/</i>
(Δs)			[3.337]
Exratevar		-2.375	-2.381
(σ)		[1.213]	[1.121]
Turnover		0.489	0.652 <i>a/</i>
(<i>to</i>)		[0.487]	[0.454]
Laglogit	0.829	0.775	0.795
$\log(sh_{t-1} / 1 - sh_{t-1})$	[0.043]	[0.085]	[0.076]

Out of sample fit (no leader var)



Out of sample fit (no leader var)

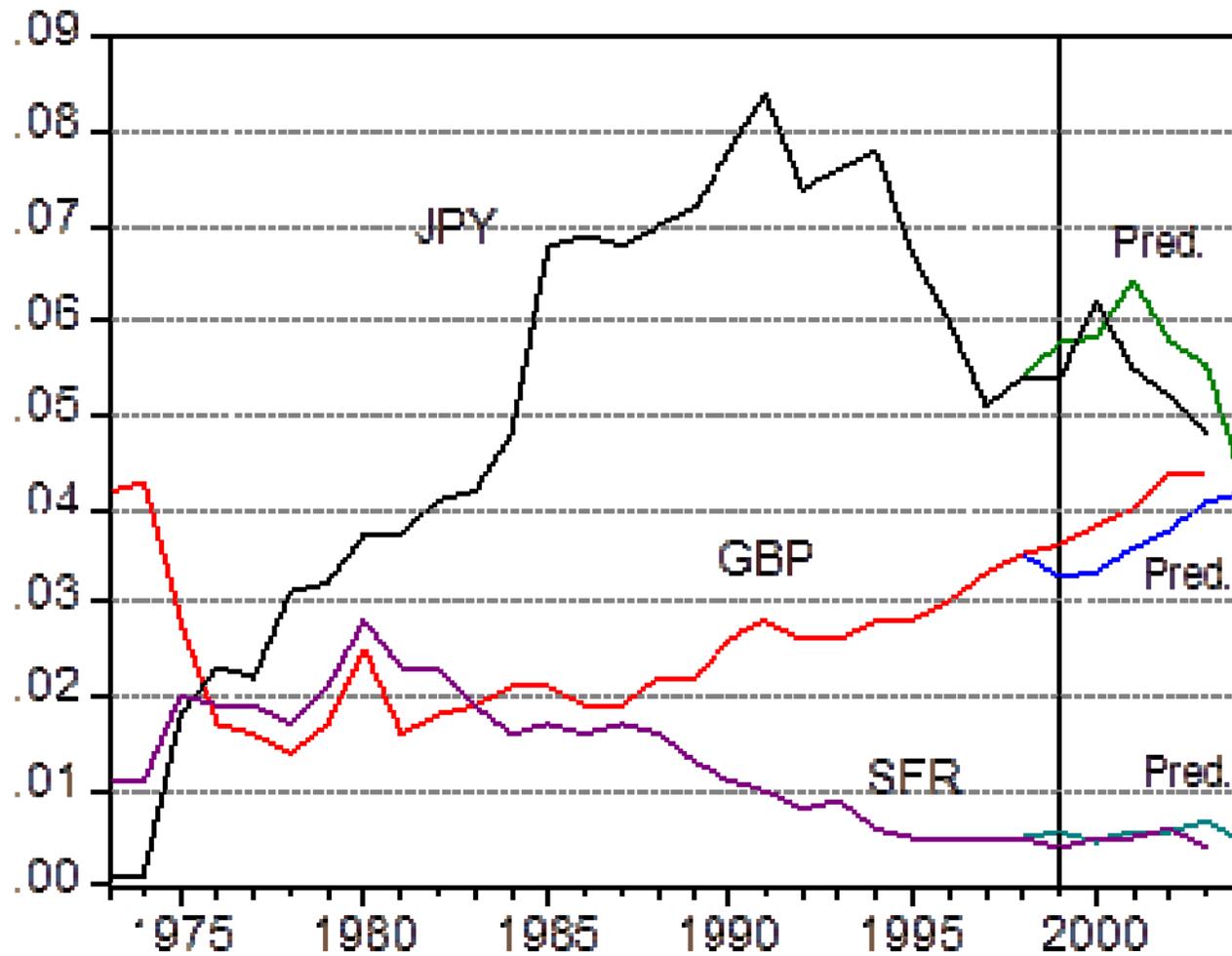


Figure 11: Case 2, Scenario B
Simulation of “No UK, Swe, Den in EMU”, and no further change in the level of exchange rates after 2004.

