



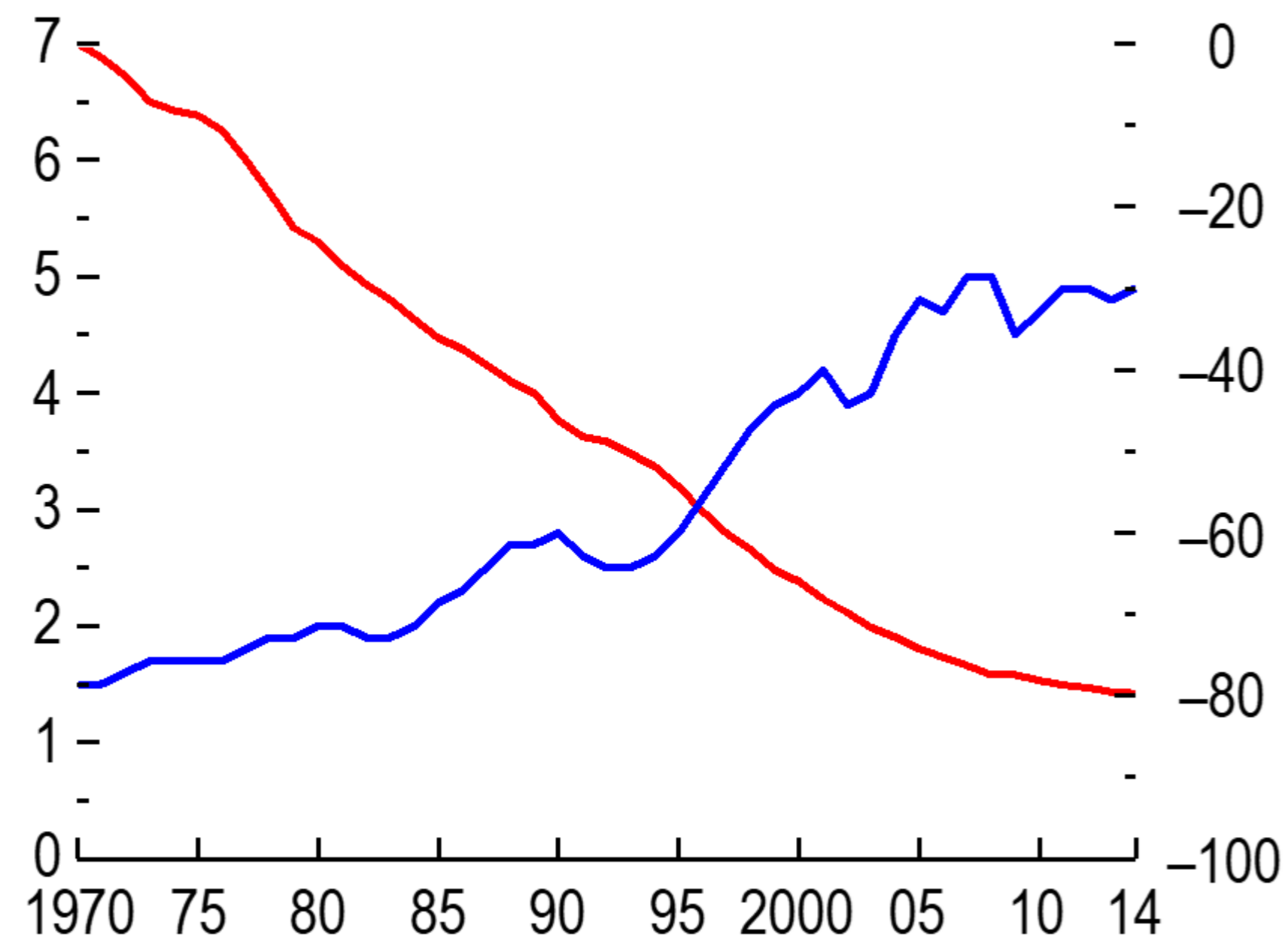
The Price of Capital Goods: An Investment Driver under Threat?

Weicheng Lian, Natalija Novta, Evgenia Pugacheva, Yannick Timmer, and Petia Topalova (team leader), with support from Jilun Xing and Candice Zhao, and contributions from Michal Andrle and Rafael Portillo

Falling relative prices of investment goods, strong capital deepening

Real Investment Rate and Changes in Relative Price of Machinery and Equipment (Percent)

1. Advanced Economies



- Real investment in machinery and equipment, percent of real GDP (left scale)
- Price of machinery and equipment relative to consumption (right scale)

