Emerging market demographics – Implications for equilibrium real interest rates

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Authors

Robert Gilhooly

Senior Emerging Markets Research Economist

Edward Glossop

Emerging Market Economist

Introduction and executive summary

Populations in developed and emerging markets are set to age rapidly, with emerging markets facing additional challenges as they 'get old' before they 'get rich'. At the extreme, this could put strain on the sustainability of social welfare models and risk adverse debt dynamics taking hold - especially if combined with shrinking workforces and lower inflation rates.

Whether economies are able to age gracefully will reflect a complex combination of their growth trajectories, real interest rates faced and policy choices.

Demographics affect real interest rates via the influence of: (i) labour force growth on trend GDP growth, and (ii) the composition of the population on savings-investment balances and, relatedly, current accounts. For emerging markets, the degree of integration with the global financial system will also overlay a global aspect to interest rates, potentially magnifying strengths and weaknesses.

This paper is the second of three 'in focus' research papers which examine the nature and consequences of long-term demographic change in the major emerging and developing countries and regions. It follows on from the first paper which focused on growth and the rise of the middle classes.

We begin by outlining the broad trends in nominal yields and inflation and then consider the influence of demographics on equilibrium real interest rates (r*), both past and future.

Our most important takeaways are that:

- Nominal yields in emerging markets have been following those in developed markets lower, in part reflecting a tamer inflationary environment. Indeed, adjusting for inflation, real yields trended down in near lockstep between 2003 and 2013. However, **EM-DM real yields have fractured since 2013, challenging the notion that real yields are a contemporaneous global phenomenon**.
- Equilibrium real interest rates underpin secular trends in real yields on government debt. These are unobservable and our calculations to derive estimates of r* for major EMs show that:
  i. **EM r* estimates have clearly trended down since the 2008 Global Financial Crisis (GFC)**, even if the timing is not particularly synchronised across countries.
  ii. **r* varies widely across the EM landscape – much more so than for DMs**. This is consistent with greater differentiation in structural drivers and more limited financial links.
  iii. **The fall in EM r* is greater than can be explained by falling potential growth alone.**
  iv. **The gap between EM and DM r* averages was close to an all-time low at the end of 2019**, suggesting that r* could be converging even if real yields are not.
- **Demographics have weighed on r* over the past 20 years in all but five major EMs.** The impact has primarily come through the effect of the slowing growth in the workforce on trend growth, rather than the influence of ageing on saving. Indeed, the impact of other factors of production via growth can be just as important, while falling DM real rates have also been a key driver.
- The secular decline of equilibrium real interest rates is set to become more modest and less broadly based over the next five years. **Demographics are becoming more adverse as dependency ratios rise and population ageing accelerates, but this continues to be offset in many countries by downward pressure from slower growth in working age populations**. China, developing Asia and Eastern Europe are still likely to see downward pressure on r*.
- **Beyond demographics, technological change and the Covid shock could continue to put r* under pressure**. A worsening of already-high levels of inequality in EMs is another risk.

Demographics will shape the EM landscape beyond their impact on growth

As outlined in our first EM demographics 'in focus' paper, demographics are a key building block of economic growth. In turn, growth is a major influence on the EM investment landscape. Stronger GDP and corporate earnings growth – realised or expected – should lift equity prices, for example. Economic development is also strongly associated with the depth and openness of financial markets and thus the ability of investors to access opportunities and contribute to market functioning.

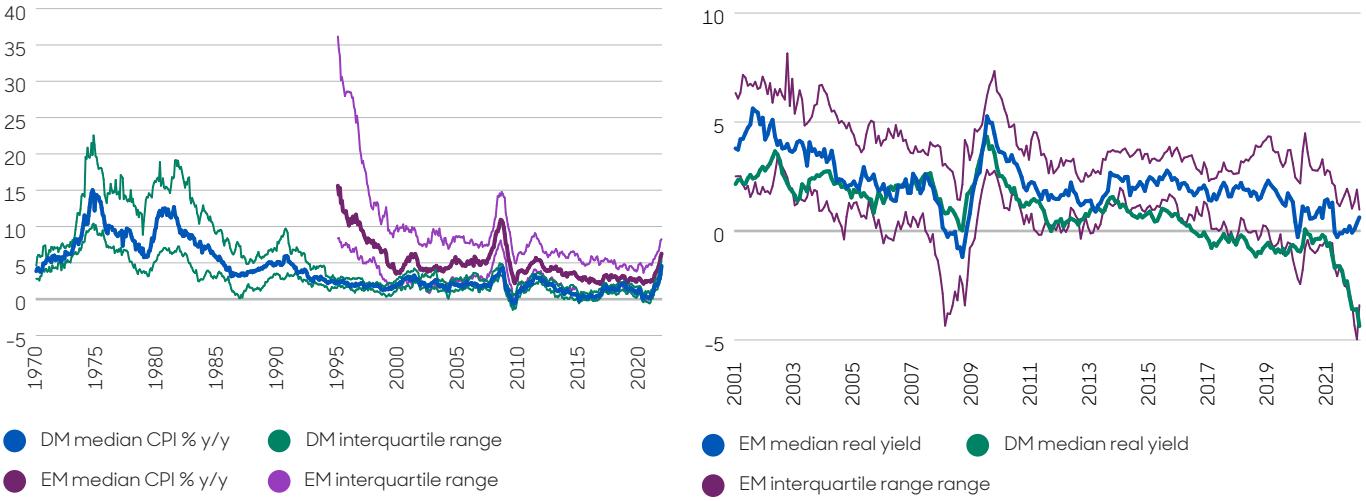
Asset prices are also determined by how investors discount future cash flows. Interest rates of debt determine not just their own price, but those of a spectrum of other assets too, with lower rates raising the value of future cash flows and vice versa. It is therefore important to form a view on how demographics will change both growth and interest rates.