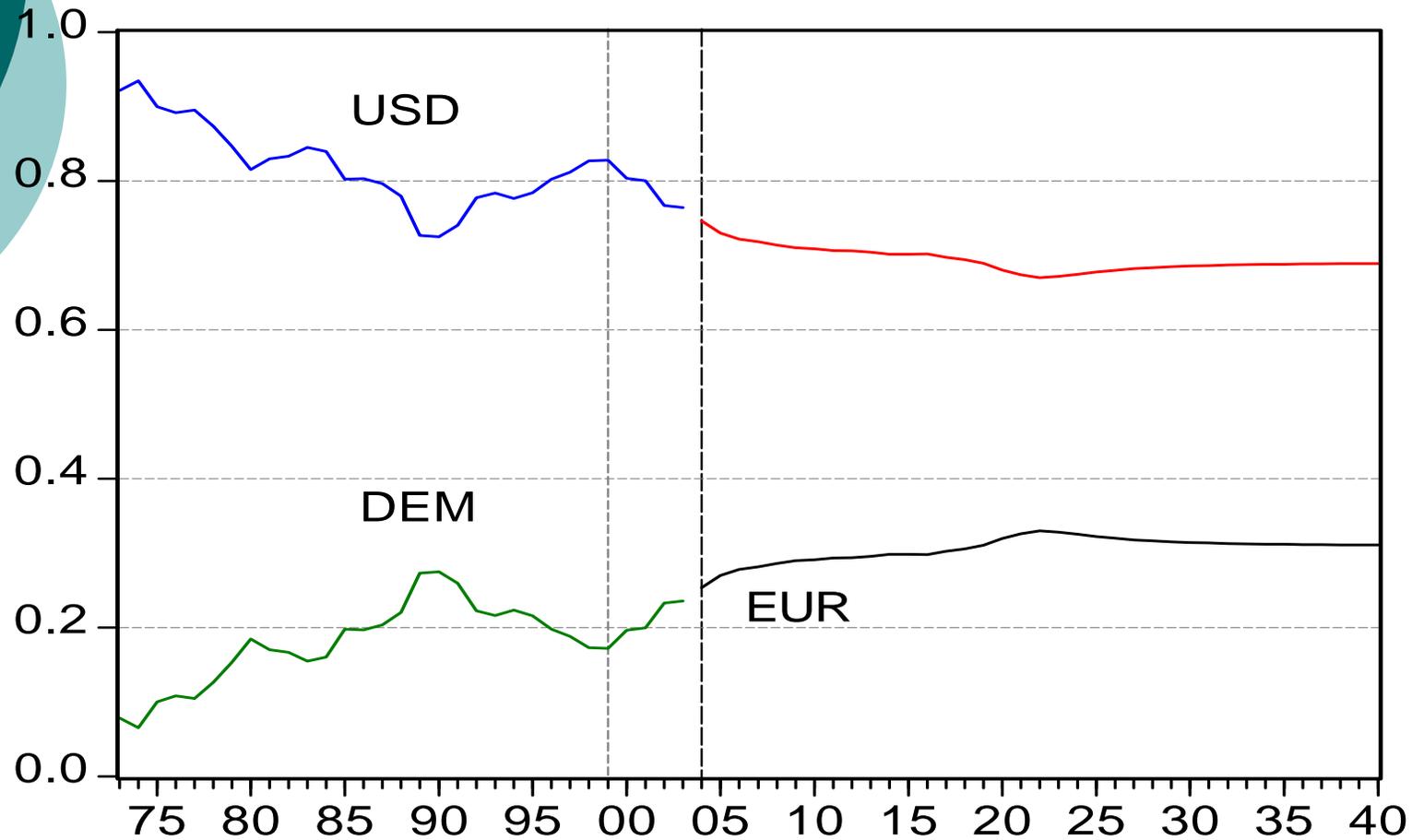


Figure 13: Case 2, Scenario D
Simulation of “No UK, Swe., Den. In EMU,”
but continued depreciation of \$ at 2001-04 rate.

