Exchange Rate Misalignment Estimates – Sources of Differences

Yin-Wong Cheung
University of California, Santa Cruz, USA

Eiji Fujii
Kwansei Gakuin University, Japan

1. Introduction

International Comparison Program (ICP)

    Internationally comparable price indices

        Purchasing power parity (PPP) – local price measure

        National price index; normalized PPP – inverse of real exchange rate

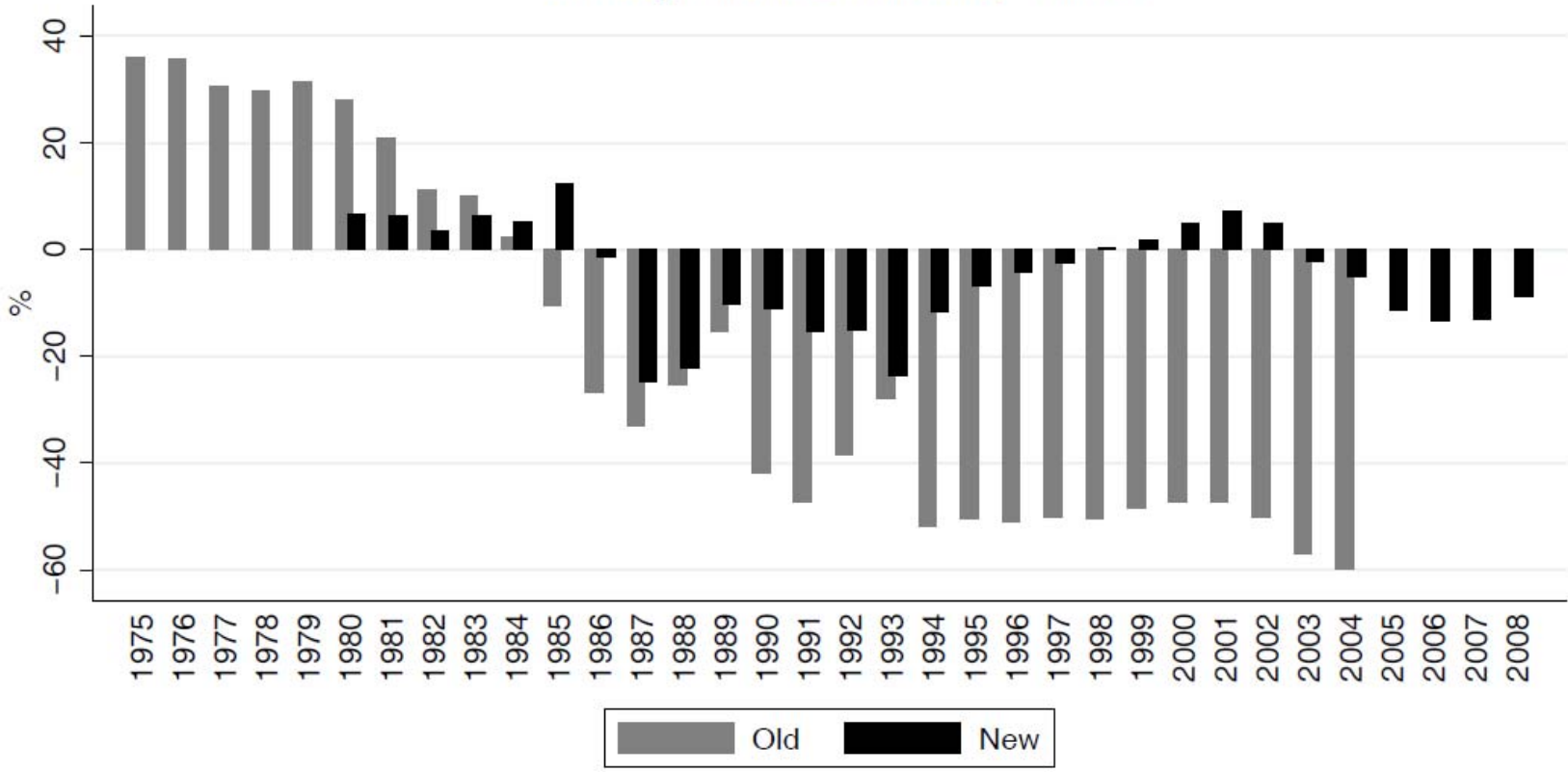Cross-country comparison exercises

Evaluating exchange rate misalignment

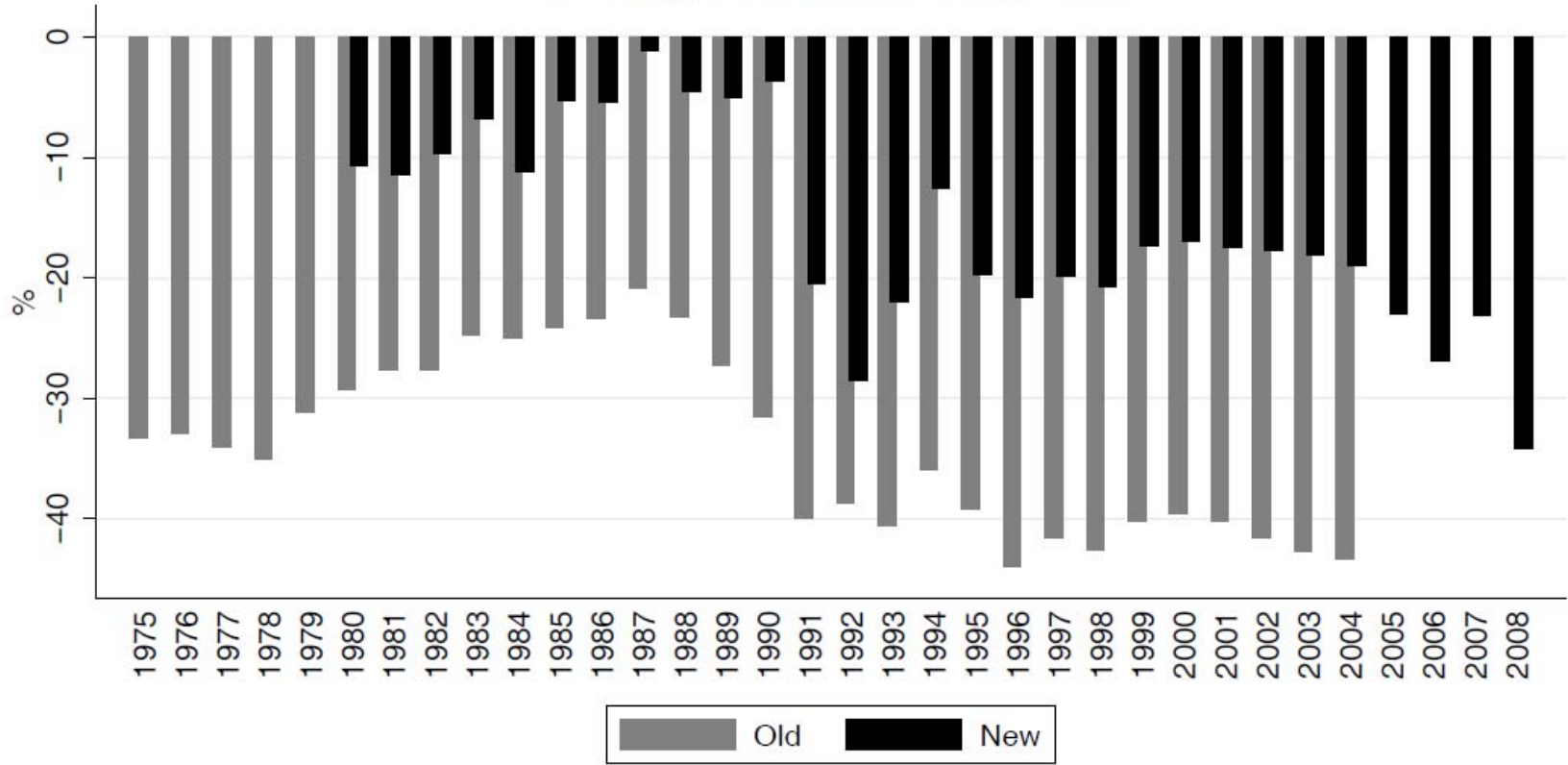The 2005 ICP survey – large data revisions

    Robustness of empirical results

Substantial changes in misalignment estimates; Penn effect regression

Misalignment Estimates, China

Legend: Old (gray), New (black)

Misalignment estimates, India

Current Study – Factors affecting changes in misalignment estimates?

Two measurement-related factors

    Survey participation

    Data quality

Four economic factors

    Initial output level

    Output growth

    Openness

    Inflation

