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Emerging and developing economies: Entering a rough patch or protracted low gear?☆

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1. Introduction

Growth in emerging market and developing economies (EMDEs) has slowed considerably since the onset of the 2008–09 global financial crisis. The slowdown has been a live global policy issue for some time given the systemic importance of these economies, which together account for 60% of global GDP in purchasing power parity (PPP) terms today compared to only 40% in 1995 (40% of global GDP in nominal US dollars today compared to from 20% in 1995). Some argue that EMDEs have stronger policy frameworks since the 2000s and their growth is resilient even if slower now than in the early 2000s (de la Torre, Levy Yeyati, & Pienknagura, 2014; Jorgenson, 2016; Subramanian & Kessler, 2013). Others note that high EMDE growth in the early 2000s largely reflected supportive external conditions, such as strong terms of trade and external demand, and easy external borrowing conditions (Aslund, 2013; Eichengreen, Park, & Shin, 2011) or that the recent slowdown aligns with a historical global tendency of growth experiences

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to have regression to the mean (Pritchett & Summers, 2014). Related studies also seek to identify factors underpinning sustained growth (Berg, Ostry, & Zettelmeyer, 2012; Bluedorn, Duttagupta, Guajardo, & Mwase 2014) or the contribution of external factors in driving EMDE growth (Abiad, Bluedorn, Guajardo, & Topalova, 2012; Almansour, Aslam, Bluedorn, & Duttagupta, 2015; IMF, 2017).

This paper draws on simple statistical analysis and the related literature to examine the roles of selective demand and supply factors in determining the trajectory of EMDE growth from a medium-term perspective. The role of demand is differentiated into domestic versus external demand. The role of supply is assessed through prospects for demographic changes. The paper also highlights the heterogeneity within the EMDE universe—between lower-income developing countries (LIDCs) and other emerging markets (EMs), and between commodity exporters versus diversified economies—an aspect that has received lesser attention in the policy literature.

We find that despite their recent strong growth, EMDEs face sizeable convergence gaps, both in absolute and conditional terms. Specifically, LIDCs have been stuck at a much slower pace of absolute convergence, in part due to their much weaker growth in the 1980s and 1990s. Regardless of the convergence potential, medium-term growth prospects differ among EMDEs due to different abilities of harnessing dividends from demand and supply growth drivers. Specifically, contributions from external demand is likely to remain modest for most EMDEs due to weaker growth in their trading partners compared to the period before 2008. In addition, some countries will also see more modest rise in domestic demand due to the rising drag from elevated public and external debt on domestic demand. On the supply side, although a group of LIDCs among EMDEs will experience increases in population growth and thereby a higher share of the working-age population, history suggests that this demographic dividend is not automatic without policies to strengthen the level and quality of labor force participation.

Our analysis indicates that while EMDEs should continue closing their income gaps vis-à-vis advanced economies, this will occur at a slower pace than seen in the early and mid-2000s. Boosting the pace of economic convergence will require, among other factors, structural reforms and investment that strengthen their medium-term growth potential further.

The rest of the paper is organized as follows. Section 2 starts by examining the state of economic convergence across EMDEs. Section 3 discusses the roles of the demand and supply drivers of EMDE growth. Section 4 offers policy conclusions.

2. Scope for economic convergence

This section takes stock of the pace of EMDEs' economic convergence thus far and examines their growth catch-up potential going forward.

Prior to the global financial crisis, growth in all groups of EMDEs outpaced advanced economies (AEs), allowing for economic convergence. We focus on three groups of EMDEs: BRICS (Brazil, Russia, India, China, and South Africa, which account for some 31% of the global GDP in PPP terms), other EMs (a group of 88 economies that account for a bit more than 22% of global GDP), and LIDCs (60 of the world's relatively poor countries, which account for some 4% of global GDP).[1] Annual growth in a median AE averaged 3.2% in the 1990s, rising slightly to 3.4% during 2000–07. Growth in a median EM (excluding the BRICS) rose from an

[1] AEs comprise 39 countries with relatively high per capita income, accounting for 43% of the global GDP in PPP terms. See Appendix A for details.

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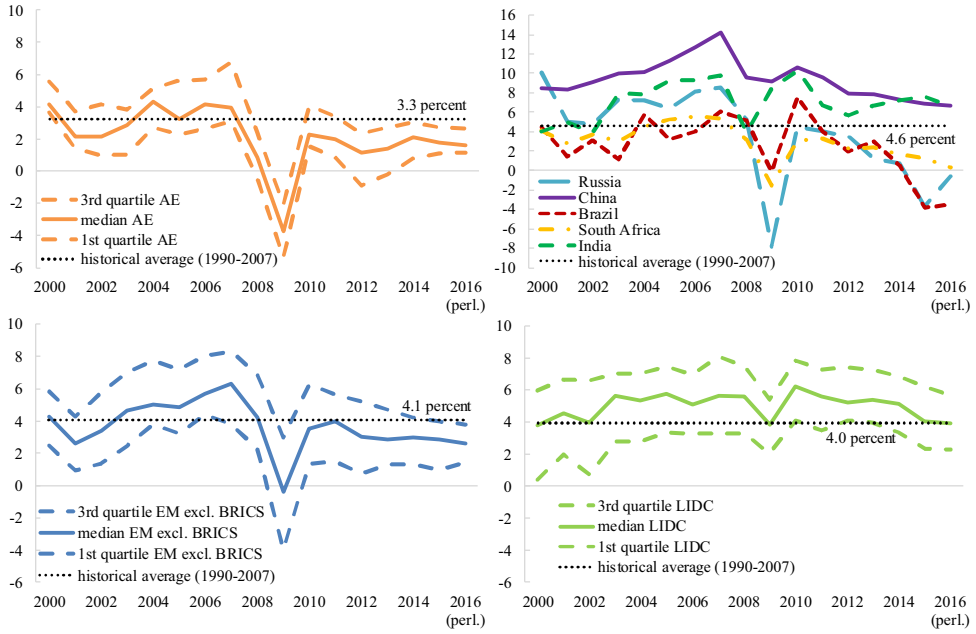

Fig. 1. Real GDP growth across the world, 2000–2016, annual percent change.
Note: AE = advanced economies; EM excl. BRICS = emerging market economies excluding Brazil, Russia, India, China, and South Africa; LIDC = low-income developing countries. See Appendix A for the definition of the economy groups. The median and quartiles are calculated within each economy group for each period. Historical averages are calculated by taking the simple average of the median of each economy group over time from 1999 to 2007.
Sources: World Economic Outlook (January 2017) and the authors' calculations.

average annual 3.7% in the 1990s to 4.6% in 2000–07, while for the median LIDC growth picked up from 3.2% to 5% over the same period. A similar growth trajectory was also experienced by the BRICS, although China's annual growth was much higher at about 10% in both periods.

Economic expansion hit a roadblock universally with the global financial crisis in 2008–09 (Fig. 1). AEs experienced recessions, and after a temporary bounce back, growth hovered around 2% in 2011–16. Among the BRICS, growth in Brazil, Russia, and South Africa—which are also commodity exporters and financially more open—suffered, more than in China and India (see also Almansour et al., 2015), although China has been slowing since 2011 on a domestic policy engineered transition away from investment-driven growth. Outside the BRICS, a typical EM slowed from an annualized 3% in 2011–14 to under 3% in 2015–16. For LIDCs, annual growth averaged 5% in 2011–14 (as in 2000–07), declining to under 4% during 2015–16.