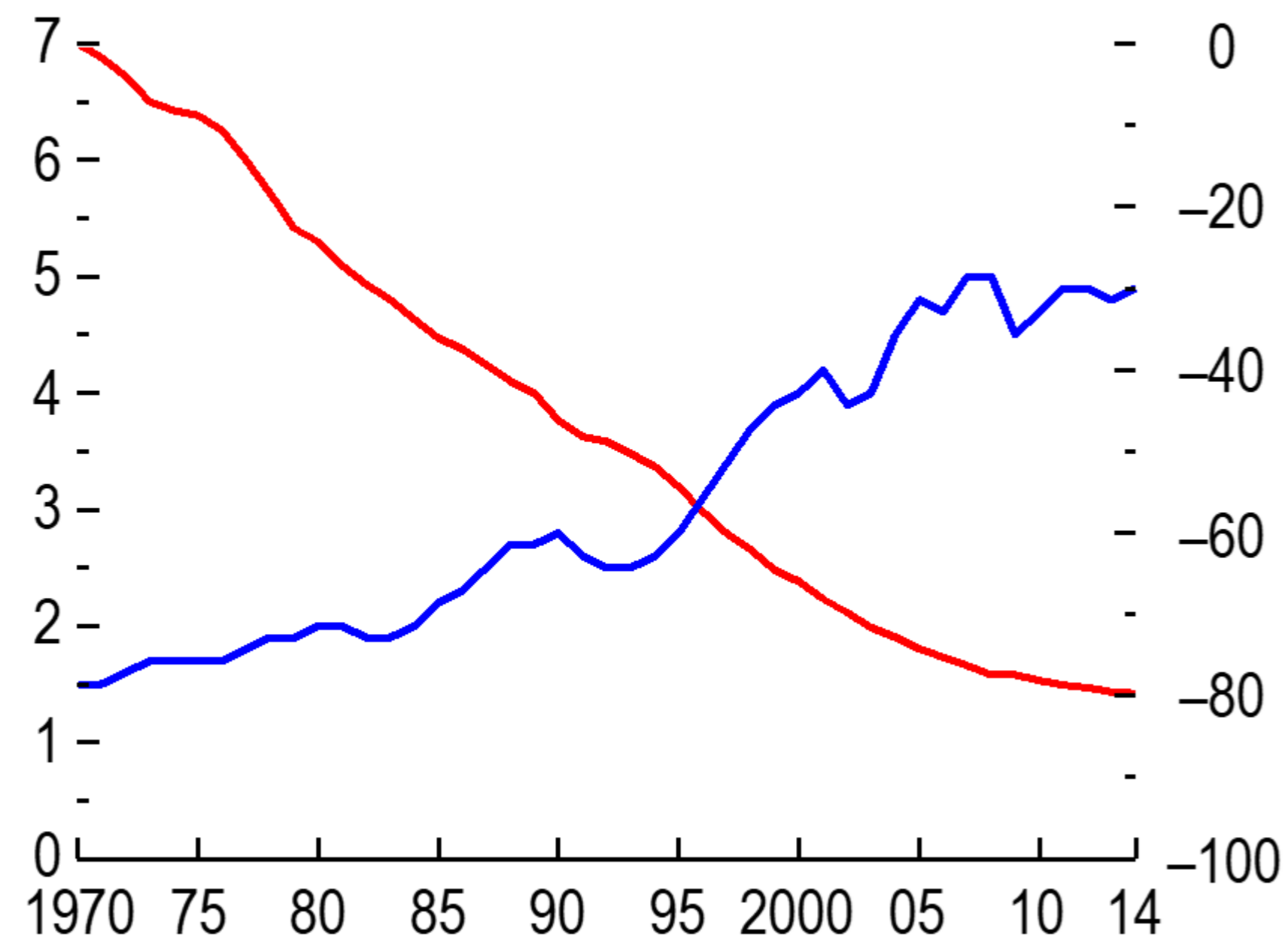
Sources: Penn World Table 9.0; IMF, *World Economic Outlook*; and authors' calculations.

Note: The figure plots the real investment rate in machinery and equipment and changes in the price of machinery and equipment relative to the price of consumption. Changes in relative prices are relative to their levels in 1970.

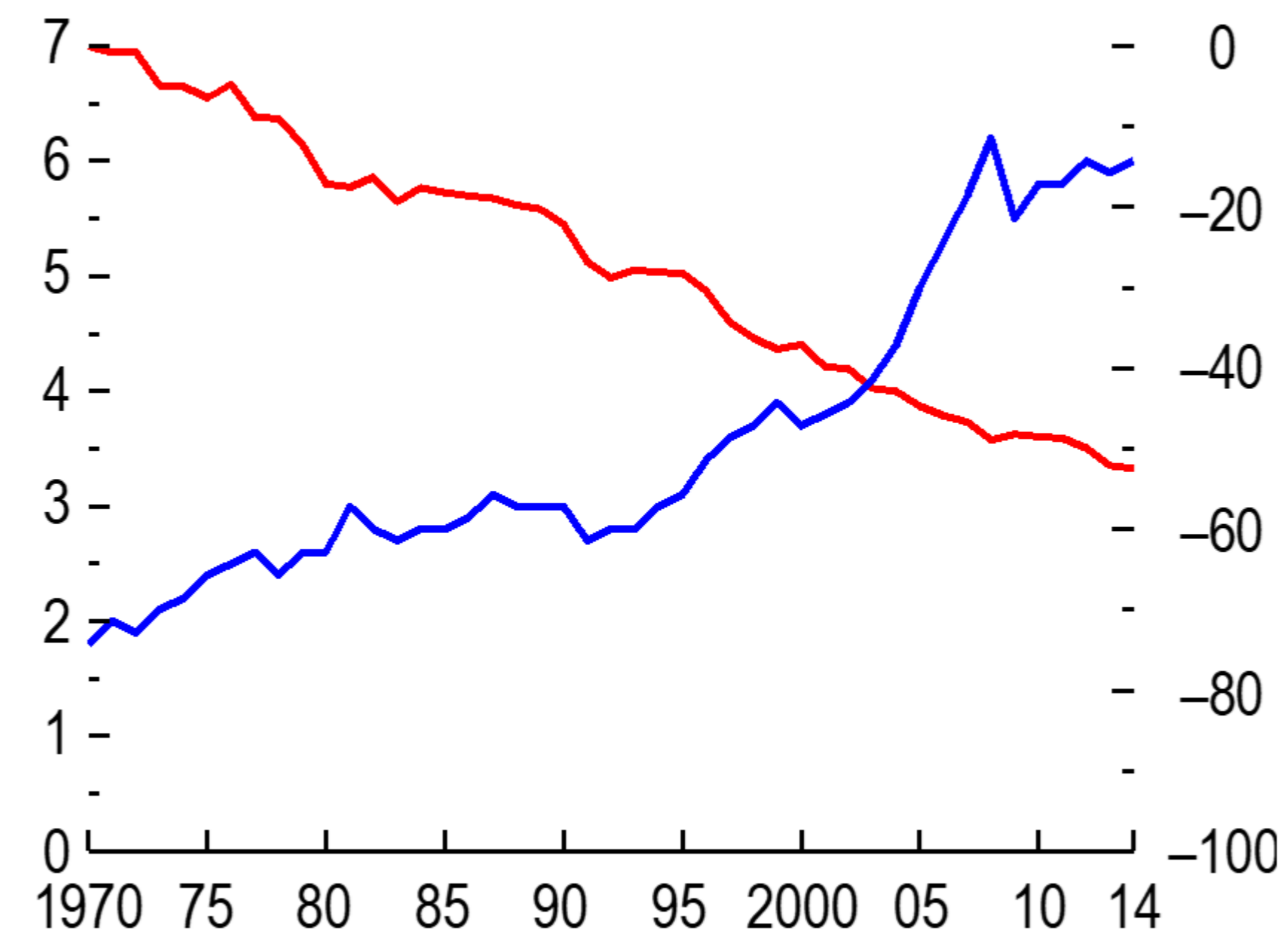
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1. Advanced Economies