2.   Preliminaries

2.1 Data

Three datasets: "*WDI* 2007" July 2007

"*WDI* 2008" April 2008

"*PWT* 6.3" *PWT* version 6.3 database

WDI 2007 and *WDI* 2008: With and without the 2005 ICP information

WDI 2007 and *PWT* 6.3:   Same ICP; different indexing and updating methods

Focus on the year 2005 currency misalignment estimates

Remark: PWT, WDI – main sources of ICP based data

2.2 Penn Effect

$$r_i = \beta_0 + \beta_1 y_i + u_i$$

$\hat{\beta}_0 + \hat{\beta}_1 y_i$ – the estimated "equilibrium" RFX

$\hat{u}_i$ – the estimated degree of misalignment

Assumption: r_i's are at equilibrium on average

Table 1. The Penn Effect Regression, the year 2005 data

	WDI 2007	WDI 2008	PWT 6.3
A. Estimation results			
GDP per capita	.366**	.249**	.347**
	(.028)	(.019)	(.030)
Adjusted R^2	.535	.559	.468
Number of obs	154	154	154
B. Implied misalignment			
China	-64.43	-14.38	-50.56
India	-57.09	-22.78	-50.67
Brazil	-2.85	-3.25	2.59
Russia	-15.44	-33.39	-17.73
C. By benchmark status			
Benchmark	3.18	-3.19	-.67
Non-benchmark	-12.13	12.18	2.58

(Constants dropped)

