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The Renminbi and Poor-country Growth

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1. INTRODUCTION

DISCUSSIONS on how best to exit from global imbalances and to create a more balanced world economy have ignored the impact on poor countries of proposals to redress these imbalances.[1] Highly publicised global imbalances in the current accounts of the balance of payments – embodied in sizable Chinese foreign exchange reserve accumulation and deepening US current account deficits over the past decade – have drawn much attention to the question of renminbi misalignment from policymakers, economists and journalists. On 19 June 2010, China announced it would allow a more flexible renminbi, signalling an end to the currency's two-year-old peg to the dollar a week before the Group of 20 summit held in Toronto. The People's Bank of China also made clear that there was no room for large-scale appreciation.

This paper introduces a development perspective into the debate on global rebalancing, especially as far as the valuation level of the renminbi is concerned. The aim is to provide evidence-based analysis on why and how the renminbi matters for poor countries. It is hoped that the paper will help inform the policy debate on global rebalancing and the renminbi in the Group of 20 and beyond by adding empirical evidence to some crucial elements of that debate. These are the following:

The views expressed herein are those of the authors and do not necessarily reflect those of the Organisation for Economic Cooperation and Development. The authors graciously acknowledge the helpful comments and criticism from an anonymous referee.

[1] There have been op-ed pieces, but they fail to present empirical evidence.

- The degree of currency undervaluation and its relationship with per capita income (convergence), as informed by the Harrod-Balassa-Samuelson (HBS) framework.
- The role of the real effective exchange rate, both its level and its stability over time, for underpinning growth in developing countries, especially in large dual economies such as China and India.
- New empirical evidence on growth linkages between China and poor countries for the last two decades and on potential displacement effects of renminbi (RMB) appreciation.

These elements should help to form a judgement about the potential developing-country beneficiaries and losers from various renminbi adjustment scenarios in forthcoming years. The paper thus hopes to fill an increasingly disturbing gap in the current global rebalancing debate, namely the implications of changes in China's role as the new engine of developing-country growth and how this role will be affected by changes in the valuation of the renminbi.

2. BY HOW MUCH HAS THE RENMINBI BEEN UNDERVALUED?

Much debate has been generated about the responsibility of China to 'play fair' with its trade partners and to dismantle what some have called a 'protectionist' fixed exchange-rate policy. From the development perspective, most of the debate has wrongly blamed the valuation of the renminbi on China's growing external surplus, crucially ignoring the exchange-rate implications of the fact that China is still a poor country, with a low per capita income relative to advanced countries.[2]

The Harrod-Balassa-Samuelson effect, described first by Balassa (1964) and independently posited by Harrod (1933) and Samuelson (1964), considers the relationship between economic development and the relative price of non-tradables to tradables to define an equilibrium real exchange rate (i.e. the nominal exchange rate adjusted for price differences between countries). The real exchange rate can thus be explained by a country's relative productivity

[2] Many studies purport to measure the degree of renminbi undervaluation using various theoretical constructs: purchasing power parity (PPP), fundamental equilibrium exchange rates, behavioural equilibrium exchange rates, permanent equilibrium exchange rate and the current account of the balance of payments. Each of these approaches uses different methods to construct an equilibrium exchange rate and derive a degree of misalignment compared to this equilibrium rate. While most of these studies agree that the renminbi is undervalued, the measured level of undervaluation varies according to the methodology used and the data sources employed; estimates on the degree of undervaluation in the 2000s vary from nearly nil to 40 per cent (see, for example, Chen, 2007; Cline and Williamson, 2008, 2010; Goldstein and Lardy, 2008; Cheung et al., 2010).

level. Poor-country currencies are normally undervalued compared to their purchasing power parity values. Convergence towards rich-country productivity levels through income per capita growth will imply considerable correction of that undervaluation. Hence, part of the undervaluation ascribed to China's currency results from market forces that make non-traded goods relatively cheap in poor countries, rather than from deliberate currency manipulation by China's authorities. To analyse the HBS-implied currency misalignment for a given year, the following simple model was estimated:[3]

$$\log\left(\frac{PPP_i}{e_i^m}\right) = \alpha + \beta.\log(GDPpercap_i) + \varepsilon_i \quad \text{for country} \quad i = 1, ..., n. \qquad (1)$$

ordinary least squares (OLS) is used to estimate a cross-country log regression of the values of a price-level index, $\frac{PPP_i}{e_i^m}$, where PPP_i is the implied purchasing power parity (PPP) exchange rate and e_i^m is the nominal market exchange rate versus the US dollar, on the GDP per capita (in 2000 constant US dollars) for each country. In this way, and similarly to Funke and Rahn (2005), $\frac{PPP_i}{e_i^m}$ serves as a *PPP*-based estimate of the real exchange rate for each country i of our sample, while GDP per capita provides a proxy of the country's productivity level, reflecting the state of economic development. Given the wide variance of the price level index values for advanced economies, GDP per capita (in constant 2000 US dollars) is used as the dependent variable and not the ratio of GDP per capita compared to the US level.[4]

The sample consists of all countries for which data were available, excluding countries whose populations were less than one million and some countries for which the currency and PPP data are at odds to such a degree they could be considered outliers.[5] This leaves a total sample of around 125 countries. The degree of HBS-implied misalignment of the exchange rate from its income-adjusted purchasing power parity is derived using the following ratio:

[3] Numerous models based on the HBS theory have been analysed over the last half-century. Most models use least squares regression to estimate the effect of a country's productivity level on its internationally comparable price level for a specific year (or between averages of the variables over several years to smooth out short-term fluctuations). Starting with Kravis and Lipsey (1983), many studies chose variables relative to a country of reference, typically the United States. Recently, Kharas (2010) used the ratio of GDP per capita (in *PPP* terms, constant 2005 US dollars), relative to the US level. Notably however, the choice of a reference country exhibits a strong influence on the results.