How did this growth experience affect EMDE income convergence? Fig. 2 documents trends in GDP-per-capita in the last five decades across country groups. For a median AE, per capita GDP growth slowed gradually as these economies converged in absolute terms to (and in cases exceeded) the benchmark per capita income level (given by U.S. per capita income level in 2000; see Fig. 2, Panel A). 26% of the AE sample of countries had reached the benchmark per capita income level in 2015 relative to only 13% of the sample in 2000. Note, however, that the kernel density function for AEs in 2015 is almost at the same place as that in 2007, reflecting the generally weaker economic conditions in AEs since the global financial crisis. In contrast, the pace of absolute convergence in EMDEs—both EMs and LIDCs—was much slower in the 1980–2000

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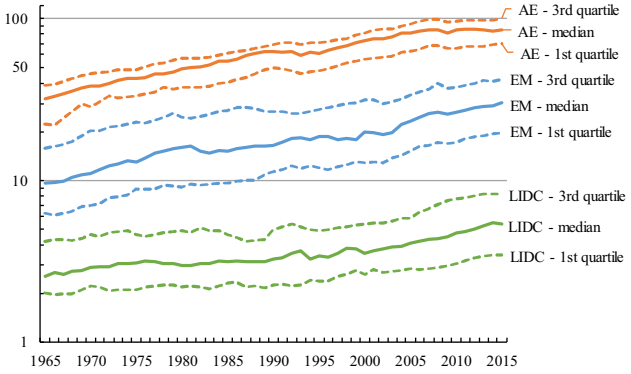
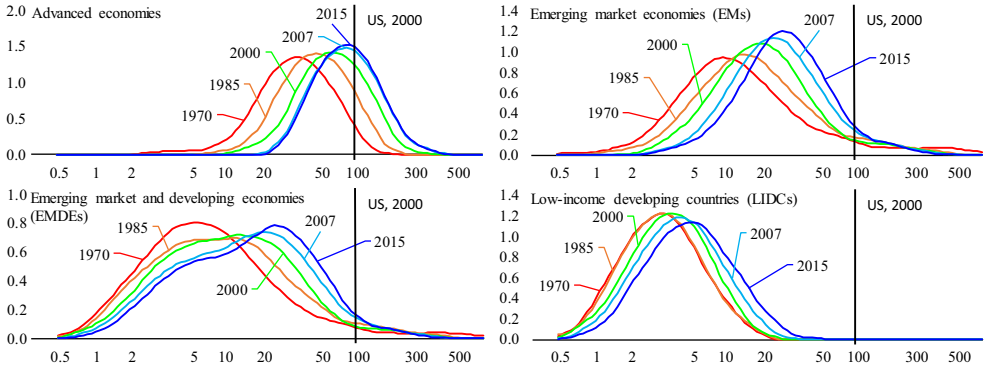


PANEL A. REAL GDP PER CAPITA, 1965-2015, INDEX: U.S. 2000 = 100, LOG-SCALE PLOT (BASE 10).



PANEL B. KERNEL DENSITY ESTIMATES OF REAL GDP PER CAPITA BY ECONOMY GROUPS

Fig. 2. State of economic convergence.
Note: AE = advanced economies; EM = emerging market economies; LIDC = low-income developing countries. See Appendix A for the definition of the economy groups. Real GDP per capita is calculated as nominal GDP in purchasing-power-parity dollars, deflated by the GDP deflator of United States (setting 2011 as the base year) and divided by the population. It is then indexed by setting the level of United States in 2000 at 100. The kernel density estimates are based on the Epanechnikof kernel function with the bandwidth chosen by Silverman's plug-in estimate (Cameron & Trivedi, 2005).
Sources: World Economic Outlook (January 2017) and the authors' estimation.

period, before picking up more robustly after 2000. For many countries in both groups, the slower pace of convergence before the 2000s reflected a combination of major challenges relating to weak institutions, economic policy slippages, high public and external debts, as well as financial crises and political shocks, including conflicts (Acemoglu & Robinson, 2012). Indeed, many LIDCs were harder hit, resulting in larger economic convergence gaps compared to EMs: the kernel density estimates of per capita real GDP in Fig. 2, Panel B, suggests that 6% of EMs had crossed the benchmark per capita income level in 2015, but LIDCs were largely behind. However, LIDCs' absolute pace of convergence picked up in the late 1990s, particularly given higher resource demand from China, which boosted terms of trade for commodity-exporting countries.

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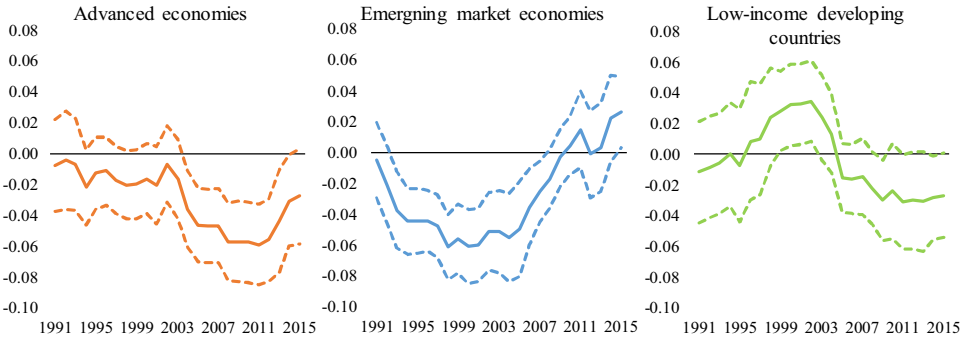

Fig. 3. Rolling estimates of the pace of economic convergence.
Note: Based on a dynamic panel maximum likelihood estimation (using Stata command *xtdpdml*), the figure shows the results of rolling regressions of annual per capita real GDP growth on lagged log per capita real GDP level, controlling for country-fixed effects and year-specific effects, using a balanced panel sample from 1970 to 2015, including 26 advanced economies, 57 emerging market economies, and 39 low-income developing economies. The rolling window size is 20 years, using annual observations. The estimated coefficient on lagged log per capita real GDP level is shown as the solid line, with dashed lines indicating the 95% confidence interval. See Appendix B for details.
Sources: World Economic Outlook (January 2017) and the authors' estimation.

To control for the role of country-specific determinants of economic convergence, we also examine the pace of conditional growth convergence (see Barro & Sala-i-Martin, 1992) across EMDEs, which provides a mixed picture. Fig. 3 shows the outcome of a series of rolling regressions of per capita real GDP growth rate on lagged per capita real GDP after controlling for country fixed effects and time dummies (see Appendix B for details). The convergence parameter has largely been negative in all country groups, implying a higher pace of convergence at lower initial income levels. While the pace appears to have declined since 2005 for EMs, the precise estimates are not statistically significant. Conversely, convergence for LIDCs has recently been stronger than in the past.

To sum, the simple statistics in this section confirm, first, that EMDEs have advanced in their income convergence vis-à-vis the US economy, particularly since the 2000s, and second, regardless of this progress, there is still a large convergence gap, particularly for LIDCs. Next, we examine the capacity of EMDEs to exploit the convergence potential going forward.

3. The demand and supply sides to growth prospects

This section examines the role of drivers from the demand and supply sides in closing EMDEs' income convergence gaps vis-à-vis higher income economies.