2. Emerging Market and Developing Economies



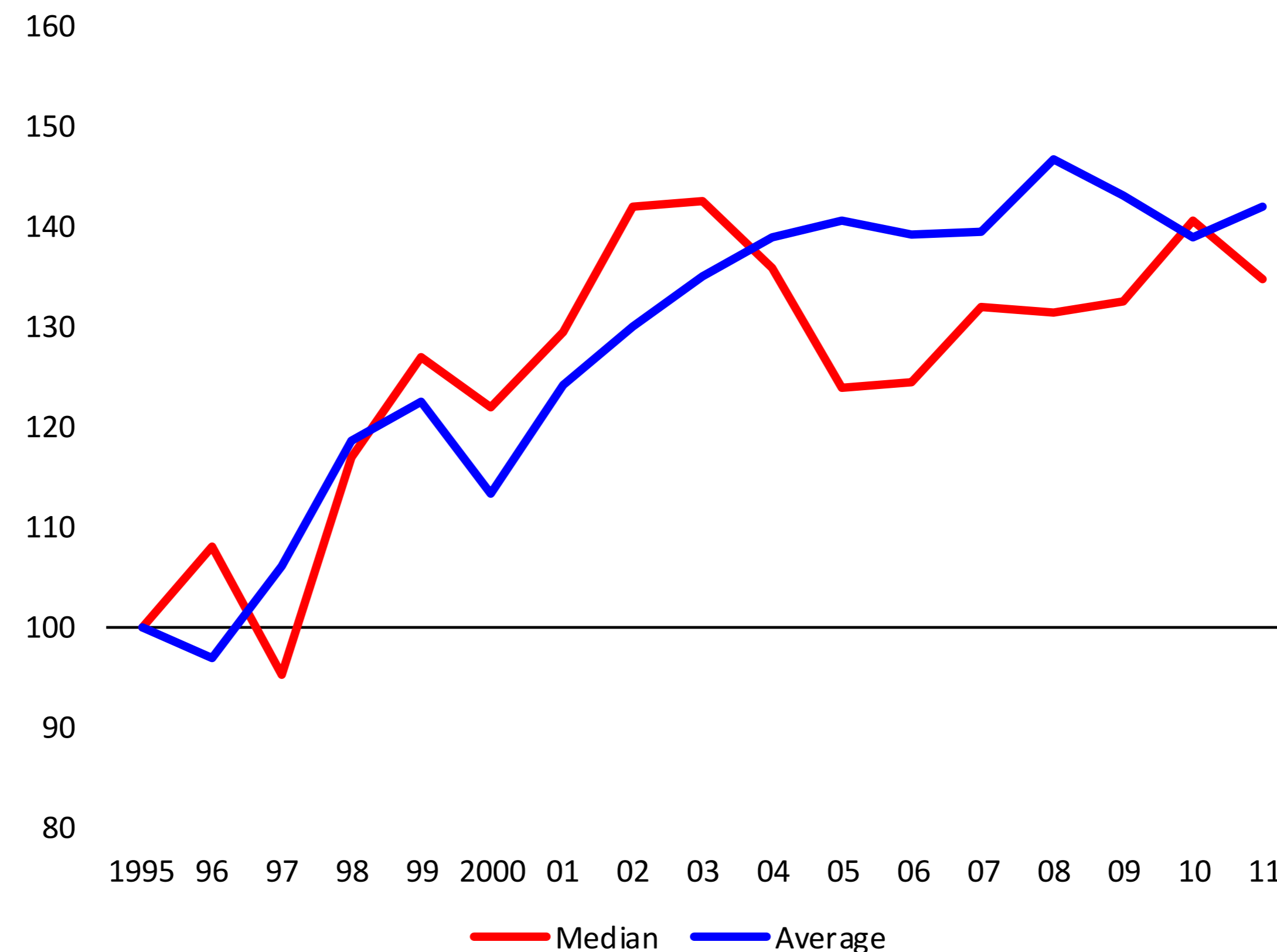
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Relative import penetration of capital goods producing sectors

Relative import penetration of capital goods producing sectors in emerging market and developing economies (1995 = 100)



Sources: World Input and Output database; and authors' calculations.