[4] There is no explicit reason to assume that countries are converging to the productivity level of the United States specifically, despite the fact that the US currency is used as the numeraire in the price level index. The choice of the dependent variable has no implication on the static degree of misalignment, because this is just normalisation to one for the US level of GDP per capita.

[5] These included Zimbabwe, Sudan, Uzbekistan, Yemen, Syria, Iran, Nigeria, Slovakia and Ecuador.

$$(degree\ of\ misalign)_i = \frac{\frac{PPP_i}{e_i^m} - (real\ exchange\ rate\ value\ on\ the\ regression\ line)_i}{(real\ exchange\ rate\ value\ on\ the\ regression\ line)_i}. \quad (2)$$

Data for GDP per capita and the nominal market exchange rate were obtained from the World Development Indicators (World Bank, 2009) for the time period 1990–2007. The choice of PPP exchange rates can have far-reaching consequences for the measured misalignment, and two sets of regressions were performed using both the PPP*s* available from the World Bank's World Development Indicators (WDI) based on the latest International Comparison Program (ICP) 2005 round[6] and the PPPs available from the Penn World Tables, in version 6.3 (PWT 6.3) based on the previous ICP round.

Indeed, the methodology used in the latest ICP round resulted in revised estimates for PPPs that have attracted controversy because they led to large downward revisions in the living standards of a number of developing countries, including China and India. For China, the change in PPPs implied an upward revision in average price levels on the order of 40 per cent, which accordingly reduced estimates of the value of China's GDP at PPP rates by 40 per cent.[7]

On one hand, using the old PPPs to analyse currency misalignment today may in fact be problematic owing to the fact that economic growth may have significantly changed the price structure of the economy since the earlier PPP round. Ravallion (2010) shows that much of the change in the Chinese PPP values observed in the surveys can be attributed to economic growth in the country itself rather than methodological issues with the ICP surveys. On the other hand, Maddison and Wu (2008) argue that the new PPPs available from the WDI do not adequately represent price levels for rural areas in developing countries like China and India. Deaton and Heston (2010) also underline this issue and try to correct for the overestimation of Chinese prices with a PPP rate that is between the value found in WDI and PWT 6.3. In response to Reisen (2009), Subramanian (2010) also posits that measures of currency

[6] For more than 40 years, the ICP has organised international efforts at comparing price levels and constructing purchasing power parity exchange rates. Each ICP round estimates PPP exchange rates in a given year for a certain number of benchmark countries and then extrapolates these results across the cross-sectional dimension to non-benchmark countries, and then backwards and forwards across time for each country using national inflation figures. Each successive round of the ICP has increased the number of countries used as benchmarks and has attempted to improve the basis on which comparable price data are collected.

[7] For more on what has become a lively debate, with broad implications for global poverty and distributional issues, see Chen and Ravallion (2008), Deaton and Heston (2010), Deaton (2010), Ravallion (2010).

undervaluation derived using the new PPPs are inaccurate because they overstate the Chinese price levels and thus understate the degree of renminbi undervaluation.[8]

Below, we compare the difference in currency misalignment estimates found with the HBS model using the World Bank's PPPs based on the latest ICP survey versus those found using the Penn World Tables 6.3 PPPs based on the previous one. The results are based on a series of cross-sectional regressions performed for the years 1990–2007 using both sets of PPPs. Depending on the country, the choice of the version of PPPs has a strong impact on the measure of misalignment.[9] In the case of China, the use of the newer PPPs leads to estimates of undervaluation which correspond to the smallest estimates mentioned in the literature (between 0 per cent and 15 per cent undervaluation), whereas the use of the older PPPs leads to estimates of undervaluation which correspond roughly to the largest estimates mentioned (between 25 and 35 per cent).

For each year (between 1990 and 2007), the log regression led to coefficients significant at the 1 per cent level, regardless whether WDI or PWT 6.3 was used. The *R*-squared also appear high for each year. Table 1 and Figure 1 present the results for 2007.

The first column (PWT 6.3) presents the results (for 2007) from a cross-country OLS regression (in logs), where the log real exchange rate (proxied by the ratio PPP/e, where PPP is the implied purchasing power parity exchange rate provided by the Penn World Table (PWT 6.3) and e is the nominal market exchange rate versus the US dollar) is regressed on log GDP per capita (in 2000 constant US dollars). The second column (WDI) presents the same cross-country OLS regression, but with the implied purchasing power parity exchange rate PPP associated with the most recent ICP survey. Standard errors are shown in parentheses. Boldface denotes significance at one per cent.

Regarding the degree of HBS-implied misalignment of the emerging countries' currencies, the main results for the year 2007 are the following:

- Using the new PPPs provided by the WDI (i.e. based on the latest survey), we find that, in 2007, the degree of HBS-implied undervaluation is estimated to be around 15 per cent for the renminbi, 20 per cent for the Indian rupee and 6 per cent for the South African rand. The Brazilian real

[8] Reisen (2009), using the new PPPs provided by the World Bank's WDI, had estimated a 12 per cent undervaluation of the renminbi below the HBS regression line for end 2008. Subramanian (2010) uses Deaton and Heston's corrected PPPs to assert that undervaluation is actually closer to 30 per cent.

[9] Among the BIICS, the influence is strong for China and India, and to a certain extent Indonesia, whereas there is only little influence on the results for Brazil and South Africa.

TABLE 1
Cross-country regression results for 2007

	log (PPP/e)	
	PWT 6.3	*WDI*
log GDP Per Capita (Constant 2000 US$)	**0.289** (0.018)	**0.200** (0.012)
Constant	**−2.966** (0.143)	**−2.075** (0.091)
Observations	129	126
R-Squared	0.666	0.708

Note:
Bold denotes significance at 1%.