3.1. Contribution from demand

Global trade growth has slowed in recent years and although expected to recover in 2017–21, the pace will be slower than seen before 2007–08 (see IMF, 2016a, and Fig. 4, Panel A). Specifically, the IMF's latest projections suggest that global trade volume growth in 2017–21 will be at or slightly above its speed in the previous five years and much lower than the pace during 2000–07. Prospects for global commodity prices, which drive terms of trade for commodity-exporting EMDEs, have also weakened sharply in 2015–16 (Fig. 4, Panel B), in some cases falling by more than half, and although set to pick up in 2017–21, futures markets suggest that these prices will

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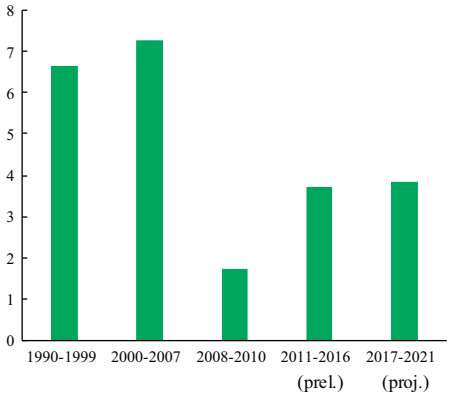
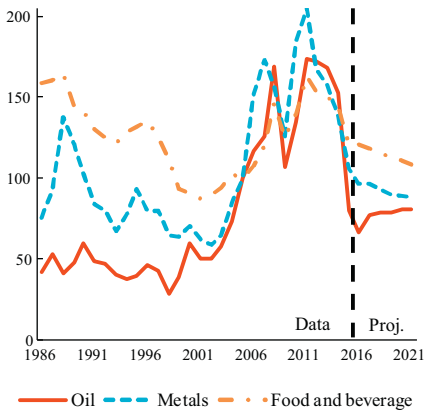


PANEL A. GLOBAL TRADE GROWTH (ANNUAL PERCENT CHANGE, PERIOD AVERAGES, CONSTANT PRICES)



PANEL B. COMMODITY PRICES, ADJUSTED FOR U.S. DOLLAR INFLATION (INDEX, 2005=100)

Fig. 4. Weak global trade prospects.
Note: In Panel B, U.S. dollar inflation is adjusted using GDP deflator in the U.S.
Sources: World Economic Outlook (January 2017) and the authors' calculations.

remain much lower than the peak levels seen before 2014. Against this backdrop, EMDEs' growth prospects will rely importantly on the degree to which domestic growth has typically been reliant on external demand, and second, the prospects for external demand originating from major trading partners. We look at each of these factors in turn.

A growth decomposition exercise suggests that EMDEs' reliance on external demand growth is significant but lower than that on domestic demand. Fig. 5 shows the contribution to real GDP growth from domestic demand (consumption and investment) versus external demand (export), adjusted for import content estimated from input–output tables.[2] In levels, external demand comprises 30–35% of GDP across most economies—with the share rising for AEs from 1990s to 2000s, and decreasingly likewise for EMDEs.[3] As Fig. 5 suggests, external demand growth has been the less dominant contributor to total growth, but its recent pace has recovered close to levels seen in the 1990s but lower than the levels in the early 2000s. The picture is far from uniform, however. Among LIDCs in particular, the contribution from external demand for commodity-exporting LIDCs collapsed in 2011–16, reflecting the sharp retreat in commodity prices after 2014. In contrast, for other LIDCs, the contribution from external demand in fact more than increased in 2011–16 relative to historical levels, reflecting income gains from the fall in prices of imported oil and other commodities. Note that such divergences are not seen among EMs – this partly reflects the fact that among LIDCs, the weighted average figures are

[2] As all the imports can be distributed into import content of the other expenditure components of GDP, we can decompose GDP into consumption, investment, and exports, after import content is subtracted from each. See the footnote on Fig. 5 for the details.

[3] Note that this growth decomposition is for accounting purposes only and should not be interpreted as an identification of the underlying drivers from domestic or external "factors." For example, external factors, such as terms of trade gains, can boost domestic demand through higher income effects. See IMF (2017) for a different approach.

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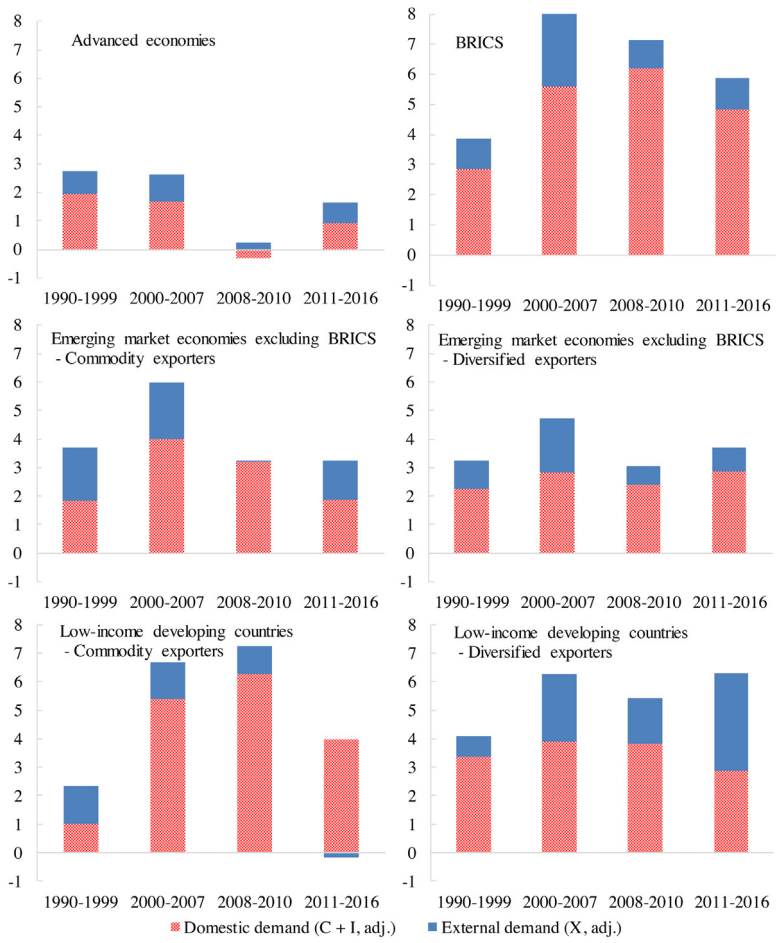

Fig. 5. Domestic and external demand components of real GDP growth.
Note: BRICS = Brazil, Russia, India, China, and South Africa. The figure shows the decomposition of real GDP growth (PPP-GDP weighted average of each group) into domestic demand (consumption and investment) versus external demand (export), adjusted for import content estimated from input-output tables. We use the estimated import content shares to construct real exports excluding imported intermediate input. As an approximation, we assume that the estimated nominal import content shares well represent the real-term import content shares, which would be the case if relative prices were constant over time. The domestic demand component is calculated as a residual but conceptually captures the sum of the contributions of consumption and investment, excluding imported final goods and intermediate input from each. We thank the authors of IMF (2016a) for sharing their estimates of import content for 169 economies from 1990 to 2013, based on the simplified Eora26 multi-regional input-output database drawing on Lenzen, Kanemoto, Moran, and Geschke (2012) and Lenzen, Moran, Kanemoto, and Geschke (2013). The estimation involves solving simultaneous equations of the import shares in intermediate input for 26 sectors, to capture both direct and indirect use of imported goods and services. We extend the import content estimates from 1980 to 2016.
Sources: Eora26 database, World Economic Outlook, and authors' calculations.