Figure 1. Misalignment Estimates
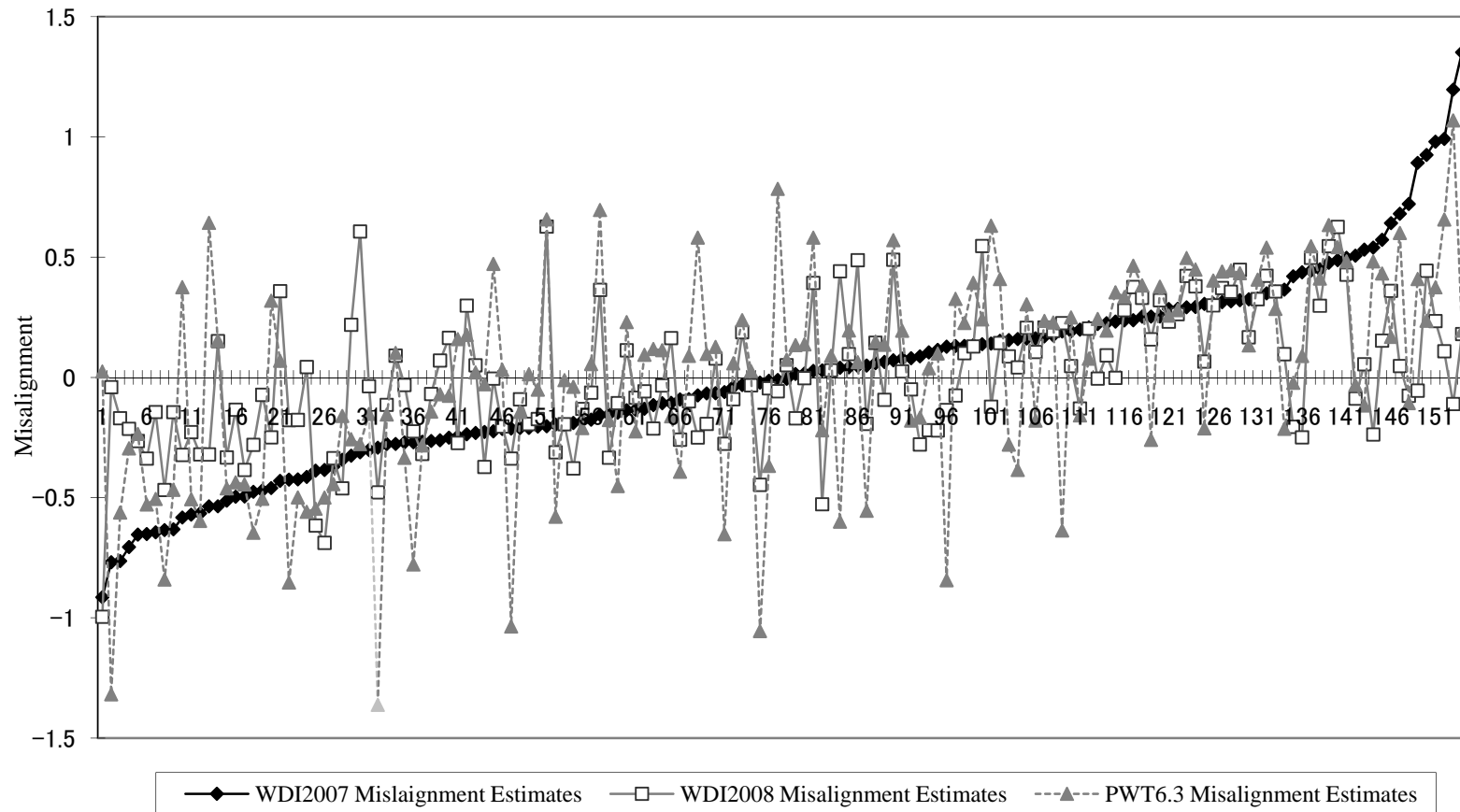
0.49: *WDI* 2007 and *WDI* 2008   0.54: *WDI* 2007 and *PWT* 6.3   0.52: *WDI* 2008 and *PWT* 6.3

3. Sources of Differences

The change in misalignment estimates: $\Delta \hat{u}_{i,v2,v1} \equiv (\hat{u}_{i,v2} - \hat{u}_{i,v1})$

$v1 = WDI$ 2007; $v2 = WDI$ 2008 or the PWT 6.3

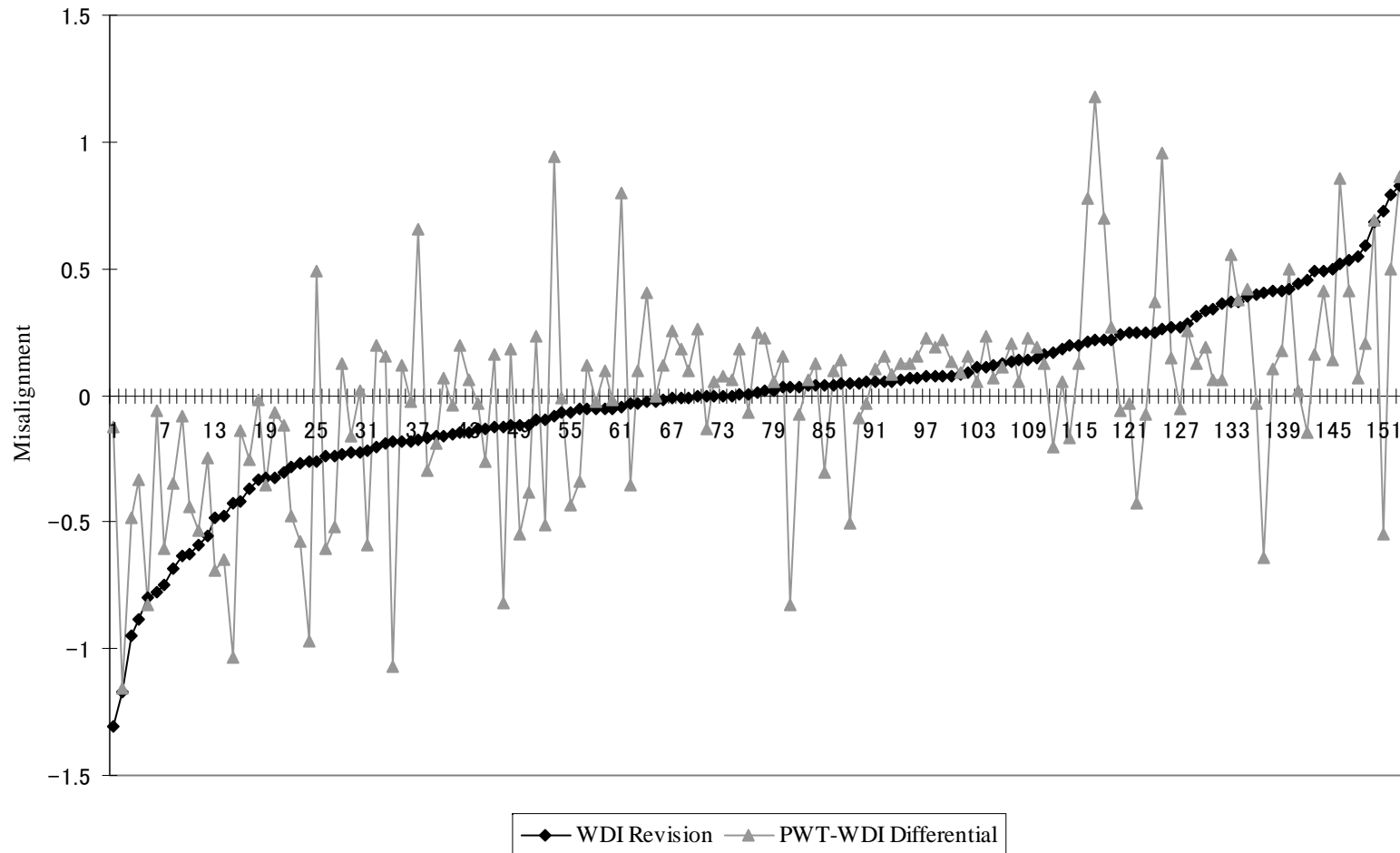$\Delta \hat{u}_{i,v2,v1} =$ "WDI revision"; $v2 \equiv WDI$ 2008