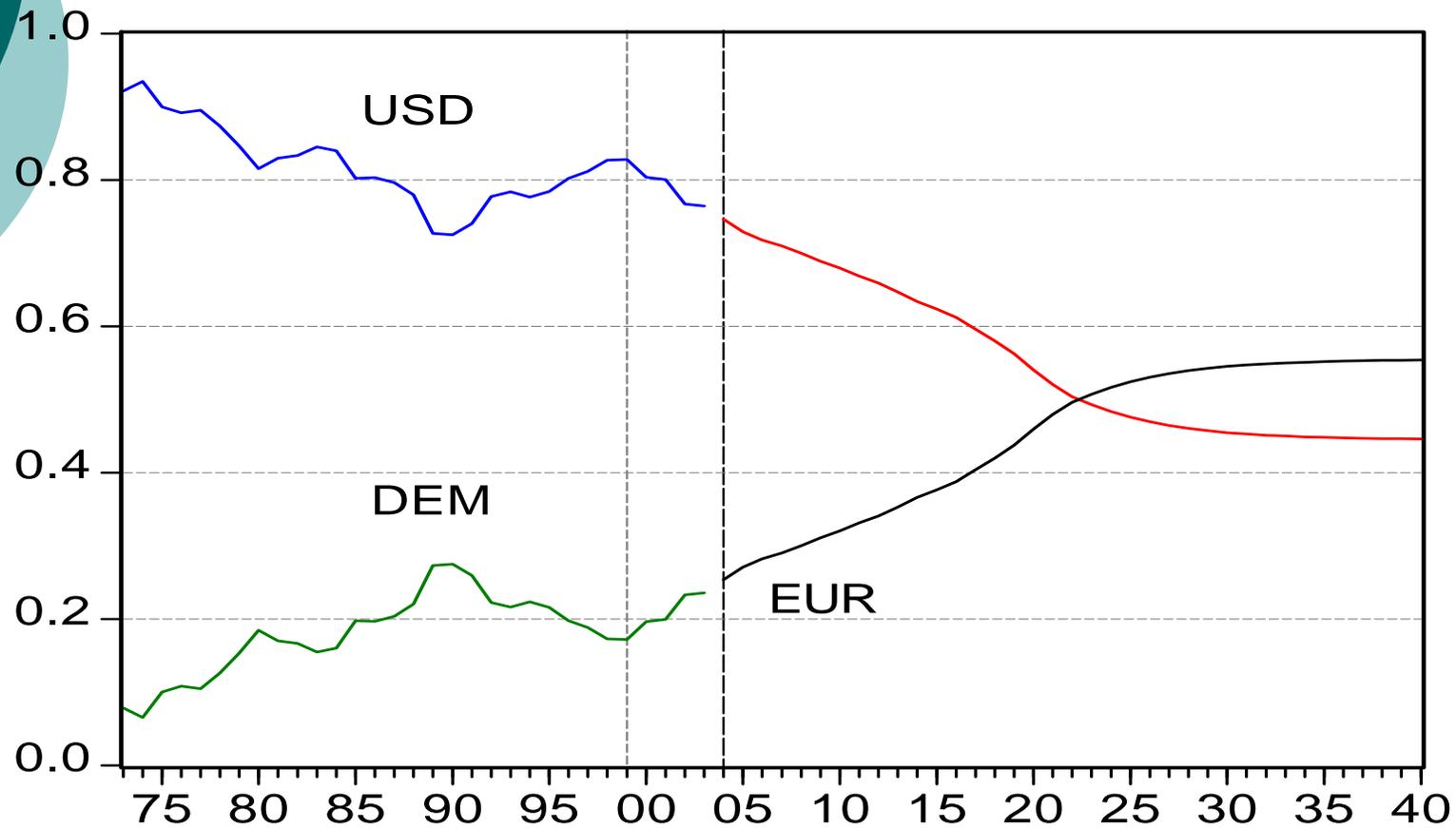