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driven to some extent by experiences in the larger economies in the group, for example by Nigeria in the group of commodity-exporting LIDCs and Vietnam in the group of diversified LIDCs.[4]

As an alternative approach, we examine prospects for EMDEs' external demand as given by their trading partners' growth.[5] Fig. 6 gives a similar picture as Fig. 5 in that, external demand growth recovered in the 2011–16 period, but was lower than the levels seen in 2000–07, which by far was the highest in two and a half decades. For both EMs and LIDCs, a large part of the recovery in recent years was boosted by external demand from AEs and BRICS (driven in large part by China's continued expansion). Looking ahead, in the absence of new shocks, if AEs continue to recover from their cyclical slowdown, and BRICS' growth remain broadly stable (as the structural slowdown in China is offset by a cyclical recovery in some of the other BRICS for overall BRICS' contribution at broadly similar levels as in 2011–16), EMDEs' external demand growth will continue to support total domestic growth, although by less than the levels seen in 2000–07.

Moving next to domestic demand, while it has remained the dominant driver of total growth across all types of EMDEs (see Fig. 5 again), its pace has declined in the last five years (2011–16) compared to the periods before for most EMDEs. There is not much variation in this picture across the different groups—in fact for commodity-exporting EMDEs, a decline in commodity prices has also likely pinched domestic demand through weaker income levels (Aslam et al., 2016).

EMDE's ability to boost domestic demand will also be affected by their recourse to financing it as many of these countries access external financial markets in a situation when total national saving rates fall short of investment rates. In this context, the secular decline in global interest rates, and attendant increase in global financial flows towards EMDEs during 2011–16 also helped these economies maintain strong domestic demand growth (see IMF, 2017). Going forward, external financing conditions will likely tighten given a prospective increase in global interest rates as AEs continue to stage cyclical recoveries and global capital flows reallocate somewhat from EMDEs to AEs. Reversals in global capital flows from EMDEs could be even sharper if the normalization of interest rates in AEs is affected by financial market volatility or increases in investors' risk aversion. Indeed, historical data suggests that gross capital flows to EMDEs in periods of relatively higher global interest rate and investor risk aversion levels were significantly lower than in other periods (Fig. 7, and IMF, 2011).

That said, the literature has well documented the role of both, push and pull factors in driving capital inflows to EMDEs. Among the latter, the role of domestic policy conditions, including growth, fiscal and monetary policy frameworks, fiscal balances and debt levels have also played a role. Against this backdrop, the evolution of leverage levels in EMDEs suggests that pull factors may also dampen the borrowing ability of some EMDEs—while the typical public and external debt levels are still modest at less than 50% of GDP, some countries have seen their debt increase very sharply (see the upper quartile of Fig. 8), and many LIDCs have reached higher risks of debt distress (see IMF, 2016b).

[4] A similar analysis based on median growth shows that the share of external demand in GDP has hovered around the historical average for all country groups, with large outliers showing sharp declines (increases) for LIDC commodity exporters (diversified exporters). These results are available on request.

[5] Specifically, for each economy trading partner growth is the weighted average of the growth for each of its trading partners (using export weights averaged over the previous three years).

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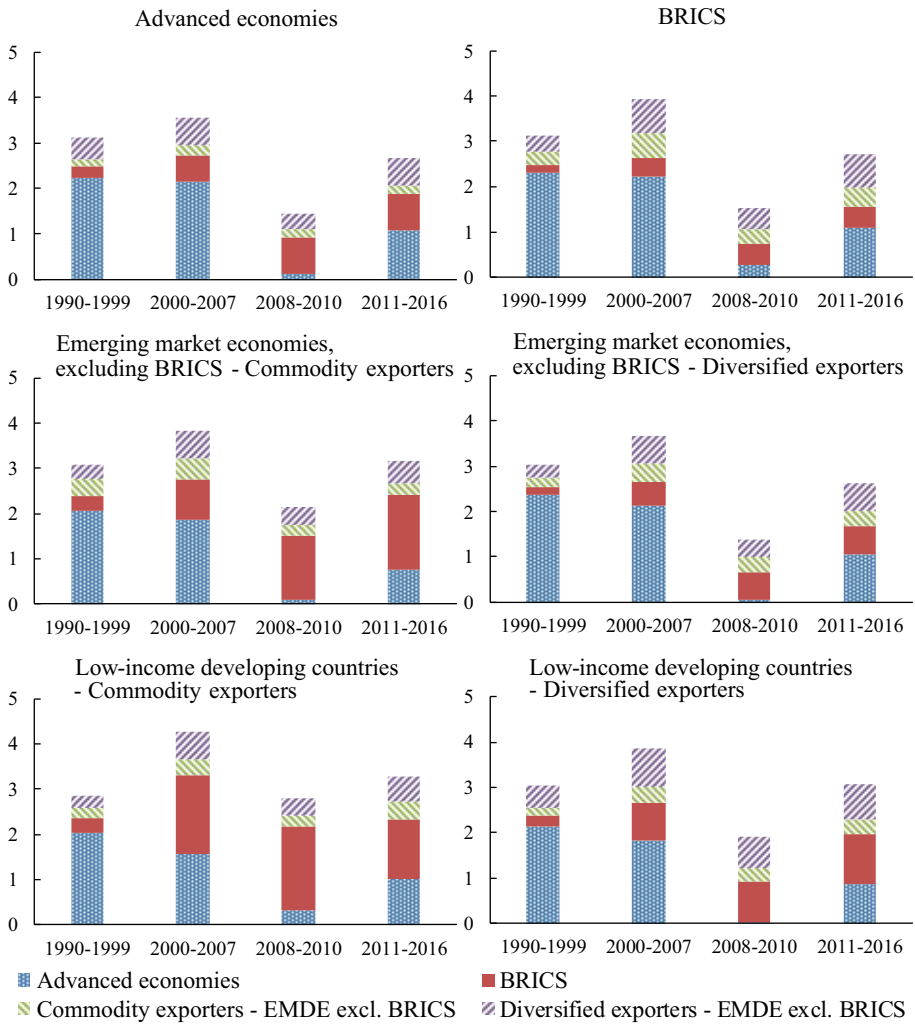

Fig. 6. Export-weighted real GDP growth of trading partners (percent; PPP-GDP weighted averages over export-origination economies, averaged over each period).
Note: BRICS = Brazil, Russia, India, China, and South Africa; EMDE = emerging market and developing economies. PPP = purchasing power parity; The figure shows PPP-GDP weighted average of trading partners' growth, which is first calculated for each economy as the average of real GDP growth rates in the economy's trading partners (i.e., export destinations), weighted by bilateral export values averaged over the previous three years. Each bar represents the average over the indicated period, with a breakdown into the contributions of groups of export destinations.
Sources: Direction of Trade Statistics, World Economic Outlook (January 2017), and authors' calculations.