Note: Relative import penetration is defined as the ratio of total imports to domestic value-added divided by that of the overall economy.

Main questions

- Key drivers of the relative price of tradable capital goods (PK)?
 - Trade integration

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- How much does it matter for real investment rate?

What is new?

Real investment and relative price of capital goods

DeLong and Summers (1991, 1993), Jones (1994), Sarel (1995), Lee (1995), Restuccia and Urrutia (2001)

Debate on factors that affect relative price of capital goods

Eaton and Kortum (2001), Hsieh and Klenow (2007), Alfaro and Ahmed (2009), Sposi (2015)

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- Revisit the debate, using the 2011 ICP data

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- Revisit the debate, using the 2011 ICP data
- Examine the role of rising trade integration in the fall in PK over time
- Quantify the contribution of the fall in PK to the rise in real investment rates

Main findings

Drivers of relative prices of capital goods

- Rise in trade integration was an important factor in the decline in the relative price of machinery and equipment in the past decades

Main findings

Drivers of relative prices of capital goods

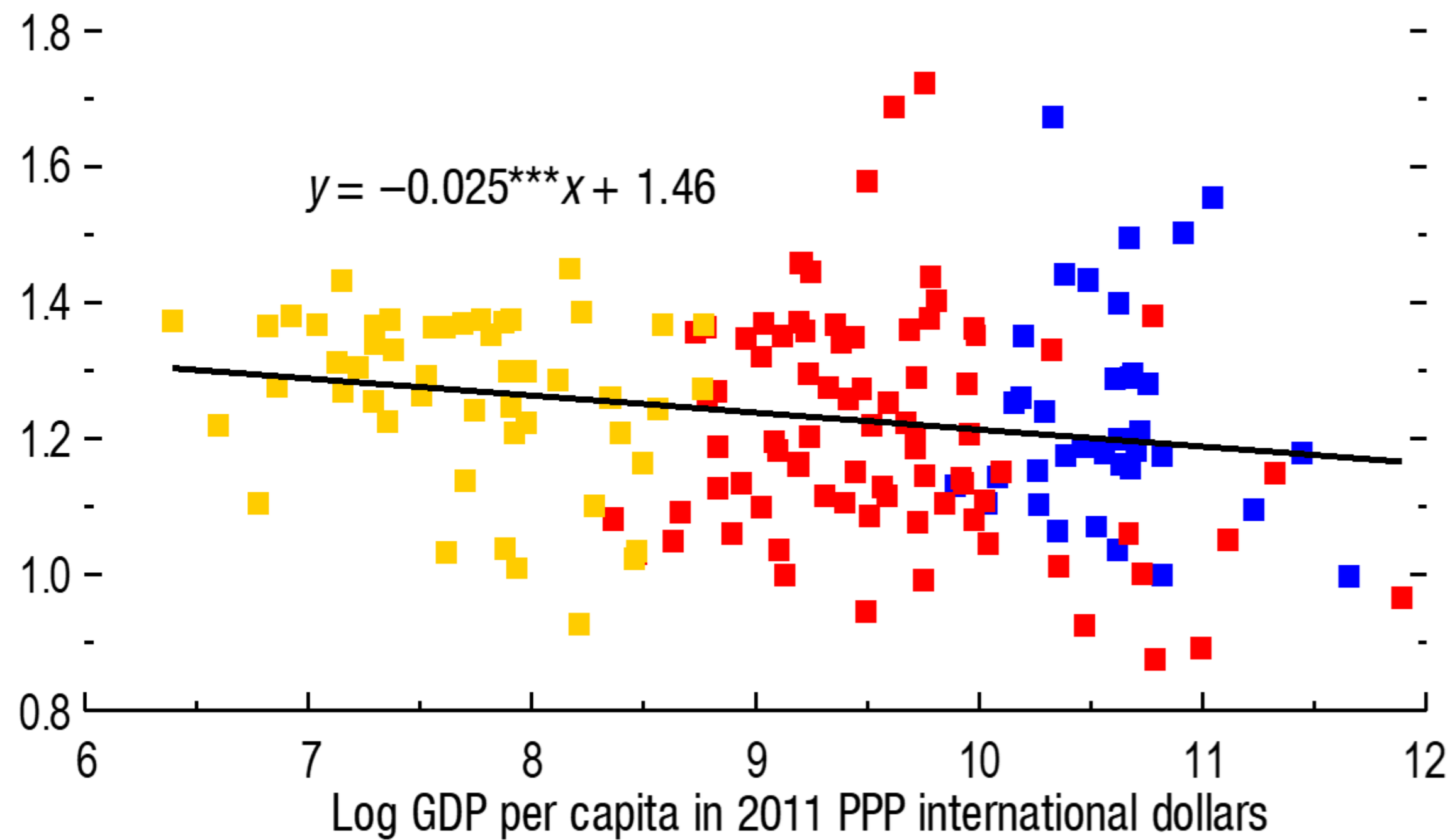
- Rise in trade integration was an important factor in the decline in the relative price of machinery and equipment in the past decades