$\qquad = $ "PWT-WDI differential"; $v2 \equiv PWT$ 6.3

$\Delta \hat{u}_{i,v2,v1} > 0$, $\hat{u}_{i,v2}$ "less undervalued than" $\hat{u}_{i,v1}$

$\Delta \hat{u}_{i,v2,v1} = r_{i.v2} - r_{i.v1} - (\hat{r}_{i.v2} - \hat{r}_{i.v1}) \equiv \Delta r_{i,v2,v1} - \Delta \hat{r}_{i,v2,v1},$

$\Delta \hat{r}_{i,v2,v1} = [(\hat{\beta}_{0,v1} + \hat{\beta}_{1,v1} y_{i,v2}) - (\hat{\beta}_{0,v1} + \hat{\beta}_{1,v1} y_{i,v1})]$ "income effect"

$\qquad + [(\hat{\beta}_{0,v2} + \hat{\beta}_{1,v2} y_{i,v2}) - (\hat{\beta}_{0,v1} + \hat{\beta}_{1,v1} y_{i,v2})]$ "Penn effect"

0.51: "WDI revision" and "PWT-WDI differential"

Table 2. The Decomposition of the Differences in the 2005 Misalignment Estimates

	n	$\Delta\hat{u}_{i,v2,v1}$	$\Delta r_{i,v2,v1}$	$-\Delta\hat{r}_{i,v2,v1}$	$-\Delta income$	$-\Delta Penn$
A. WDI revision						
Total	154	0	.116	-.116	.043	-.160
Benchmark	122	-.063	.046	-.109	.015	-.125
Non-benchmark	32	.243	.386	-.143	.148	-.291
$\Delta\hat{u}^{+}_{i,v2,v1}$	80	.243	.298	-.055	.110	-.165
$\Delta\hat{u}^{-}_{i,v2,v1}$	74	-.262	-.079	-.183	-.028	-.154
B. PWT-WDI differential						
Total	154	0	-.031	.031	-.021	.052
Benchmark	122	-.038	-.064	.026	-.031	.057
Non-benchmark	32	.147	.093	.054	.020	.033
$\Delta\hat{u}^{+}_{i,v2,v1}$	89	.250	.145	.105	.050	.054
$\Delta\hat{u}^{-}_{i,v2,v1}$	65	-.342	-.273	-0.69	-.118	.050
C. The BRIC Countries						
i. WDI revision						
China		.500	.506	-.006	.180	-.186
India		.343	.440	-.097	.010	-.107
Brazil		-.004	.092	-.096	.161	-.259
Russia		-.179	-.088	-.091	-.025	-.065
ii. PWT-WDI differential						
China		.138	.070	.068	.015	.053
India		.064	.014	.050	-.025	.059
Brazil		.054	.020	.034	.009	.040
Russia		-.022	-.062	0.40	-.024	.064