Source: Authors' calculations based on data described in the text.

appeared overvalued by around 8 per cent and the Indonesian rupee by around 3 per cent, following a decade of undervaluation.[10]

- Using the older PPPs drawn from PWT 6.3, we find that the degree of undervaluation is significantly more important for China, India and Indonesia. The renminbi appears then significantly undervalued over the whole period, with a degree of undervaluation of around 35 per cent in 2007. The corresponding estimates of undervaluation of 27 per cent for the Indian rupee, 11 per cent for the Indonesian rupee, 7 per cent for the South African rand and to an HBS-implied overvaluation of 17 per cent for the Brazilian real.

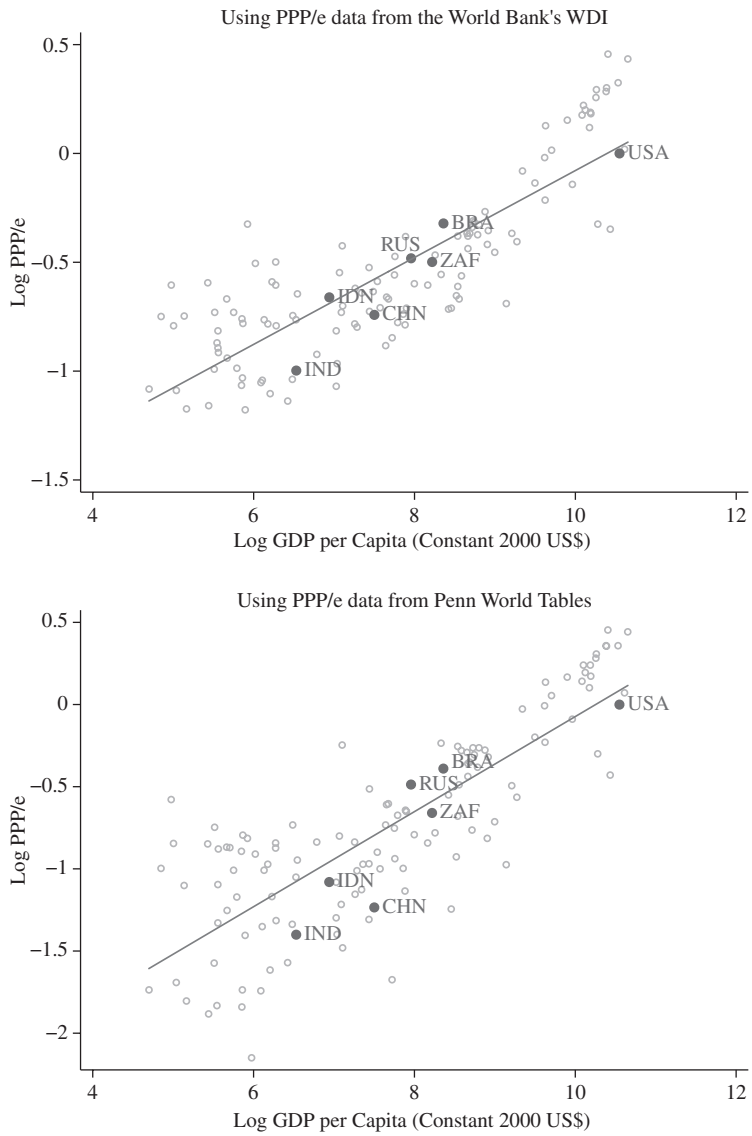
In either case, from the results and discussion above, it is clear that the Chinese currency was undervalued up to around 15 per cent in 2008 even when taking into account the level of Chinese development. In Section 3, which follows, we look at adjustment scenarios, and what effects a possible renminbi appreciation may have on continued Chinese growth. In Section 4, we look at how this growth may in turn impact on other poor countries.

3. RENMINBI APPRECIATION AND CHINA'S GROWTH

It is hard to forecast the effects of real renminbi appreciation on China's future growth rate. Much will depend on the scale and speed of currency appreciation; much will depend on the counterfactual growth effects of the policy status quo of pegging the renminbi to the US dollar; and much will depend on whether the real appreciation occurs through nominal appreciation or through positive inflation differentials with trade partners. But development economists must be concerned

[10] The ICP 2005 revisions to PPP tended to be larger in a magnitude the poorer a given country, either due to methodological difficulties measuring prices in poor countries or because the overall price structure has changed most in poor countries over the last 15 years.

FIGURE 1
Exchange-rate misalignment implied by the Harrod-Balassa-Samuelson model, 2007

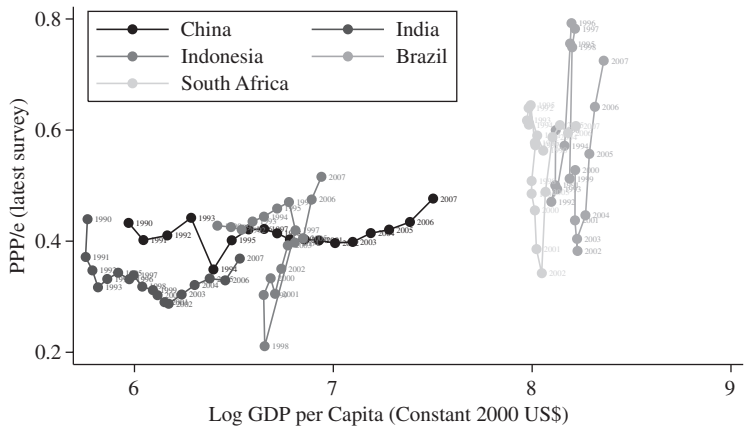


Source: Authors' calculations based on Aten et al. (2009); World Bank (2009).

nevertheless about a potential slowdown triggered by currency appreciation, not least because China has contributed to global growth in general and to poor-country growth in particular in the 2000s (as will be shown in Section 4).

Stellar growth performance in China and India has gone along with a stable path of real exchange rates. As Williamson (2000) suggests, large

FIGURE 2
Individual adjustment paths between 1990 and 2008



Source: Authors' calculation based on data from World Bank (2009).

fluctuations of real effective exchange rates can undermine incentives to invest in non-traditional sectors.[11] A recent McKinsey report (2009) confirmed that executives from different countries expect investment decisions to be significantly affected by heightened exchange-rate volatility.