Macro implications of declining relative price of capital

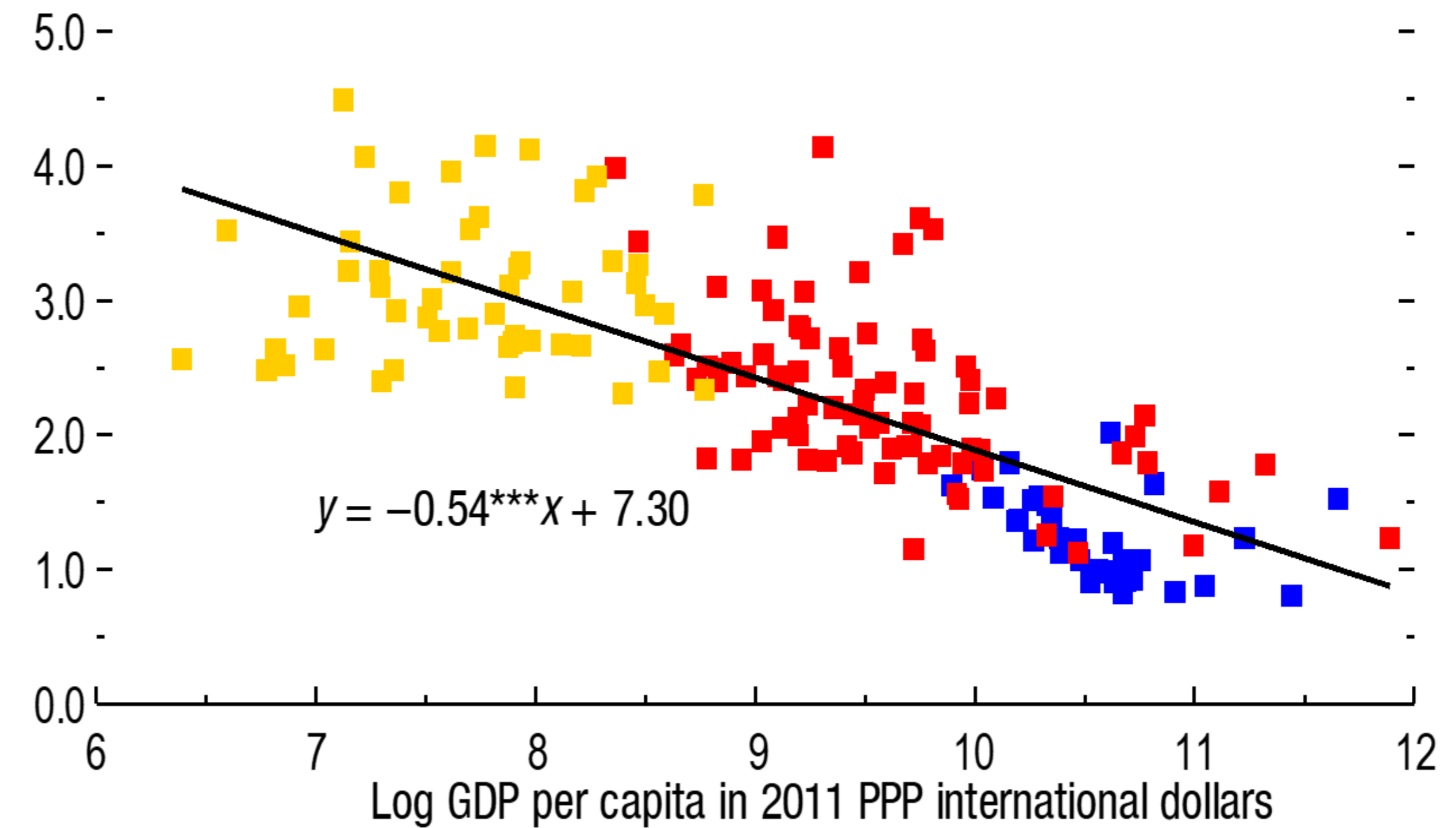
- The decline in the relative price of investment goods can explain around 40 percent of the increase in real investment rates in an average economy since the 1990s

EMDEs still face higher prices of machinery and equipment, especially relative to the price of consumption