Panel A: $\Delta\hat{r}_{i,v2,v1}$'s < 0

      Benchmark Vs Nnon-benchmark countries

      Positive Vs Negative revisions

Panel B: $\Delta\hat{r}_{i,v2,v1}$'s mostly > 0

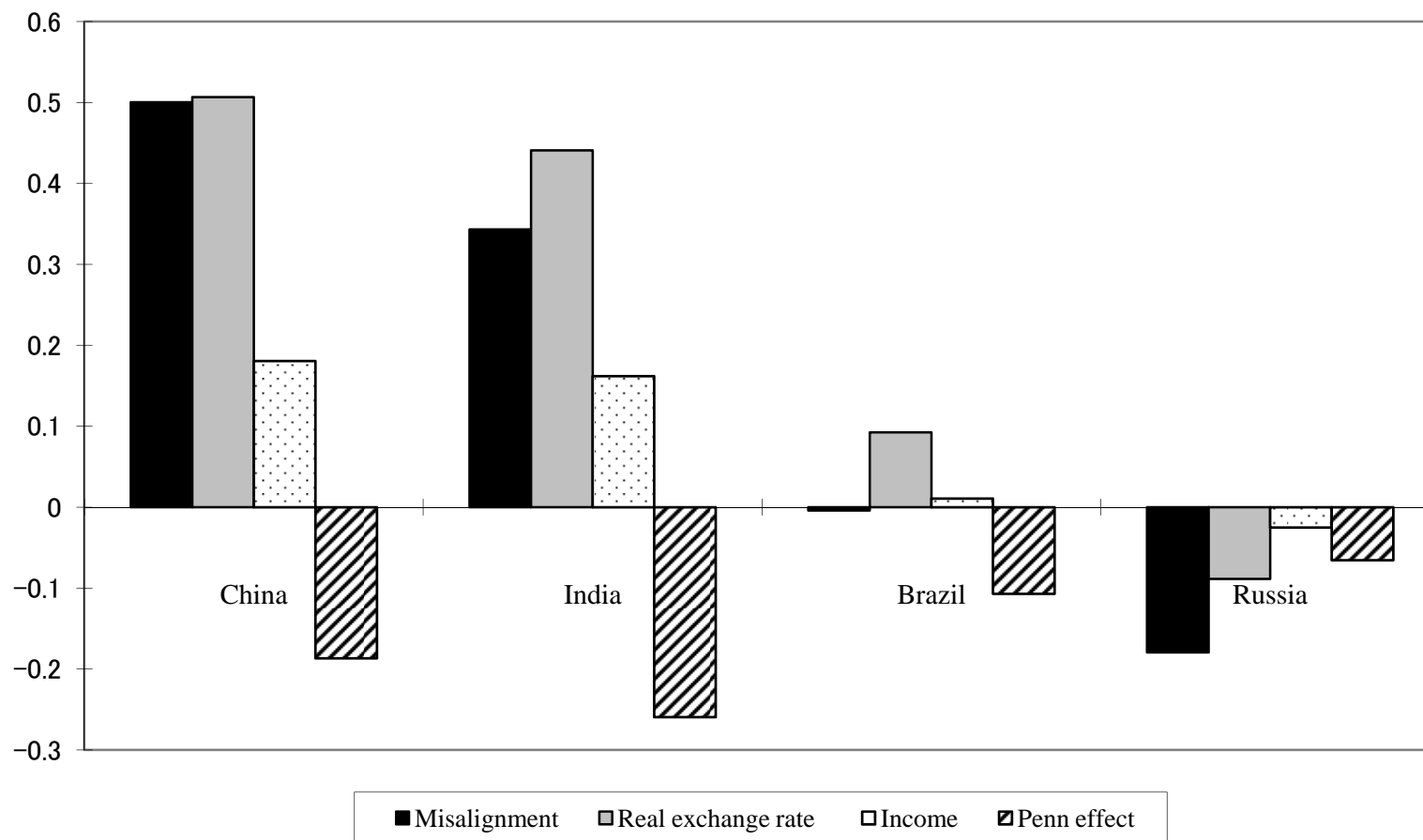   *PWT* 6.3: non-benchmark countries have a smaller undervaluation

      PWT 6.3: higher number of "larger" misalignment estimates
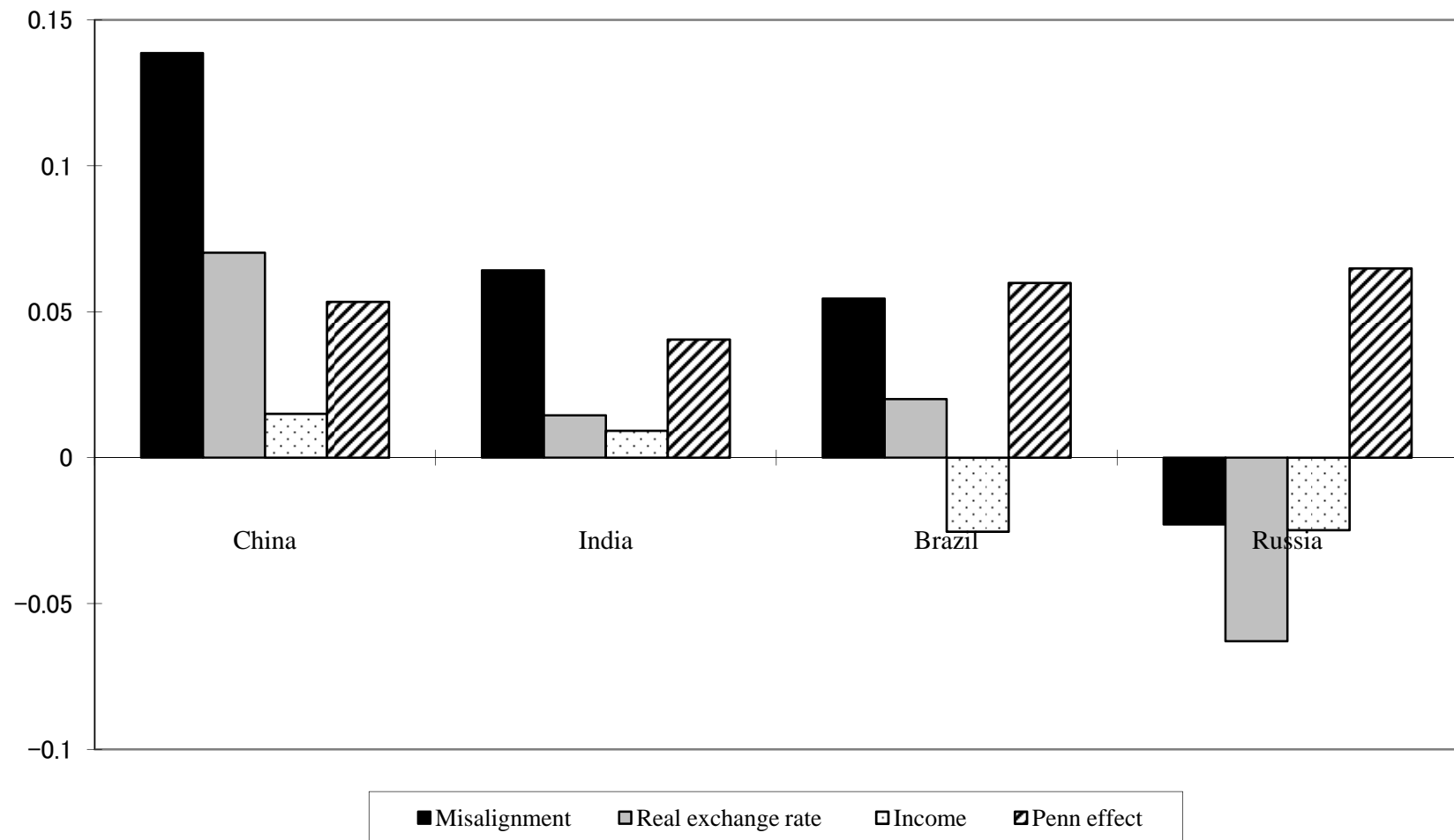