Stable does not imply flat: the HBS model suggests convergence be accommodated through upward real currency appreciation. This is exactly what was observed in China and India during the last two decades (see Figure 2). The smooth real exchange-rate path in China and India is contrasted to the other three countries with which the OECD is in 'enhanced engagement', namely Brazil, Indonesia and South Africa. These countries have been characterised by considerable exchange-rate instability over the last two decades. Figure 2, which relates the PPP estimate of the real exchange rate (US = 1) to the logarithm of the corresponding countries' per capita GDP, shows a striking association of exchange-rate stability with income convergence. Figure 2 suggests that sustained growth benefits from an exchange rate that is not only competitive, but also stable.

There is analysis and evidence that warns against real exchange-rate instability and premature currency appreciation during a country's convergence process. Post-war development economists emphasised a dualistic framework which assumed a large subsistence, stagnant agricultural sector containing surplus labour existing side by side with a small, growing and dynamic capitalist urban industrial sector characterised by rising productivity. The outlines of this framework are often attributed to Lewis (1954), who modelled an economy with a rural–urban divide in productivity and labour markets.

[11] See for instance: http://www.iie.com/publications/papers/paper.cfm?ResearchID=392

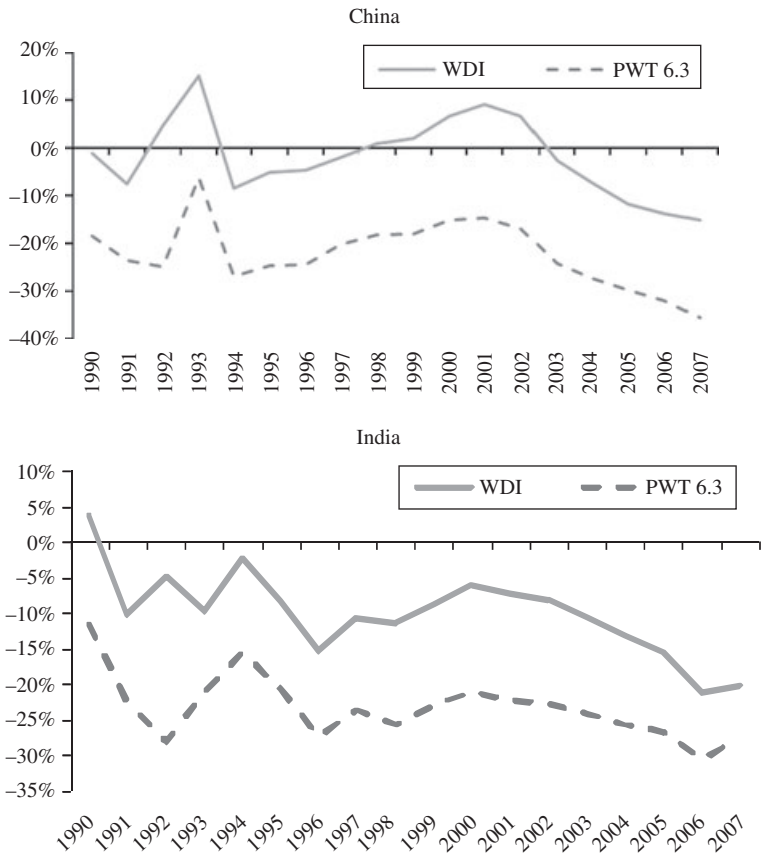
Rodrik (2008) presents evidence that growth in large 'dual' economies such as China and India is supported by a competitive exchange rate. In the absence of perfect financial markets, a competitive exchange rate is a powerful policy instrument to incentivise resources (including subsistence labour) to move from low- to high-productivity sectors. High-productivity activities are concentrated in otherwise inefficiently small export industries, which hold the learning capacity through gradual technological and skill upgrading of productive activities that allow increasing sophistication and value-added in domestic production.

A mercantilist policy approach of 'exchange-rate protection', however, is at odds with the neoclassical view that real exchange-rate misalignment creates distortions that are themselves bad for long-run growth (e.g. Corden, 1994). A recent IMF paper (Berg and Miao, 2010), argues that the determinants of exchange-rate misalignment are themselves independent drivers of growth; still, the IMF paper confirms Rodrik's analysis by producing empirical evidence, with a data set based on 181 country observations during 11 five-year periods from 1950–54 to 2000–04, that not only are currency overvaluations bad for growth but also are underevaluations good for developing-country growth.

The evidence presented above argues against overvaluation and, implicitly, premature currency appreciation. However, when the country has reached a certain level of development, a real gradual appreciation can accompany a sustained convergence towards higher GDP per capita levels. The real appreciation of the domestic currency can stimulate domestic demand (through raising purchasing power of consumers) and help rebalance an economy towards the internal market. This could be a particularly accurate description of the Chinese economy if the demand from OECD countries slows down in the future. The degree to which appreciation threatens to cool down China's export-led growth engine depends on the sophistication of China's exports and the timing of that appreciation as measured by the degree of convergence with advanced economies. Figure 3 suggests that now may be the right time for some renminbi appreciation. The degree of HBS-implied undervaluation of the renminbi has globally increased between 1990 and 2007, with some fluctuations.[12] Until China loosened its dollar peg in June 2010, there had been a recent accentuation in the degree of undervaluation, which is consistent with the increasing Chinese current account surpluses. The degree of HBS-implied undervaluation that has evolved during the period of strong convergence has been equally marked for India's currency, the rupee.

[12] When using the ICP 2005, the renminbi appeared even slightly overvalued at the beginning of the 2000s.

FIGURE 3
China and India: Harrod-Balassa-Samuelson-implied misalignment between 1990 and 2007



Source: Aten et al. (2009); World Bank (2009).