Absolute prices in 2011



Relative prices in 2011



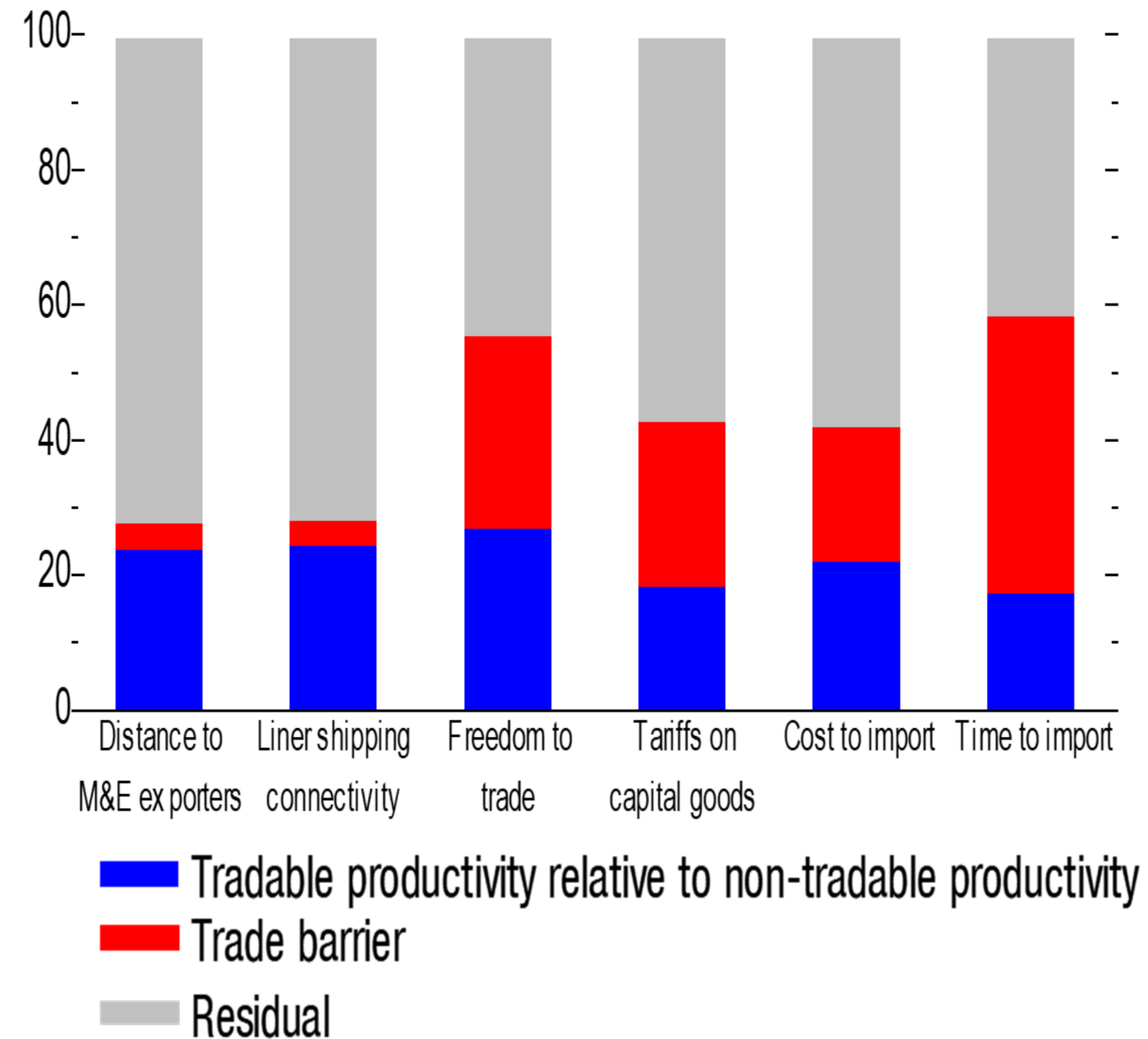
■ AE ■ EM ■ LIC

Sources: International Comparison Program (ICP) 2011, and authors' calculations.

Note: The absolute price of Machinery and Equipment is the price level of Machinery & Equipment, derived by the ICP using a similar basket of products across countries, relative to its US level. The relative price is the price of Machinery & Equipment relative to the price of consumption.

Trade costs explain cross-sectional variation in relative price of capital goods

Cross-Country Variation in Relative Capital Goods Price Explained by Relative Productivity and Trade Costs
(Percent)



Sources: International Comparison Program (ICP) 2011; and authors' calculations.

Note: The relative price of machinery and equipment is the price level of machinery and equipment relative to the price of consumption, both derived from the ICP. 14

A regression analysis: over time changes

$$\ln\left(\frac{P_{i,j,t}}{\bar{P}_{i,t}}\right) = \alpha_{i,j} + \mu_{i,t} + \beta \ln(\text{Relative import penetration}_{i,j,t-1}) + \gamma \ln(\text{Relative productivity}_{i,j,t-1}) + \varepsilon_{i,j,t}$$

$$\ln(\text{Relative productivity}_{i,j,t}) = \tilde{\alpha}_{i,j} + \tilde{\mu}_{i,t} + \rho \ln(\text{Relative import penetration}_{i,j,t-1}) + v_{i,j,t}$$

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Sector level import tariffs $\tau_{i,j,t}$ as an instrumental variable for import penetration

Data: World Input-Output Dataset, 33 sectors 40 countries, 1995-2011

Deepening trade integration reduces PK directly

Relative Producer Prices, Trade Integration and Relative Productivity

Dependent Variable:	IV	IV	IV	IV	IV
Relative Producer Prices	(1)	(2)	(3)	(4)	(5)
Relative Import Penetration _{t-1}	-0.574*** (0.163)	-0.413*** (0.148)	-0.964*** (0.374)	-0.461** (0.200)	-0.458*** (0.177)
Relative Import Penetration _{t-1} × Capital Goods Dummy	0.033 (0.322)	0.037 (0.384)	0.183 (0.617)	-0.375 (0.574)	-0.040 (0.359)
Relative Productivity _{t-1}	-0.328*** (0.032)	-0.349*** (0.041)	-0.274*** (0.034)	-0.302*** (0.031)	-0.368*** (0.039)
Number of Observations	16,077	12,575	3,502	12,321	15,086
R ²	0.56	0.63	0.40	0.71	0.61
Relative Import Penetration for Capital Goods Sectors	-0.541* (0.287)	-0.375 (0.375)	-0.781* (0.420)	-0.836 (0.561)	-0.498 (0.340)
Sample	All	AE	EMDE	Post 2000	All ¹

Source: Authors' calculations.