Panel C - four BRIC countries

      China and India Vs Brazil and Russia

Figure 3. Decomposition of Misalignment Changes for the Four BRIC Countries

A. WDI Revision

B. PWT-WDI Differential

3.2 Regression Analysis I: Measurement Related Factors

$$\Delta \hat{u}_{i,v2,v1}^{+} = \alpha_0 + \alpha_1 D_{i,nBM} + \alpha_2 Q_i + \varepsilon_i ; \qquad \Delta \hat{u}_{i,v2,v1}^{-} = \alpha_0 + \alpha_1 D_{i,nBM} + \alpha_2 Q_i + \varepsilon_i$$

Table 3. Revision in Misalignment Estimates - Measurement-Related Factors

	WDI revision			PWT-WDI differential		
Panel A. $\Delta \hat{u}_{i,v2,v1}^{+}$						
93NBM	.258**		.153**	.061		.030
	(.051)		(.054)	(.057)		(.068)
Low data quality	-	.239**	.180**	-	.131**	.120*
		(.032)	(.031)		(.038)	(.047)
Adjusted R^2	.291	.288	.384	.001	.073	.064
n	80	67	67	89	72	72
Panel B. $\Delta \hat{u}_{i,v2,v1}^{-}$						
93NBM	.041	-	.067	-.039	-	-.029
	(.095)		(.140)	(.100)		(.113)
Low data quality	-	-.304**	-.312**	-	-.284**	-.280**
		(.046)	(.049)		(.048)	(.051)
Adjusted R^2	-.011	.096	.083	-.014	.069	.050
n	74	54	54	65	49	49

3.3 Regression Analysis II: Economic Factors

$$\Delta \hat{u}_{i,v2,v1}^{+} = \alpha_0 + \beta_1 IY_i + \beta_2 AG_i + \beta_3 OG_i + \beta_4 AI_i + \varepsilon_i,$$

$$\Delta \hat{u}_{i,v2,v1}^{-} = \alpha_0 + \beta_1 IY_i + \beta_2 AG_i + \beta_3 OG_i + \beta_4 AI_i + \varepsilon_i.$$

Table 4.   Revision in Misalignment Estimates - the Role of Economic Factors

	WDI revision					PWT-WDI differential				
Panel A. $\Delta \hat{u}_{i,v2,v1}^{+}$										
GDP per capita	-.098** (.016)	-	-	-	-.093** (.017)	-.089** (.022)	-	-		-.071** (.020)
GDP per capita growth rate	-	-.100 (.107)	-	-	-.024 (.104)	-	-.287* (.108)	-		-.075 (.083)
Openness growth			.009 (.086)	-	.039 (.070)	-			-.138 (.123)	-.164 (.101)
Average inflation	-	-	-	.021 (.015)	.012 (.017)	-	-	-	.023† (.013)	.019 (.015)
Adjusted R^2	.265	.002	-.013	.060	.268	.133	.071	.017	.049	.239
n	80	80	77	80	77	89	89	85	89	85
Panel B. $\Delta \hat{u}_{i,v2,v1}^{-}$										
GDP per capita	.104** (.030)	-	-	-	.076** (.025)	.069* (.029)	-	-	-	.066† (.034)
GDP per capita growth rate	-	.286† (.149)	-	-	.244 (.131)	-	.224* (.195)	-	-	.404† (.169)
Openness growth			.129 (.109)	-	.079 (.108)	-		.123 (.132)	-	-.005 (.118)
Average inflation	-	-	-	-.011 (.019)	-.014 (.021)	-	-	-	-037** (.010)	-050** (.012)
Adjusted R^2	.136	.036	.003	-.005	.146	.052	.015	-.0003	.082	.199
n	73	73	70	74	69	65	64	62	65	61

3.4 Regression Analysis III: A Combined Model

$$\Delta \hat{u}_{i,v2,v1}^{+} = \alpha_0 + \alpha_1 D_{i,nBM} + \alpha_2 Q_i + \beta_1 IY_i + \beta_2 AG_i + \beta_3 OG_i + \beta_4 AI_i + \varepsilon_i$$

$$\Delta \hat{u}_{i,v2,v1}^{-} = \alpha_0 + \alpha_1 D_{i,nBM} + \alpha_2 Q_i + \beta_1 IY_i + \beta_2 AG_i + \beta_3 OG_i + \beta_4 AI_i + \varepsilon_i$$