Note:
Calculations based on both the new PPPs derived from the International Comparison Project's most recent round included in the WDI and using the old PPPs, which still can be found in Penn World Tables Version 6.3.

4. CHINA'S GROWTH AND POOR-COUNTRY GROWTH

Whether the renminbi will continue to underpin China's growth is of increasing importance to poor countries, as will be shown in this section. Recent research by Levy-Yeyati (2009) shows that growth for a sample of emerging economies[13] from 2000 onwards has been more dependent on growth in China than in the G7, a reversal of their dependence in the 1990s. Splitting the data between earlier (1993–99) and later (2000–09)

[13] Argentina, Brazil, Chile, Colombia, Mexico, Peru, Hong Kong, China, India, Indonesia, Malaysia, Philippines, Singapore, Chinese Taipei, Thailand, Czech Republic, Hungary, Poland, Turkey, and South Africa.

periods, Levy-Yeyati (2009) finds that the explanatory power of G7 growth virtually disappears in the later period, as a result of increasing Chinese influence. Splitting the two components reveals that the percentage elasticity of growth in the sample to G7 growth in the later period was just 0.267; the corresponding elasticity to China's growth, meanwhile, had grown to 1.115; that is, one percentage point of GDP growth in China was associated with growth in the sample of emerging economies of more than one percentage point.[14]

To analyse the impact of China's growth on a broad group of poor (rather than merely the 'emerging') countries, we look at the relationship between China's growth rate and those of 115 developing and emerging countries for the period between 1990 and 2009. The impact of China's growth can be quantified using a fixed-effects model, which allows us to analyse a cross-section of developing countries over time. The fixed-effects estimator allows the constant term to differ across cross-section units, which captures the cross-country factors that differ. Additionally, the time series dimension of the data provides us with additional information.

Our empirical model includes only the external growth as the driver of growth, whereas there may be other factors driving growth, as in growth models. We assume that using the fixed-effects estimator overcomes this and other potential problems that may be caused by omission of these factors.

As we are interested in the long-run economic growth linkages, not business cycle synchronicity which relies on the cyclical component of GDP, we use real GDP growth rates in our analysis for both the dependent and explanatory variables (not the de-trended series). The business cycle models may be more suitable for analysing output shocks; a fixed-effects panel approach is more appropriate for analysing longer-term trends. As China's impact on long-run growth of developing economies is our question of interest, we follow the latter methodology.

We are interested in the following outcomes: (i) the significance of the impact of industrialised (i.e. high-income OECD) economies on the developing economies; (ii) the stronger growth association between China and the developing economies replacing the previous economic link between industrialised and developing economies; (iii) the implications of these relationships for possible outcomes of a renminbi appreciation, i.e. how much a one per cent of slowing

[14] Levy-Yeyati (2009) tests whether EM sensitivity to global growth has declined over the years by regressing EM growth on G7 growth and evaluating how the coefficients have evolved since the inception of emerging markets as an asset class in 1993. Splitting the data between early (1993–99) and a late (2000–09) periods, and assuming for simplicity that trend growth remained stable within each, the specification is a regression of the growth rate of economy's cyclical output (relative to a log linear GDP trend) on the G7 and Chinese cycles, based on quarterly, seasonally adjusted GDP data, identifying the late period (2001–09) with an interacting dummy.

down of the Chinese economy would affect the growth rates of the developing economies.

The empirical framework is a fixed-effects panel regression with the following specification:

$$\begin{aligned} g_{it} &= \alpha + \mathbf{x}_{it}\boldsymbol{\beta} + u_{it}, t = 1990, \ldots, 2009 \text{ and } i = 1, \ldots, N \\ u_{it} &= \eta_i + v_{it} \\ \mathbf{x}_{it} &= \begin{bmatrix} g_{oecd,t} \\ g_{china,t} \\ g_{china,t} * dummy_{2000} \\ g_{oecd,t} * dummy_{2000} \\ dummy_{2000} \end{bmatrix}. \end{aligned} \tag{3}$$

The analysis uses annual data for 1990–2009. The dependent variable g is the annual real GDP growth rate; $\boldsymbol{\beta}$ is the matrix of parameters to be estimated; $\mathbf{X}$ is the matrix of independent variables that included growth rates for OECD economies and China; dummy_{2000} is the dummy variable that takes on the value of 1 for the years 2000,..., 2009 and zero otherwise; u is the error term.[15]

Our model of estimation can also be written more explicitly as:

$$\begin{aligned} d\log\left(GDP_{i,t}\right) = \alpha &+ \beta_1 d\log\left(GDP_{OECD,t}\right) + \beta_2 d\log\left(GDP_{OECD,t}\right) \\ &* dummy_{2000-2009} + \beta_3 d\log\left(GDP_{China,t}\right) + \beta_4 d\log\left(GDP_{China,t}\right) \\ &* dummy_{2000-2009} + dummy_{2000-2009} + u_{i,t} \\ &where \quad u_{i,t} = v_{it} + \eta_I. \end{aligned} \tag{4}$$

Hypotheses: **H1**: If the growth association between China and the developing economies has increased over the last decade, β_4 should be positive and significant.

H2: If the growth association between industrialised and developing economies has increased over the last decade, β_2 should be positive and significant.

H3: If China has replaced the industrialised economies as the new source of growth for developing economies, we should observe a non-significant and/or negative β_2 and a positive and significant β_4.

[15] Because the regressions are on growth rates, it is not necessary to test for unit roots and co-integration in the data. The Hausman tests show that the use of fixed-effects rather than random-effects is more appropriate for the data. The results are available from the authors upon request.