3.2. *Contribution from supply*

Next, the role of the expected demographic transitions in the EMDE universe on their medium-term growth potential is examined. The ongoing global demographic evolution is now well-established, with studies documenting *first*, a slowdown in global population growth, and *second,* its changing structure with a rapidly aging population (see IMF, 2004 for a general discussion;

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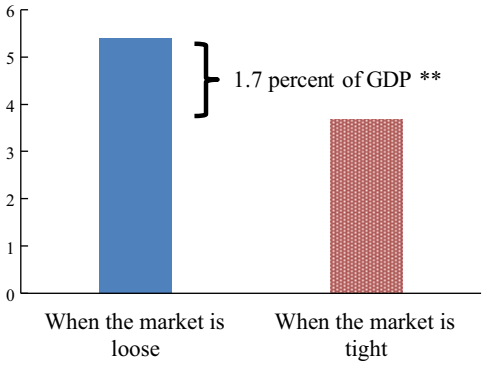

Fig. 7. Private capital inflows (gross) to EMDEs, excluding BRICS, conditional on the global financial market condition (percent of GDP).
Note: The sample includes EMDEs excluding BRICS, consisting of 148 economies, from 1990 to 2015. The figure shows gross private capital inflows to the economies in the sample in percent of the sum of nominal GDP in U.S. dollars in the sample economies, averaged over two sets of periods identified as "When the market is loose" and "When the market is tight." We classify the years 1991–1994, 2004–2007, and 2012–2015, as "When the market is loose" based on the following two criteria: the real 6-month London interbank offered rate (LIBOR; period average; adjusted for inflation expectation by subtracting inflation in U.S. GDP deflator in the same year) is lower than 3%; and Chicago Board Options Exchange's Volatility Index (VIX©) is below 20 (retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/VIXCLS, February 16, 2017). All the other years are classified as "When the market is tight." The difference in gross private capital inflows between the two sets of periods is statistically significant at the 5% level.
Sources: Chicago Board Options Exchange, Financial Flow Analytics, World Economic Outlook, and authors' calculations.

Gordon, 2012, 2014 and IMF, 2015a for studies on advanced economies). We draw on this literature to examine the differential demographic shifts and their implications across EMDEs.

Fig. 9 documents population dynamics across different country groups. Population growth has slowed and largely flattened among AEs at less than ½% per year in 2016 (Panel A), and it is slowing universally elsewhere (BRICS, other EMs and LIDCs). Note however, population growth is still typically high in LIDCs—averaging annually 2.4% in 2011–15 compared to under 1.5% in most EMs—even if slowing. The share of working-age population in total is also set to decline in the next 5 years across EMDEs (Panel B), with a few exceptions such as Brazil, India, South Africa, and LIDCs. Specifically, the working-age population share is expected to drop from 73.9 in 2011–15 to 70.8% in 2016–20 for China and fall more sharply from 70.9 to 66.6 over the same period for Russia. Among EMs outside of the BRICS, this share is projected to decline from 66.7 in 2011–2015 to 66.2 in 2016–20. However, for a median LIDC, the share of working-age population is set to rise from 55.4 in 2011–15 to 56.9 in 2016–20, providing the scope for higher labor force participation rates, a phenomenon that has been coined as a possible demographic dividend (see IMF, 2015b) that can provide a tailwind to growth from the supply side.

Would a higher share of the working-age population in younger economies ensure increases in labor force participation? Here, history provides a mixed report. First, there has been a strong positive relationship between increase in the share of working-age population (SWAP) in total population and employment rates (Fig. 10, Panel A). However, the association between SWAP and per capita income gains is much weaker (Fig. 10, Panel B). For a typical economy over the 1994–2014 period, each percentage increase in the SWAP rate is associated with a 0.6% point increase in the employment ratio, and only 0.07% increase in per-capita GDP growth. Clearly, the

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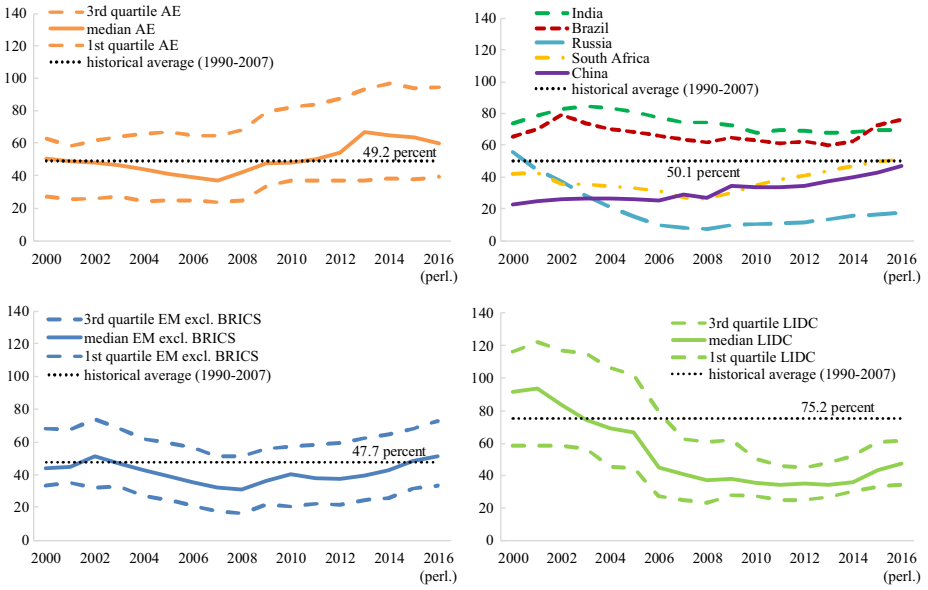
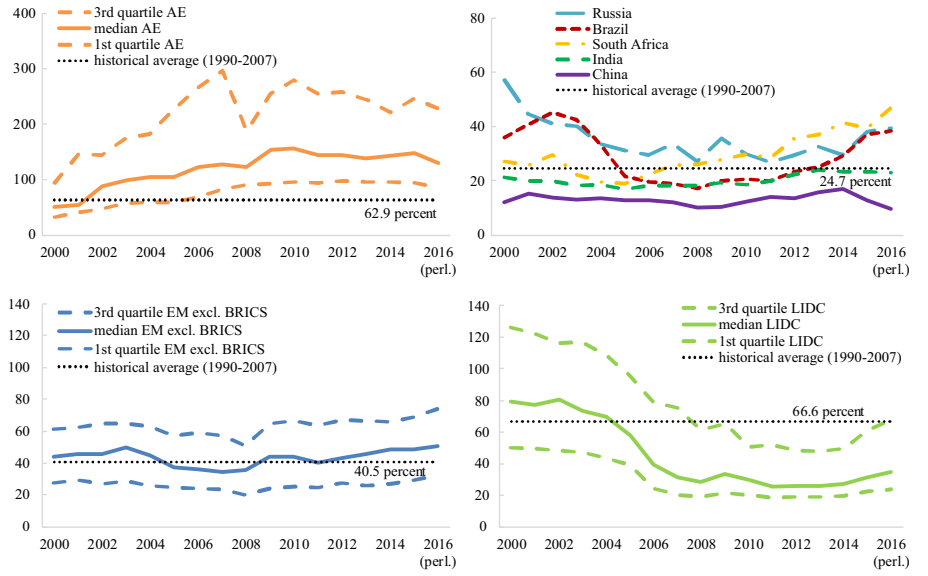


PANEL A. PUBLIC DEBT – BOTH EXTERNAL AND DOMESTIC, IN PERCENT OF GDP



PANEL B. EXTERNAL DEBT (PRIVATE AND PUBLIC) IN PERCENT OF GDP

Fig. 8. Evolution of leverage levels.
Note: AE = advanced economies; EM excl. BRICS = emerging market economies excluding Brazil, Russia, India, China, and South Africa; LIDC = low-income developing countries. See Appendix A for the definition of the economy groups. The median and quartiles are calculated within each economy group for each period. Historical averages are calculated by taking the simple average of the median of each economy group over time from 1999 to 2007.
Sources: World Economic Outlook (January 2017) and the authors' calculations.