Table 5. A Combined Model

	WDI revision		PWT-WDI differential	
Panel A: $\Delta\hat{u}^{+}_{i,v2,v1}$				
93NBM	.150*	.164**	-.067	-
	(.067)	(.053)	(.082)	
Low data quality	.198**	.194**	-.031	-
	(.069)	(.031)	(.062)	
GDP per capita	-.004	-	-.100*	-.074**
	(.037)		(.043)	(.021)
GDP per capita growth rate	.215*	.197*	-.005	-
	(.095)	(.084)	(.114)	
Openness growth rate	-.069	-	-.196	-.166
	(.053)		(.158)	(.102)
Average inflation	-.140	-	-.049	.021
	(.234)		(.031)	(.015)
Adjusted R^2	.403	.418	.124	.242
n	65	65	70	85
Panel B: $\Delta\hat{u}^{-}_{i,v2,v1}$				
93NBM	.107	-	.061	-
	(.073)		(.172)	
Low data quality	-.065	-.182**	-.188	-
	(.073)	(.043)	(.128)	
GDP per capita	.070†	-	.072	.053*
	(.041)		(.047)	(.029)
GDP per capita growth rate	.335	.398†	.379	.421*
	(.217)	(.229)	(.276)	(.170)
Openness growth rate	.016	.025	-.293	-
	(.135)	(.153)	(.182)	
Average inflation	-.066	-.065	-.018	-.051**
	(.053)	(.055)	(.024)	(.012)
Adjusted R^2	.217	.189	.129	.197
n	50	50	45	64