The GDP data are obtained from IMFs WEO and IFS databases for the time period 1990–2009. The GDP growth rates are calculated as log differences using annual data. We use a time-break to segregate the 1990s and the 2000s; our hypotheses are based on the fact that these two time periods differ significantly for both the global economy and the developing world.[16] The 1990s represent a highly volatile period particularly for the emerging and developing economies with several financial crises, while the 2000s can be considered a more tranquil period for the developing countries with enhanced integration of the global economy, a rising profile of China in the world economy (with WTO membership since 2001), and high global liquidity. Two interaction terms are included as explanatory variables to capture the impact of OECD growth and China's growth in the second period. Our sample consists of 115 emerging and developing countries which we divide first into income groups and then into export groups, as we expect the impact of China across these groups to differ significantly. The income groups, low and middle, are formed based on the World Bank definitions. The first grouping serves to test whether the links between China and the low- and middle-income economies are significantly different because of the different economic and trade linkages these groups have with China.

In addition, countries are grouped by exports into oil- and non-oil exporters (see Table A1 in the Appendix).[17] This serves as a robustness check for the results that we obtain from the income-group analysis. A significant number of countries in the developing world are oil or raw material exporters. With increasing demand from China for these commodities, China became a large trading partner for these economies in the 2000s. By focusing on how the changes in growth association differ across these two groups, we are able to see whether China's rise as the new engine of growth was driven solely by the commodity linkage. Therefore, results are reported for the non-oil group. This group consists of middle-income economies that are not oil exporters to make the results comparable, because the oil exporters are principally middle-income countries.[18] An additional explanatory variable is the average annual growth rate for industrialised economies. This is computed as the average of individual growth rates of high-income OECD economies weighed by the dollar GDP of the previous year.[19]

[16] Several possible break points (1998–2002) were tested. The Akaike and Schwarz information criteria indicated the optimal break point was either 2000, 2001 or 2002 depending on the criteria and/or the sample. Results are available from the authors upon request. The fact that the results differed only slightly between the different break points however justifies the selection of 2000 as the chosen break point for the analysis, as the growth interrelationships changed only gradually, rather than one single year to the next.

[17] These are based on the categories defined by the IMF (WEO October 2009).

[18] Except Chad, all the oil-exporting countries are in the middle-income group.

[19] Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, UK and United States.

To estimate the impact of a slowdown in the Chinese economy on individual developing countries, a series of panel regressions are run. Rather than attempting to isolate each of the channels by which Chinese growth might be expected to influence growth in the developing countries, this paper focuses solely on quantifying the impact of variations in both OECD and Chinese growth. The results for low- and middle-income emerging/developing economies are reported first. Second, the results for the oil-exporting economies are discussed. The results are presented in Table 2. The first column presents the figures for the low-income group of countries, whereas the second column presents these for the middle-income group. In the third column, the results for the non-oil-exporting countries are shown.

Similar to Levy-Yeyati (2009), we find that introduction of China into the model decreases the impact of OECD countries in the 2000s, i.e. the coefficient on OECD growth becomes negative and/or insignificant.[20]

Table 2 presents the results of the fixed-effects panel regression of growth rates at annual frequency. The growth rates of the group of countries are regressed on average high-income OECD growth (denoted by OECD), interaction term of OECD growth and time dummy for the 2000s (denoted by $OECD_{2000}$), growth rate of China (China), interaction term of China's growth and time dummy for the 2000s ($China_{2000}$) and the time dummy for the 2000s (dummy, equals zero for the years between 1990 and 1999 and 1 otherwise). The last three rows illustrate the number of observations, number of cross-sections (i.e. countries) and *R*-squared for each panel regression.[21] Columns 2, 3, 4 and 5 show the regression results for four country groups: low-income, middle-income, all developing countries except the oil exporters and oil and raw material–exporting countries. Reported are the estimated coefficients with their t-statistics in parentheses. Figures in boldface indicate significance at the 10 per cent level. The reported standard errors have been calculated using the robust variance matrix estimator suggested by Arellano (1987) following White (1984), which is valid in the presence of heteroscedasticity and serial correlation given that the number of countries in each sample is large relative to the number of time periods.[22]

The main findings of our analysis are the following:

[20] We do not report these results here for the sake of brevity, however they are available upon request from the authors.

[21] The reported *R*-squared value is the 'within' *R*-squared. The overall *R*-squared values for the four groups are 0.04, 0.10, 0.05 and 0.09, respectively. The difference between these two reported figures provides us with the additional explanatory power obtained from the fixed-effects estimation.

[22] The possibility of serial correlation in the idiosyncratic error term was addressed through the Wooldridge test for serial correlation in panel data, following Wooldridge (2002) and Drukker (2003). Results are available from the authors upon request.

TABLE 2
Impact of China on the low- and middle-income country growth[a]

	Low-income	*Middle-income*	*Non-oil*	*Oil and Raw Materials*
OECD (β_1)	0.479	**0.578**	**0.934**	−0.542
	(1.20)	(1.83)	(2.78)	(−1.19)
$OECD_{2000s}$ (β_2)	−0.45	0.0344	−0.325	**0.865**
	(−1.06)	(0.11)	(−1.00)	(1.90)
China (β_3)	**−0.261**	0.0251	**0.216**	**−0.295**
	(−1.76)	(0.26)	(2.29)	(−2.14)
$China_{2000s}$ (β_4)	**0.598**	**0.637**	**0.423**	**0.936**
	(3.45)	(4.48)	(3.51)	(3.61)
Dummy	−0.022	**−0.0416**	−0.0176	−0.0829
	(−1.13)	(−2.45)	(−0.98)	(−3.32)
Observations	668	1503	1152	729
Cross-sections	35	77	59	37
R^2	0.06	0.11	0.11	0.10

Notes:
Bold denotes significance at 1%.
[a] The results are valid in the presence of serial correlation and cross-sectional heteroscedasticity.