Note: All regressions include country-year and country-sector fixed effects. Standard errors clustered at the country

¹ Relative labor productivity_{t-2} is used as an instrument for relative labor productivity_{t-1}.

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

Deepening trade integration raises labor productivity

Labor Productivity and Trade Integration

Dependent Variable:	IV	IV	IV	IV
Relative Productivity	(1)	(2)	(3)	(4)
Relative Import Penetration _{t-1}	1.363*** (0.363)	0.793*** (0.305)	2.403** (1.041)	1.251*** (0.449)
Relative Import Penetration _{t-1} × Capital Goods Dummy	1.407** (0.671)	1.965*** (0.665)	0.160 (1.648)	2.810 (1.751)
Number of Observations	16,077	12,575	3,502	12,321
R^2	0.91	0.92	0.88	0.92
Relative Import Penetration for Capital Goods Sectors	2.771*** (0.564)	2.758*** (0.624)	2.563*** (1.089)	4.061*** (1.686)
Sample	All	AE	EMDE	All, Post 2000

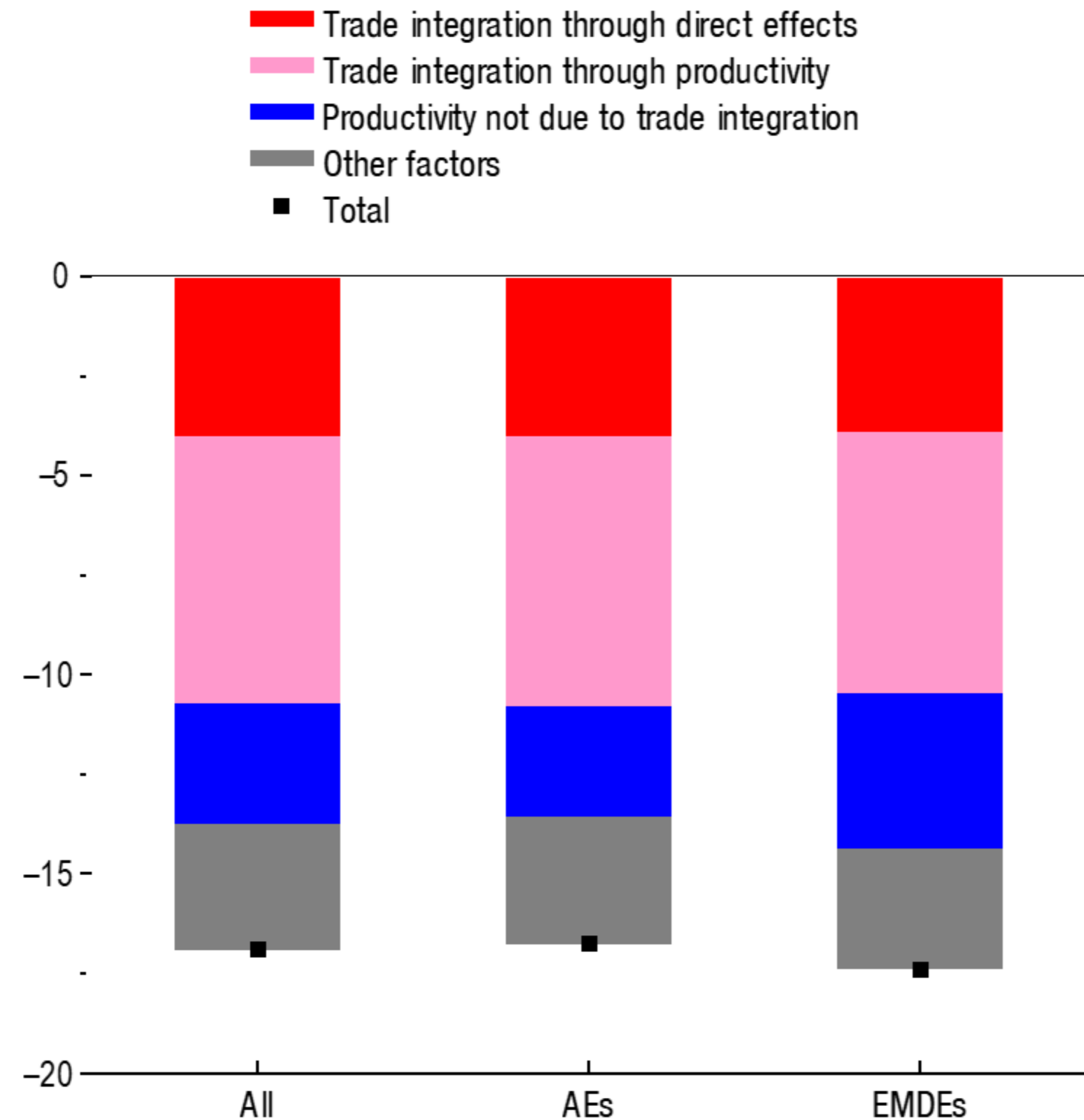
Source: Authors' calculations.

Note: All regressions include country-year and country-sector fixed effects. Standard errors clustered at

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A significant fraction of the fall in PK was attributed to a rise in trade integration

Contributions to Changes in Relative Producer Prices of Capital Goods: 2000-11 (Percent)



Source: Authors' calculations.

Note: The figure combines the estimated elasticities of producer prices to trade integration and relative labor productivity, and changes in these factors for the capital goods sector between 2000 and 2011 to compute their contribution to the observed change in the producer price of capital goods relative to the price of consumption.