Figure 4. Actual and Predicted Misalignment Changes

A.   WDI revision

B. PWT-WDI differential

Legend: ■ Actual ▨ Measurement ☐ Economic ⊟ Combined ▧ Parsimonious
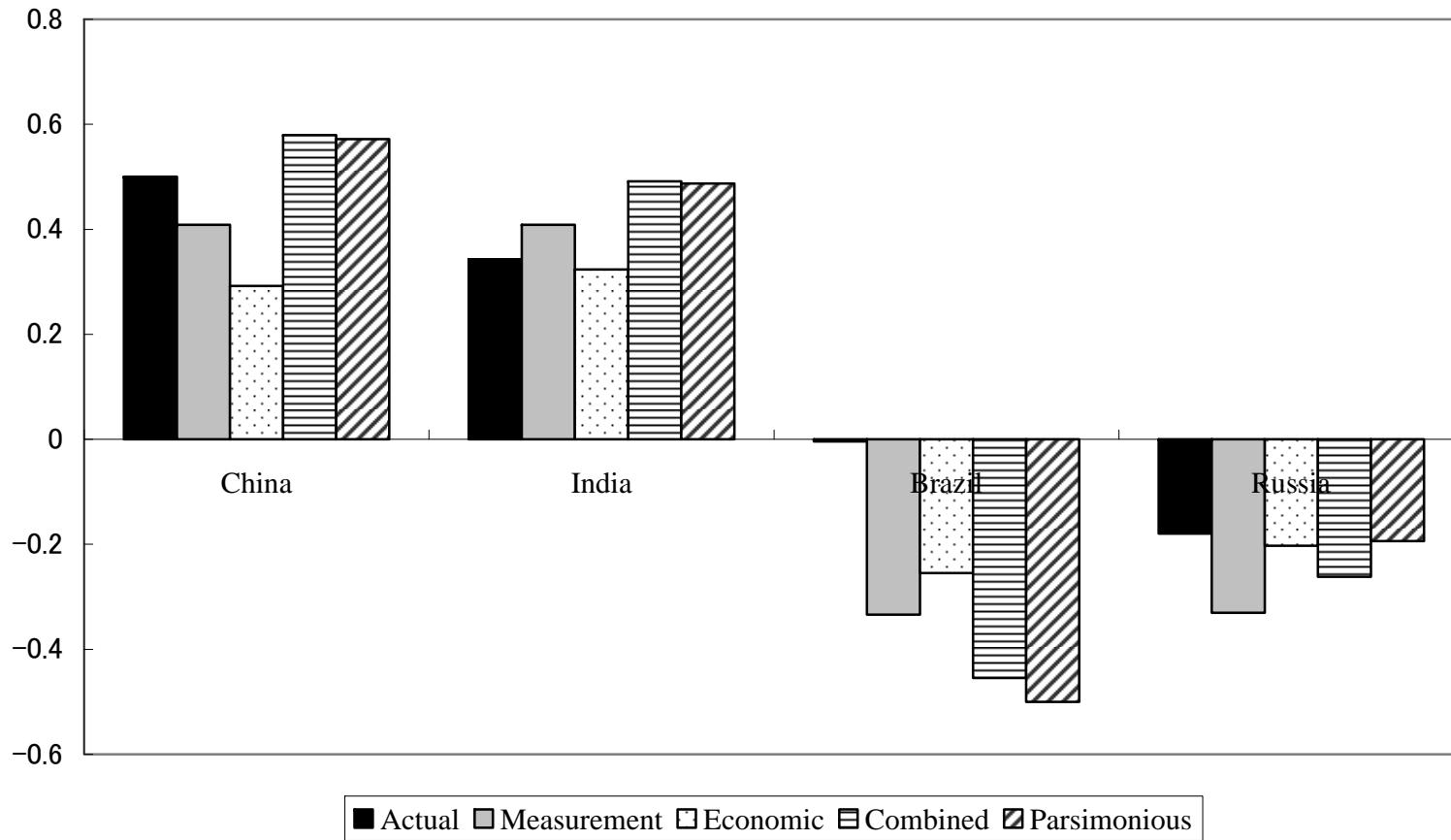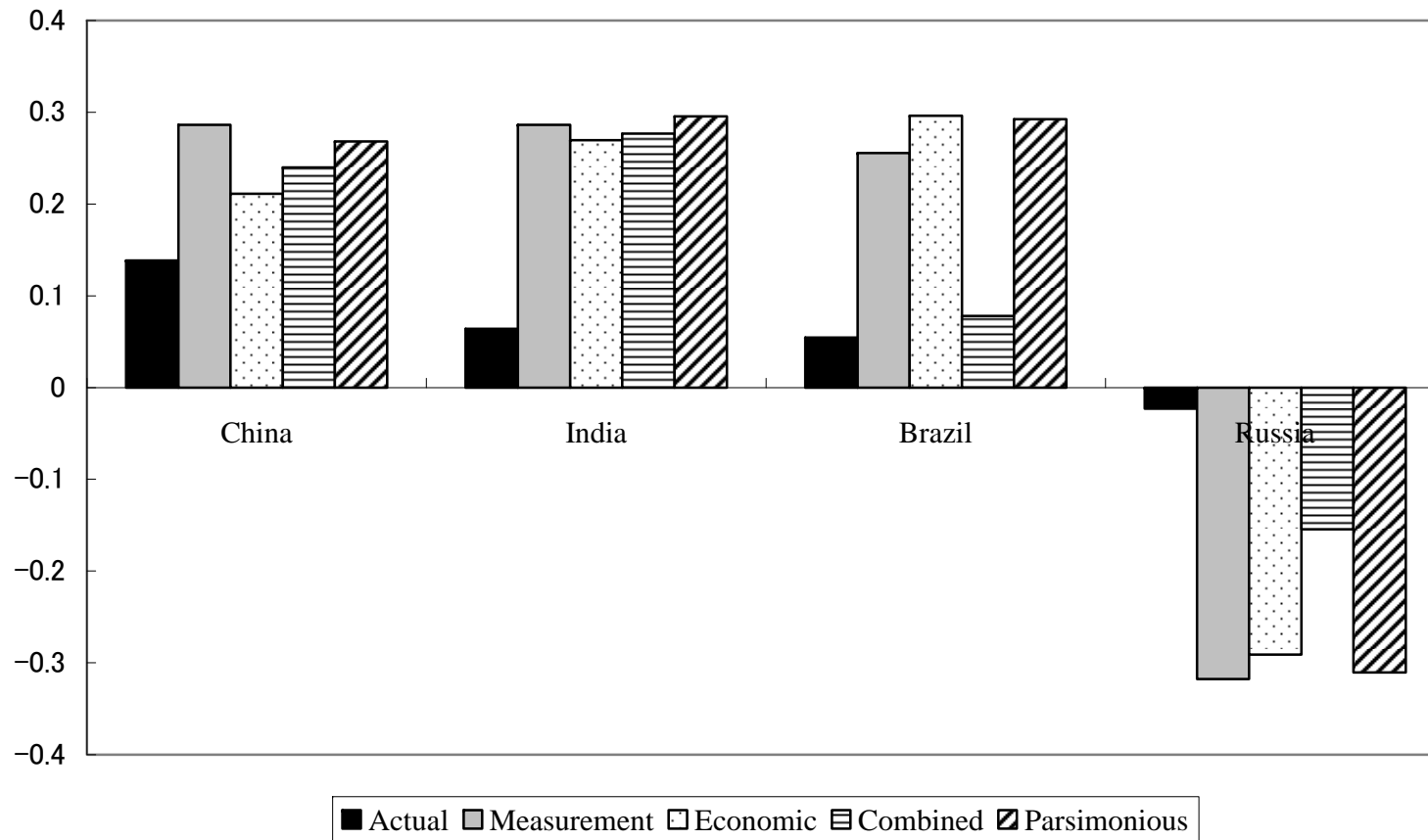
3.5 Some Additional Analyses

a. $r_i = \beta_0 + \gamma_0 D_{i,ADV} + \beta_1 y_i + \gamma_1 D_{i,ADV} y_i + u_i$

Table 6. The Modified Penn Regression Estimation Results

	WDI 2007	WDI 2008	PWT6.3
A. Estimation results			
GDP per capita	.243**	.131**	.196**
	(.039)	(.017)	(.036)
Advanced*GDP per capita	.381*	.210	.066
	(.166)	(.151)	(.166)
Advanced country dummy	.643**	.648**	.707**
	(.107)	(.082)	(.112)
Adjusted R^2	.598	.713	.576
Number of obs	154	154	.154
B. Implied misalignment			
China	-52.93	-6.33	-37.31
India	-53.88	-22.05	-47.27
Brazil	11.33	12.82	20.79
Russia	1.88	-13.15	4.27
C. By benchmark status			
Benchmark	3.72	-2.11	.32
Non-benchmark	-14.19	8.04	-1.23

b.   "WDI 2010", March 2010

c.   The 1993 Penn effect regression

4.   Concluding Remarks

Always hard to absorb large revisions

The ICP update: Large PPP-based RFX revisions; Large Misalignment revisions

> different indexing and projection methods

WDI revisions – measurement-related and economic factors.

WDI and PWT differential – economic factors.

Adjusted R-squares: +ve changes (up to 42%), -ve changes (up to 20%)

Relevance and usefulness of misalignment estimates???

Fragility of the exchange rate misalignment assessment exercise

Would not stop policymakers and commentators ……