1. The impact of China's growth on both the low- and middle-income countries has grown significantly in the 2000s. The results show that a one per cent change in China's growth rates will result in a change around 0.34 per cent in the same direction in the low-income countries. As for the middle-income countries, the corresponding growth association is 0.66 per cent.
2. The impact of OECD countries has significantly decreased over the same period for the low-income countries with a coefficient close to zero (0.03 per cent to be precise). As for the middle-income countries though, there has not been a significant decrease in the impact of OECD growth in the 2000s. The total impact is around 0.6 per cent change in the growth rates per one per cent change in OECD growth rates. Chinese growth's impact on middle-income countries however has increased over the period, and the impacts of China and OECD growth seem to be of similar magnitude. This can be attributed to the higher integration of the group of middle-income economies with the global economy, whereas the low-income economies tend to be more segmented.

These results clearly illustrate strengthening growth associations between China and the developing countries. In this case, any shock to China's growth will be reflected in the growth rates of these countries. Should the revaluation of the renminbi result in decreasing growth rates in China, the developing countries would significantly suffer from this external shock.

The third column of Table 2 illustrates the results for the non-oil exporter developing economies. The results of the export-based analysis show that the China impact is not limited to oil-exporting developing countries. On the contrary,

the increasing growth association with China in the 2000s is a robust finding that pertains to non-oil countries. Consequently, China's strengthening growth engine role for poor countries is not merely driven by the oil-exports channel.

Why are these new growth linkages important in the context of RMB valuation? Rodrik (2010) has produced panel regressions, which suggest that a 10 per cent nominal effective appreciation of the Renminbi would reduce China's annual per capita growth by 0.86 percentage points. This reduction in China's growth would translate into a drop of GDP growth in poor countries (based on our growth sensitivity estimates of 0.34 per cent) by 0.29 percentage points of annual per capita income growth. To be sure, these are back-of-the-envelope calculations that ignore adjustment and substitution effects, but they serve to illuminate the potentially high adjustment cost that a renminbi appreciation might entail for the world's poor outside China, an aspect entirely neglected in current macroeconomic policy debates.

Recent estimates (Chhibber and Nayyar, 2008), for 52 low- and middle-income countries during the period from 1990 to 2000 put the elasticity of poverty to growth at around minus two. A rise of one percentage point in China's annual per capita income growth, given the poor-country growth elasticity of 0.34 estimated above, would thus translate into a 0.68 per cent reduction in poverty in poor countries. In other words, roughly annually 7.7 million of the world's 1.2 billion poor outside China (according to the most recent World Bank poverty analysis data) are lifted from abject poverty, defined as a daily consumption level below one dollar, through each percentage point of China's per capita growth. In this sense, China may have been the most potent poverty reduction engine outside its borders during the first decade of the 21st century.

China's rapid growth and the attendant demand for other countries' goods have had positive spillover effects to poor countries. Still, higher tradable goods production in China results in lower traded goods production elsewhere in the developing world – entailing a growth cost for these countries. Are these the poor countries, as suggested by Subramanian (2010)? Quite the contrary.

The trade patterns of growing countries tend to be quite dynamic. If factors are being accumulated at differential rates, the composition of output can change quite quickly. When one of the factors of production advance faster, e.g. skills in China, then China's skill-intensive output will rise disproportionately.[23] Moreover, the terms-of-trade impact of the Asian drivers depend heavily on the source of the growth, with capital-driven growth increasing agricultural and energy prices much more than productivity-driven growth. Changes in the variety and quality of exports – as emphasised by Hummels and Klenow (2005) – can greatly increase the welfare benefits to the Asian giants and their trade partners. Either higher real wages or real appreciation of

[23] This is called the Rybczynski effect.

the Chinese currency will quicken China's structural upgrading. This would further soften the price pressures on low-skilled goods and on low-income countries. At the same time, technological upgrading in China would move China's price impact from the middle-income countries to the high-income economies. This process is likely to be protracted, given the considerable reserve army of unskilled labour in China, however.

Using the unit prices of exports to investigate changing comparative advantage and the evolution of export sophistication, Fu et al. (2010) find that middle-income countries are the most affected by China's export expansion through price competition particularly after the late 1990s as a consequence of China's market expansion, its WTO entry and exchange-rate variation. The unit price of China's exports appears to have a significant impact on the unit prices of the exports from middle- and high-income countries. For the exports from the low-income countries, their price does not appear to be in significant price competition with those from China.

In their study on the impact of China's exports on global manufactures prices, Fu et al. (2010) perform a two-period test, choosing 1997 as the break point for their sample period 1989–2006, both because it marked the deepening of intensive innovation-based growth in China and because of the 1997 Asian financial crisis's impact on excess capacity in the region. After 1997, they find considerable changes in the competitive advantage of China and its major competitors in Asia. Whereas prior to the late 1990s, the prices of low-income countries were most affected by Chinese exports, after 1997, it was the middle-income countries that were most affected by China's export expansion. Moreover, evidence from this study also indicates a price depression effect of China's exports on high-income countries in low-technology product markets. The real effective exchange rate of the renminbi exerted a significant pressure on the export prices of middle-income countries after 1997, but there were no significant impacts in that regard for low-income countries.

5. CONCLUSIONS

The Harrod-Balassa-Samuelson effect has several important and far-reaching policy implications for China and the world economy:

- First, the major part of the undervaluation ascribed to China's and other currencies results from market forces that make non-traded goods relatively cheap, rather than from deliberate currency manipulation by China's authorities alone;
- Second, a rapid convergence of per capita income to rich-country levels will gradually eliminate the Balassa-Samuelson effect, leading to a real

effective currency appreciation either through nominal exchange-rate upward flexibility or through positive inflation differentials with rich-country trade partners;

- Third, the resulting real currency appreciation implies heavy valuation losses on official foreign exchange reserves in renminbi terms as these are held in key advanced-country currencies. China is an 'immature' lender to the extent that it cannot lend to them in its own currency yet. It has an interest, therefore, to shrink the overall level of foreign exchange reserves or, alternatively, shrink its rich-country currency share, for example by investing in gold and other stores of value.