The long-run elasticity is smaller than 1

Sectoral Real Investment Rate and Relative Prices of Machinery and Equipment

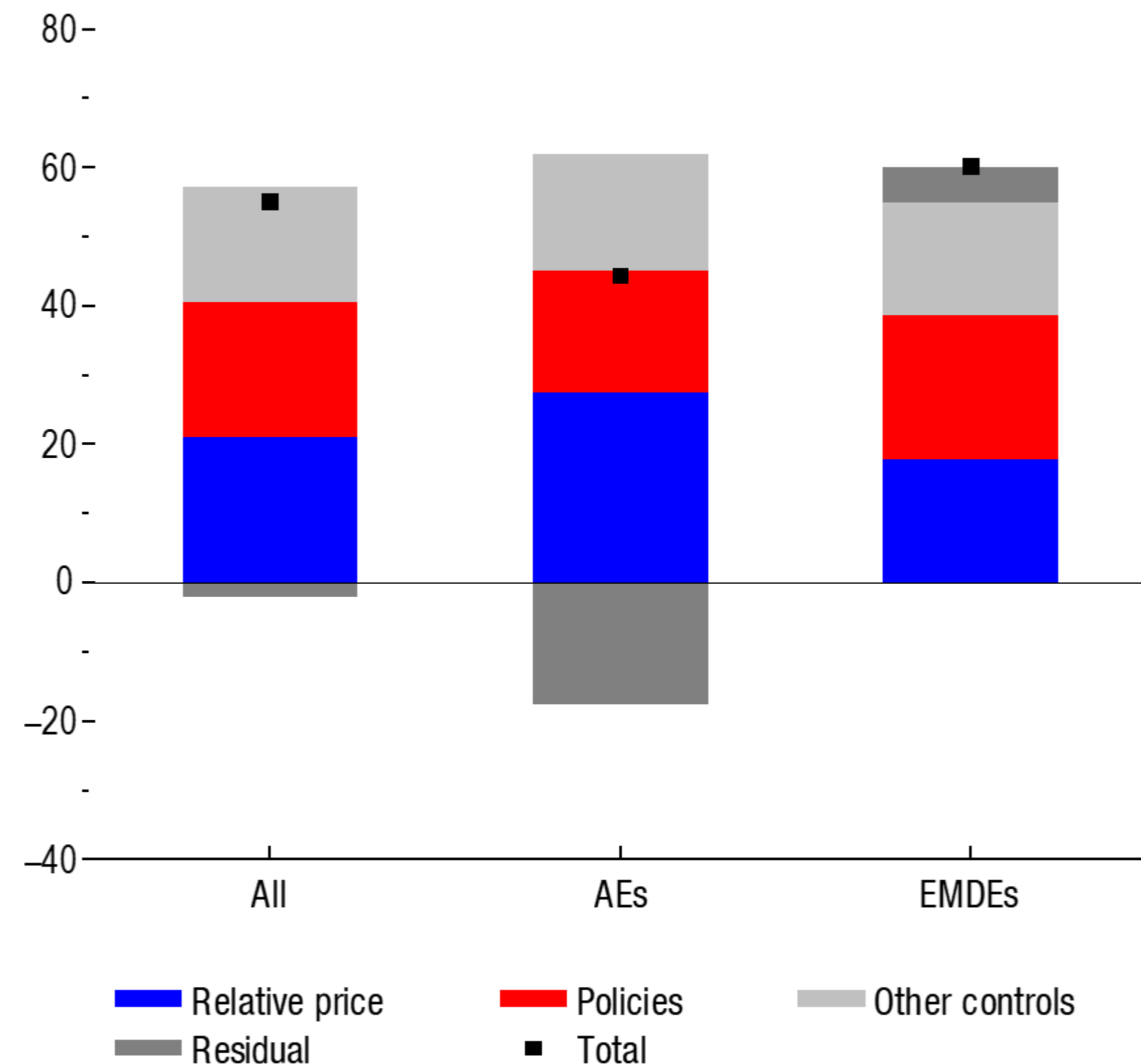
Dependent Variable:	IV	IV
Log Real Investment-to-GDP Ratio	(1)	(2)
Log Relative Price	-0.326*** (0.078)	-0.528*** (0.068)
Number of Observations	971	971
R^2	0.94	0.93
First Stage F-Statistic	645	729
Period Fixed Effects	No	Yes
Country-Period Fixed Effects	Yes	No
Country-Sector Fixed Effects	Yes	Yes

Source: Authors' calculations.

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Fall in PK: a sizable share of increases in real investment rate

Contributions of Relative Prices to Increases in Real Investment in Machinery and Equipment, 1990-94 to 2010-14 (Percent)



Source: IMF staff calculations.

Note: The figure presents the contribution to the observed increase in real machinery and transport equipment investment-to-GDP ratios between 1990-94 to 2010-14 from the relative price of machinery and transport equipment, various policies, and other controls.

Summary and policy implications

- The decline in the relative price of machinery and equipment was driven by rising trade integration and faster productivity growth in the capital goods producing sectors
- The declines in relative investment prices have provided an important boost to real investment rates over the past three decades
- Slowing trade integration and the possibility of its reversal could pose a threat to further declines in the relative price of capital goods and, hence, investment
 - Avoid trade barriers that could disrupt global supply chains and limit the spread of knowledge across borders
 - Support innovation that can fuel productivity gains in the capital goods producing sector