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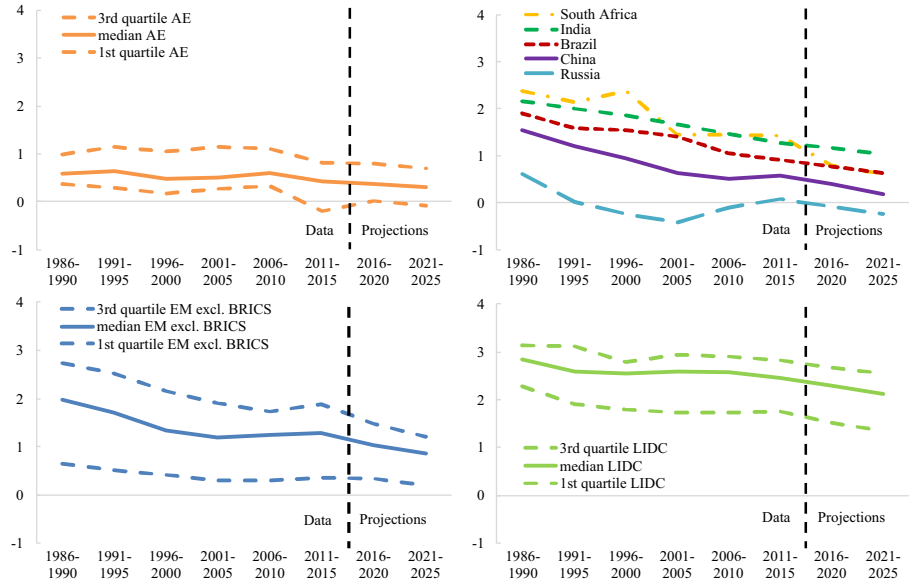
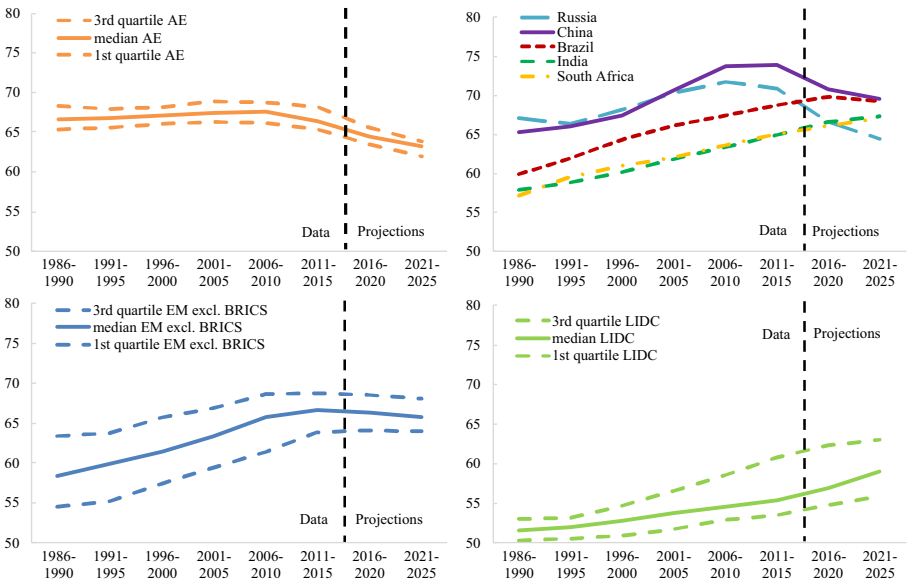


PANEL A. POPULATION GROWTH



PANEL B. SHARE OF WORKING-AGE POPULATION (SWAP)

Fig. 9. Global population dynamics.

Note: AE = advanced economies; EM excl. BRICS = emerging market economies excluding Brazil, Russia, India, China, and South Africa; LIDC = low-income developing countries. See Appendix A for the definition of the economy groups. The median and quartiles are calculated within each economy group for each period. Historical averages are calculated by taking the simple average of the median of each economy group over time from 1999 to 2007. Medium variant projection is used.

Sources: World Development Indicators, World Population Prospect (United Nations, 2015), and the authors' calculations.

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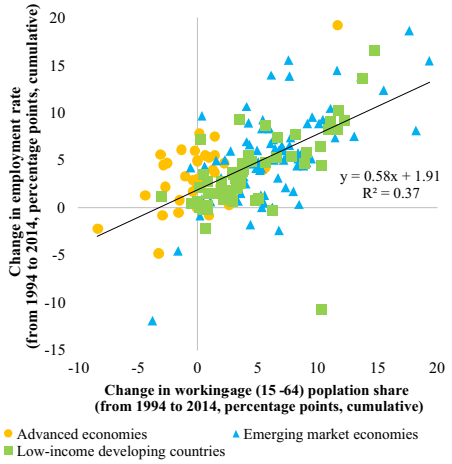
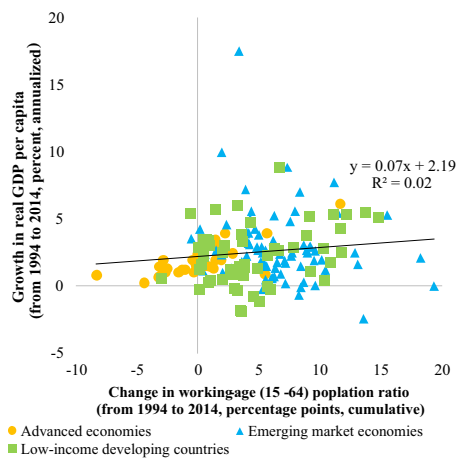


PANEL A. WORKING-AGE POPULATION AND EMPLOYMENT



PANEL B. WORKING-AGE POPULATION AND PER CAPITA REAL GDP

Fig. 10. Demographic transition and income convergence: do they move together?.
Note: The employment rate is the number of employees over total population (instead of population over age 15), and the working-age population share is the number of people of age 15–64 over total population, as well. The slope coefficient of the fitted line in Panel A is significant at the 5% level, and the one for Panel B is significant at the 10% level.
Sources: World Development Indicators and the authors' calculations.

relation between SWAP and employment ratios need not be one-for-one as younger generations may have a higher preference for education or leisure over work. In this regard, the relation between increases in SWAP and per capita income levels is more telling, which suggests that higher per capita income levels in economies with higher share of the young is not automatic.

Moreover, countries with higher than typical increases in the SWAP have also tended to see higher youth unemployment rates (Fig. 11), confirming that demographic dividends are not assured without specific reforms that increase overall productivity levels, as well as those that create job opportunities to absorb the new workforce entrants. Besides broad-based macroeconomic stability and policy certainty to create a strong business-friendly environment and boost investment, policies would need to focus on improving the "quality" of labor through improvements in access to education, measures to allow labor market flexibility while supporting workers with retraining options for job searches, investment that raises agricultural productivity in countries at early stages of structural transformation and economic diversification, as well as measures to strengthen infrastructure and health among other key public services.