Although China's surpluses are structural and linked to its unequal growth, the appreciation of its real exchange rate is bound to pay a significant role in rebalancing China's future growth performance towards consumption. Economic history suggests that fast-growing economies like China can appreciate considerably versus mature economy currencies owing to rapid productivity increases. Between 1960 and 1978, for example, the deutsche mark appreciated cumulatively by almost 60 per cent against the US dollar, while the Japanese yen appreciated by almost 50 per cent (Ferguson and Schularick, 2009).

Given the size of these historical appreciation episodes, the potential trajectory of renminbi appreciation creates an acute risk-management challenge for Chinese entities that have foreign currency assets or revenue streams, for which hedging instruments or proxies have to be developed – gradually. It is thus important that any renminbi appreciation is gradual along the convergence path depicted in Figure 2 and along financial-sector development rather than squeezed into a short time span. This is not just important for China but also for the other poor- and middle-income countries whose growth has recently been strongly associated with China's growth. Table 3 summarises the discussion and the potential growth impact of renminbi for low- and middle-income countries.[24]

Poor countries must be concerned that China as an engine of their recent growth performance is not pushed into a precipitous, deflationary currency appreciation as was Japan until 1995. Japan's long-lasting deflationary slump, after the yen had more than quadrupled relative to the US dollar from 1971, replete with a near-zero interest liquidity trap and heavily impaired bank balance sheets provides a strong warning should China be pushed into the same fate (McKinnon and Schnabl, 2009). Considering the evidence on the lack of export competition between China and poor countries and their dependence on China's growth for

[24] This is obviously a very broad summary of likely effects which does not do justice to country situations. For example, the net growth effect for resource-rich middle-income countries is likely to resemble the negative impact that a real effective appreciation of the renminbi would have on low-income countries. However, the empirical evidence presented in the literature reviewed does not allow further country disaggregation.

TABLE 3
The potential growth impact of renminbi appreciation on developing countries

Impact Channel	*Indirect Growth Effect*	*Price Competition Effect*	*Total Effect*
Low-income countries	Negative	Insignificant	Negative
Middle-income countries	Negative	Positive	Ambiguous

Source: See discussion in text based on own estimates; Rodrik (2008); Levy-Yeyati (2009) and Fu et al. (2010).

their own growth performance, the growth impact for poor countries of a sudden and perhaps 'excessive' renminbi appreciation would be likely to be very negative, indeed. The growth impact on middle-income countries would be indeterminate, as the negative engine effect of a slowdown in China's growth might be compensated through increased competitiveness that resource-poor middle-income countries would enjoy as a result of an appreciated renminbi.

By extension, therefore, not just China but likewise other poor countries – in particular those which now have a low index of export similarity with China – have a vested interest in China's exchange rate to remain conducive to growth. This does in no way imply that exchange-rate parities should remain at current levels; to the contrary, further convergence will require renminbi appreciation. However, it should also not be ignored that an undervalued exchange rate seems to stimulate growth in China more than it does in the average sample of developing countries owing to the large reservoir of surplus labour and the huge gap in the productivity levels of modern and traditional parts of the economy; the same observation should hold for India in particular.[25] Consequently, a persistent positive growth differential for the converging middle-income and poor-country world may well depend on the continued competitiveness of the Chinese renminbi.

APPENDIX

TABLE A1
Country Groupings

By Income Level			*By Main Source of Export Earnings*	
Low Income	*Middle Income*		*Oil*	*Raw Materials*
Bangladesh	Albania	Lesotho	Algeria	Burkina Faso
Benin	Algeria	Libya	Angola	Burundi
Burkina Faso	Angola	Lithuania	Azerbaijan	Chile
Burundi	Argentina	Macedonia	Chad	Congo Dr

[25] To the extent that the need to reduce global imbalances does not entirely obviate Rodrik's (2010) estimates.

TABLE A1 *Continued*

By Income Level			*By Main Source of Export Earnings*	
Low Income	*Middle Income*		*Oil*	*Raw Materials*
CAF	Armenia	Malaysia	Colombia	Guinea
Cambodia	Azerbaijan	Maldives	Congo Republic	Guinea Bissau
Chad	Belarus	Mauritius	Ecuador	Guyana
Comoros	Belize	Mexico	Gabon	Malawi
Congo DR	Bhutan	Moldova	Indonesia	Mali
Eritrea	Bolivia	Mongolia	Iran	Mauritania
Ethiopia	Botswana	Morocco	Kazakhstan	Mongolia
Gambia	Brazil	Namibia	Libya	Mozambique
Ghana	Bulgaria	Nicaragua	Mexico	Namibia
Guinea	Cameroon	Nigeria	Nigeria	Papua New Guinea
Haiti	Cape Verde	Pakistan	Russia	Sierra Leone
Kenya	Chile	Panama	Sudan	Solomon Islands
Kyrgyzstan	Colombia	Papua New Guinea	Syria	Zambia
Lao	Congo Rep	Paraguay	Turkmenistan	
Liberia	Ivory Coast	Peru	Venezuela	
Madagascar	Costa Rica	Philippines	Yemen	
Mali	Djibouti	Poland		
Mauritania	Dominica	Romania		
Malawi	Dominican	Russia		
Mozambique	Ecuador	South Africa		
Myanmar	Egypt	Samoa		
Nepal	El Salvador	Sri lanka		
Niger	Fiji	St. Kitts		
Rwanda	Gabon	St. Lucia		
Senegal	Georgia	St. Vincent		
Sierra leone	Grenada	Sudan		
Tajikistan	Guatemala	Surinam		
Tanzania	Guyana	Swaziland		
Togo	Honduras	Syria		
Uganda	India	Thailand		
Vietnam	Indonesia	Tunisia		
Yemen	Iran	Turkey		
Zambia	Jamaica	Uruguay		
Zimbabwe	Jordan	Venezuela		
	Kazakhstan			
	Latvia			

This table presents the country grouping used in the panel estimation. The countries in the low- and middle-income groups are based on 2010 World Bank Country classifications. The groupings by main source of export earnings are based on IMF WEO (2010) classifications.

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