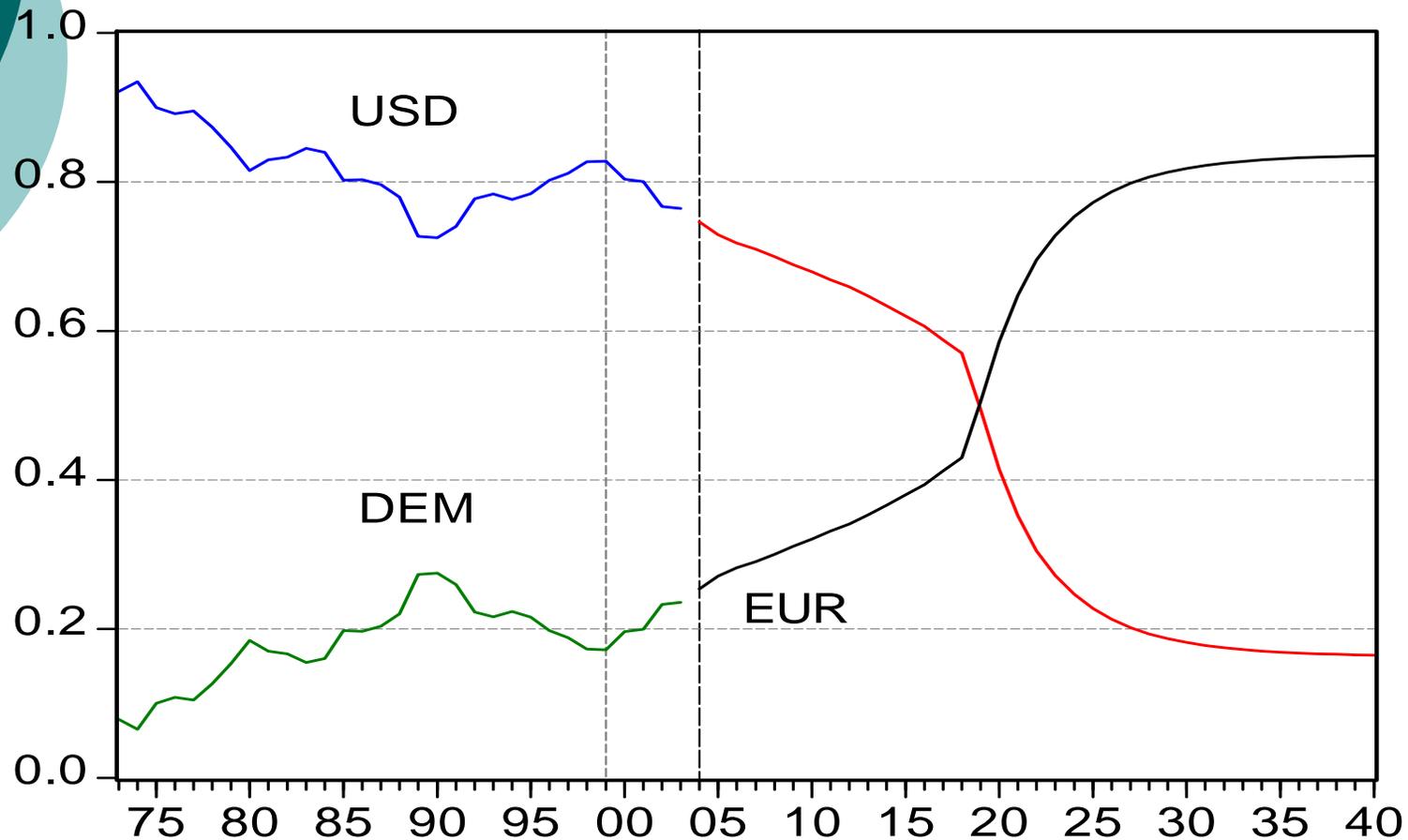