We next focus on how EMDEs have fared with respect to advancing on the "quality" of labor force, through improvements in access to education as given by the average years in schooling. As shown by Fig. 12, impressive progress has been made by many EMDEs in converging to average education levels of today's advanced economies, as given by the U.S. level as of 2000. However, similar to the prevailing gaps in income convergence, wide education gaps also remain, with the average years in schooling in a typical EM (LIDC) in 2010–14 only three-quarters (one-half) of the number of years in the U.S. economy as of 2000. Closing these gaps in human capital further underscores the importance of the structural reforms discussed above. Even among countries that are not set to experience an increase in the share of the young, closing the prevailing education

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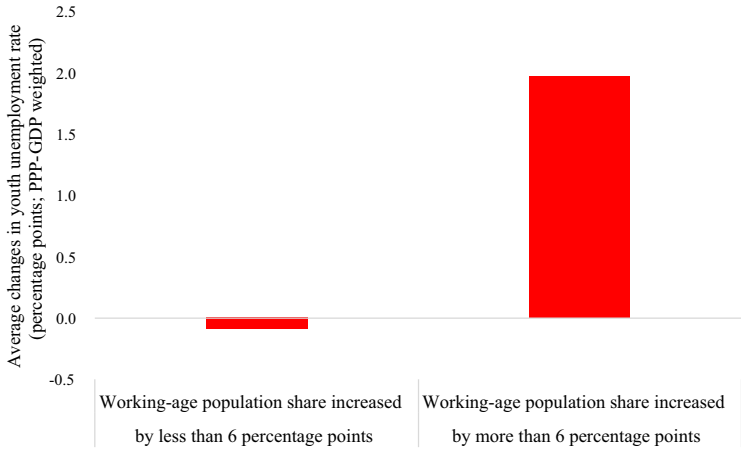

Fig. 11. Youth unemployment and working-age population (EMDE sample; cumulative changes during 1994–2014; PPP-GDP weighed average).
Note: EMDE = emerging market and developing economies. The figure shows PPP-GDP weighted averages of changes in youth unemployment between 1994 and 2014 for two sets of EMDEs: the ones where the share of working-age population (age 15–64) increased by less than 6% points from 1994 to 2014, cumulatively; and the others where the share of working-age population increased by more than 6% points from 1994 to 2014, cumulatively. The 6% threshold is motivated by the median change of 5.4% points.
Sources: World Development Indicators and the authors' calculations.

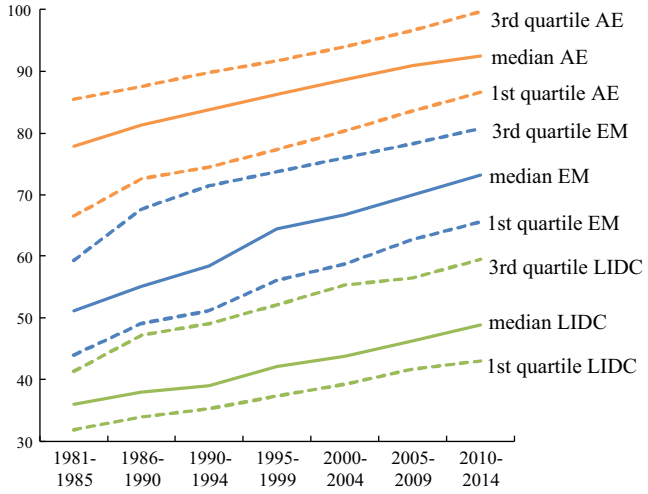

Fig. 12. Convergence gaps in education (human capital index: U.S. 2000 = 100).
Note: AE = advanced economies; EM = emerging market economies; LIDC = low-income developing countries. See Appendix A for the definition of the economy groups. Human capital index is measured based on average years of schooling (variable "hc") normalized by setting the level of United States in 2000 at 100.
Sources: Penn World Table (version 9.0; Feenstra, Inklaar & Timmer, 2015) and the authors' calculations.

gaps will help boost labor productivity of the existing labor force and support faster income convergence.

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4. Policy implications

The analysis in this paper suggests that while EMDEs have made impressive progress in closing their convergence gaps with AEs, there is still ample room for catch-up growth potential. Also, demand and supply factors suggest that growth will likely pick up in most EMDEs in the next five years compared to the previous five. However, most of these countries are entering a lower gear for growth compared to the levels seen in the early and mid-2000s, stemming from more moderate expansions in external demand, rising drag from leverage (as seen in elevated public and domestic debt levels in some countries) and a likely retreat in external financing flows that would dampen domestic demand further. Population growth forecasts suggest that demographic dividends are not everywhere, nor automatic. Historical evidence suggests that even where there is scope for demographic dividend, harnessing it will require structural reforms and institutional building (see also Rodrik, 2014; IMF, 2005, 2016c; Fabrizio et al., 2017). Specifically, despite progress, education gaps across the EMDE world remain wide, closing which will help support better quality of labor, especially in countries expecting to see increases in the population share of the young. To sum, policies that reduce the impediments to the demand and supply drivers highlighted in the analysis will improve the pace of economic convergence for EMDEs, although policy priorities will clearly differ according to country-specific circumstances.

Appendix A. Definitions of country/economy groups

We use the classification of the *World Economic Outlook* (IMF, 2016d) to form the following country/economy groups. The terms "country" and "economy" do not always refer to a territorial entity that is a state as understood by international law and practice as noted in IMF (2016d). Economies are classified as a commodity exporter if more than 50% of export earnings are from fuel or primary commodity exports, and classified as a diversified exporter otherwise.

Advanced economies (AEs, 39 economies): Australia, Austria, Belgium, Canada, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hong Kong S.A.R. of China, Iceland, Ireland, Israel, Italy, Japan, Korea, Latvia, Lithuania, Luxembourg, Macao S.A.R. of China, Malta, Netherlands, New Zealand, Norway, Portugal, Puerto Rico, San Marino, Singapore, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Taiwan Province of China, United Kingdom, United States.

BRICS (5 economies): Brazil, China, India, Russia, South Africa.

Emerging market economies excluding BRICS (EMs excl. BRICS, 88 economies): Albania, Algeria, Angola, Antigua and Barbuda, Argentina, Armenia, Azerbaijan, The Bahamas, Bahrain, Barbados, Belarus, Belize, Bosnia and Herzegovina, Botswana, Brunei Darussalam, Bulgaria, Cabo Verde, Chile, Colombia, Costa Rica, Croatia, Dominica, Dominican Republic, Ecuador, Egypt, El Salvador, Equatorial Guinea, Fiji, Gabon, Georgia, Grenada, Guatemala, Guyana, Hungary, Indonesia, Iran, Iraq, Jamaica, Jordan, Kazakhstan, Kosovo, Kuwait, Lebanon, Libya, Macedonia, Malaysia, Maldives, Marshall Islands, Mauritius, Mexico, Micronesia, Montenegro, Morocco, Namibia, Oman, Pakistan, Palau, Panama, Paraguay, Peru, Philippines, Poland, Qatar, Romania, Samoa, Saudi Arabia, Serbia, Seychelles, Sri Lanka, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Suriname, Swaziland, Syria, Thailand, Timor-Leste, Tonga, Trinidad and Tobago, Tunisia, Turkey, Turkmenistan, Tuvalu, Ukraine, United Arab Emirates, Uruguay, Vanuatu, Venezuela.

Low-income developing countries (LIDCs, 60 economies): Afghanistan, Bangladesh, Benin, Bhutan, Bolivia, Burkina Faso, Burundi, Cambodia, Cameroon, Central African Republic, Chad,

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Comoros, Democratic Republic of the Congo, Republic of Congo, Côte d'Ivoire, Djibouti, Eritrea, Ethiopia, The Gambia, Ghana, Guinea, Guinea-Bissau, Haiti, Honduras, Kenya, Kiribati, Kyrgyz Republic, Lao P.D.R., Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Moldova, Mongolia, Mozambique, Myanmar, Nepal, Nicaragua, Niger, Nigeria, Papua New Guinea, Rwanda, São Tomé and Príncipe, Senegal, Sierra Leone, Solomon Islands, Somalia, South Sudan, Sudan, Tajikistan, Tanzania, Togo, Uganda, Uzbekistan, Vietnam, Yemen, Zambia, Zimbabwe.

Emerging market and developing economies (EMDEs, 153 economies): BRICS, EMs excl. BRICS, and LIDCs.

World (192 economies): AEs and EMDEs.

Commodity exporters (59 economies): Afghanistan, Algeria, Angola, Argentina, Azerbaijan, Bahrain, Bolivia, Brunei Darussalam, Burkina Faso, Burundi, Central African Republic, Chad, Chile, Colombia, Democratic Republic of the Congo, Republic of Congo, Côte d'Ivoire, Ecuador, Equatorial Guinea, Eritrea, Gabon, Guinea, Guinea-Bissau, Guyana, Iran, Iraq, Kazakhstan, Kuwait, Liberia, Libya, Malawi, Mali, Marshall Islands, Mauritania, Mongolia, Niger, Nigeria, Oman, Papua New Guinea, Paraguay, Qatar, Russia, Saudi Arabia, Sierra Leone, Solomon Islands, South Africa, South Sudan, Sudan, Suriname, Timor-Leste, Trinidad and Tobago, Turkmenistan, Tuvalu, United Arab Emirates, Uruguay, Uzbekistan, Venezuela, Yemen, Zambia.

Diversified exporters (133 economies): All economies not classified in Commodity Exporters. All AEs are included in this category.

Appendix B. Regression analysis on the pace of economic convergence

We empirically investigate the pace of economic convergence in a regression model. The purpose is to get a sense on how the speed of convergence has been changing over time, parsimoniously controlling for heterogeneity of different economies, rather than quantifying structural parameters or searching for the drivers of growth (see Durlauf, 2009, for the latest literature survey). We split the sample by the level of income, assuming that the pace of convergence is similar within the subgroups.

We consider the following model:

$$y_{it} - y_{i,t-1} = \beta_t y_{i,t-1} + \eta_i + d_t + \varepsilon_{it} \quad (1)$$

where y_{it} is log of real GDP per capita; β_t is time-varying pace of economic convergence; η_i is economy-fixed effect; d_t is year-specific effect (as a dummy); and ε_{it} is the residual; for economy i in year t. Real GDP per capita is constructed as nominal GDP in purchasing-power-parity dollars (*PPPGDP*), deflated by the GDP deflator (*NGDP_D*) of United States (setting 2011 as the base year) and divided by the population (*LP*).

Based on the standard (exogenous) growth model, time-varying coefficient β_t reflects (i) the pace of net "capital" accumulation; and (ii) the pace of technical efficiency growth—both conditional on the initial level of per capita income as well as country-specific and time-specific effects. Note that "capital" here should be viewed as including not only physical capital (equipment and

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structures), but also other intangible capital (brand and intellectual property) and human capital (education and skills).[6] Specifically, we consider:

$$Y_{it} = K_{it}^{\alpha}(A_{it}L_{it})^{1-\alpha}, \tag{2}$$

$$K_{i,t+1} = I_{it} + (1 - \delta_{it})\,K_{it}, \tag{3}$$

where Y_{it} is real GDP; K_{it} is (a general form of) capital stock; A_{it} is labor-augmented technical efficiency; L_{it} is population (letting the difference between labor supply and population absorbed in A_{it}); I_{it} is gross investment; and δ_{it} is the depreciation rate; for economy i in year t, with parameter α representing output-capital elasticity, assumed to be less than one. Combining Eqs. (2) and (3) yields[7]:

$$\begin{aligned} y_{it} - y_{i,t-1} &= \alpha\left[\log(i_{i,t-1} + 1 - \delta_{i,t-1}) - \log(1 + n_{it})\right] + (1-\alpha)\log\left(1 + g_{it}\right) \\ &\simeq \alpha\left(i_{i,t-1} - \delta_{i,t-1} - n_{it} - g_{it}\right) + g_{it}, \end{aligned} \tag{4}$$

where i_{it} is the investment capital stock ratio (I_{it}/K_{it}); g_{it} is the technical efficiency growth rate; and n_{it} is the population growth rate. Eq. (1) can therefore be seen as a linear approximation of the expectation of the right hand side of Eq. (4) conditional on the value of $y_{i,t-1}$, as well as an economy's average of $y_{it} - y_{i,t-1}$ over the sample period and the cross-section average for each period.

Eq. (4) provides interpretations of the changes in coefficient β_t. A standard argument is that $i_{i,t-1}$ is decreasing in $y_{i,t-1}$ (negatively contributing to coefficient β_t), because the economy heading to a steady state would accumulate capital faster (slower) if the current capital stock is significantly below (closer to) the level of the steady-state capital stock. This mechanism would be mitigated when investment flows to lower-income countries were slowed due to changing risk appetite, for example. Another argument is that g_{it} is also decreasing in $y_{i,t-1}$, due to technology catch-up effects.

We estimate Eq. (1) using a dynamic panel maximum likelihood method proposed by Moral-Benito (2013; implemented by Stata command *xtdpdml*), with a balanced panel data from 1970 to 2015, including 26 advanced economies, 57 emerging market economies, and 39 low-income developing economies. To capture the changes in the pace of convergence over time, we conduct a rolling estimation with the rolling window size of 20 years, using annual observations.

We have tried several other estimation methods but found that most of them are potentially subject to the Nickel bias (Barro, 2014) or the asymptotic bias for GMM estimators shown by Hsiao and Zhang (2015). The methods that we have tried include fixed-effect OLS; mean-group estimator by Pesaran and Smith (1995); first difference GMM by Arellano and Bond (1991); forward-orthogonalized GMM with backward-orthogonalized instruments by Hayakawa (2009); system GMM by Arellano and Bover (1995) and Blundell and Bond (1998). With these methods, we tend to obtain large point estimates, which is in line with symptoms shown in Barro (2014) and

[6] Mankiw, Romer, and Weil (1992) emphasize the importance of taking into account human capital. Recently, Jones (2016) also finds the larger contribution of human capital than physical capital in explaining cross-country income differences.

[7] In deriving Eq. (4), we use the standard log approximation, $\log(1 + x) \simeq x$, but not log-linearization around the steady state, taking it into account that most of EMDEs' real GDP per capita may not yet be close to their steady state levels. In the literature, typically the model is first set up in a continuous-time setting and is then solved with log-linear approximation around the steady state (see for example, Durlauf & Quah, 1999). Our discrete time formulation will result in the same equation to this convention once we log-linearize Eq. (4) around the steady state.

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Hsiao and Zhang (2015), while our baseline estimates produced by the panel dynamic maximum likelihood seem to be less affected.

We have also tried estimating Eq. (1) using the 5-year observations, instead of annual observations, for possible gains from avoiding misspecification bias due to long lagged and nonlinear effects in the spirit of Jordà (2005). The use of 5-year observations leads to computational difficulty, especially for our preferred method of the dynamic panel maximum likelihood, resulting in volatile estimates or even a failure to compute estimates. For other methods that stably compute estimates, the results are generally similar to what we obtain with annual observations, indicating that misspecification bias may be small in our model.

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