Figure 14: Case 4, Scenario D
Simulation of "UK entry"
and continued depreciation of \$ at 2001-04 rate.



Summary

	Rate of long depreciation equals 1990-2004 rate (0%) (Scenario A)	Level of exchange rate stays at end-2004 levels (Scenario B)	Rate of long depreciation remains at 2004 rates (Scenario C)	Rate of depreciation over 2001-04 period continues (Scenario D)
UK, Swe., Den. stay out, US grows relative to Euro Area (Case 1)	USD retains dominance	USD retains dominance	USD retains dominance	EUR exceeds USD in 2024
UK, Swe., Den. stay out of EMU (Case 2)	USD retains dominance	USD retains dominance	USD retains dominance	EUR exceeds USD in 2023
UK, stays out of EMU (Case 3)	USD retains dominance	USD retains dominance	USD retains dominance	EUR exceeds USD in 2022
UK joins EMU in 2020 (Case 4)	USD retains dominance	EUR exceeds USD in 2022	EUR exceeds USD in 2022	EUR exceeds USD in 2020



Conclusion

Either of two scenarios could result in € surpassing \$ as international reserve currency in the 2020s:

1. Euro-land surpasses US in economic size (incl. FX turnover), esp. if UK were to join
2. Dollar continues to depreciate at the rate of recent years, e.g., as a result of large US current account deficits

Regression Results: Industrial Countries

Panel Regression

Pre-euro (1973-98)							
Dependent variable: logit							
	[1]	[2]	[3]	[4]	[5]	[6]	[7]
Constant	-0.367	-0.480	-0.378	-0.550	-0.238	-0.258	-0.297
	[0.139]	[0.160]	0.140	[0.165]	[0.163]	[0.164]	[0.186]
GDPratio (y)	1.432	1.807	2.202	3.326	0.904	1.738	1.368
	[0.705]	[0.752]	[1.048]	[1.193]	[0.806]	[1.173]	[0.952]
Inflationdiff (π)	-3.082	-4.254	-3.030	-4.694			
	[1.132]	[1.401]	[1.133]	[1.420]			
Depreciation (Δs)					-0.358	-0.226	-1.432
					[1.775]	[1.780]	[2.200]
Exratevar (σ)	-0.116	-0.685	-0.370	-1.388	0.224	-0.112	-0.379
	[0.573]	[0.699]	[0.628]	[0.818]	[0.754]	[0.829]	[1.227]
Fxturnoverratio (to)		0.472		0.685	-0.075	-0.003	0.167
		[0.334]		[0.357]	[0.383]	[0.390]	[0.519]
GDPlleader (leader)			-0.180	-0.315		-0.192	
			[0.181]	[0.193]		0.196	
laglog($sh_{t-1}/1 - sh_{t-1}$)	0.935	0.915	0.933	0.903	0.956	0.952	0.941
	[0.027]	[0.030]	[0.027]	[.031]	[0.032]	[0.032]	[.036]
N	182	182	182	182	182	182	148
sample	73-98	73-98	73-98	73-98	73-98	73-98	73-98
Adj R2	0.98	0.97	0.97	0.98	0.97	0.97	0.97