Nominal yields have fallen, reflecting both lower inflation and real rates

Government bond yields have been trending down in developed markets since the 1980s. DM yields have also traded in an increasingly narrow range, reflecting not just similar economic structures and obstacles, but also a highly integrated financial system with the US at its core. Nominal yields in EM have followed those in DM lower with a lag, even if they remain on average at a higher level and have shown a smaller degree of convergence and co-movement.

Sliding EM and DM government bond yields could imply that common trends are at work. Indeed, in both EM and DM lower nominal yields have in part reflected a tamer inflationary environment (pre-Covid), helped by a growing number of independent central banks (see Chart 1, LHS). Moreover, adjusting for differing inflation rates, median real yields in EM and DM moved in near lockstep between 2003 and 2013, falling by roughly 1.5 percentage points over this 10-year period.

Chart 1 – As EM inflation has trended lower, EM and DM real yields no longer move together



Source: Haver, Refinitiv, aRI (March 2022).

[1] Note: real yields calculated on ex post basis.

A large body of academic literature, such as Rachel & Smith (2015), points towards an underlying downward trend in equilibrium real interest rates as the explanation for the fall of real yields in DMs. Many papers conclude that secular trends – including demographics – explain much of the fall in real yields.

It is possible that r* is essentially a global phenomenon, reflecting interconnected financial markets. Commentators have in the past pointed to the co-movement of EM and DM real yields as evidence that this co-movement extends beyond just DMs, despite EMs being much less integrated into the global financial system. However, this co-movement has fractured since 2013: DM real yields fell below zero in 2016 while EM real yields were relatively steady until Covid-19 hit. Indeed, real yields have diverged notably since Covid emerged, despite similar increases in inflation (see Chart 1, right vs. left panels).[2]

This raises the question as to whether real yields could converge once again or whether divergence is set to persist. Perhaps the search for yield, strong commodity prices and 'hyper-globalisation' contributed to an unsustainable convergence between EM and DM that would not normally persist given different economic structures and underlying trends. On the other hand, continued financial integration could push real yields back together, particularly if aided by a convergence in r*.

[2] The divergence in EM-DM ex ante real yields is similar, i.e. using the 3-year average of inflation as a proxy for inflation expectations. DM ex ante real yields are however stable, while EM ex ante real rates rise.

Written in the stars: equilibrium real interest rates (r*)

Real 10-year government bond yields may be indicative of moves in equilibrium interest rates, but r* is ultimately unobservable.

Most estimates of r* have focused on DMs, especially the United States. Estimates of r* for emerging markets are comparatively sparse. Academic studies to date have considered some individual EMs – such as Brazil, Mexico, Russia and South Africa - but a comprehensive study is lacking.

Before we turn to our approach for estimating r* for the major EMs, it is worth outlining the concept of r* and how theory suggests it links to demographics.

The theoretical r* concept is closely (and positively) related to the growth rate of potential output. Stronger potential growth raises the rate of return on investments - spurring demand for funds to invest in physical assets - while expectations of stronger future income growth can support household consumption by reducing the need to save.

Demographics therefore interact directly and indirectly with r* via the building blocks of potential growth and the impact on savings-investment balances, respectively. In the latter case, when a country has a large pool of workers who save more than they consume, total savings rise, while fewer dependants can amplify this effect by raising savings per worker. Investment may be spurred, but at the whole-economy level aggregate savings rise, pushing down interest rates. Indeed, this dynamic underpins the notion of a 'demographic dividend' whereby a more favourable population structure helps economies, particularly emerging markets, to grow.

We adapt the work of Holsten, Laubach & Williams (2016) (HLW) to compute r* estimates for 20 major EMs. The modelling itself is complex and Appendix 1 provides more details on the challenges of applying HLW in an EM context. But the intuition is that r* is determined by potential growth and other factors, and can be defined by the absence of growing inflationary or deflationary pressures.

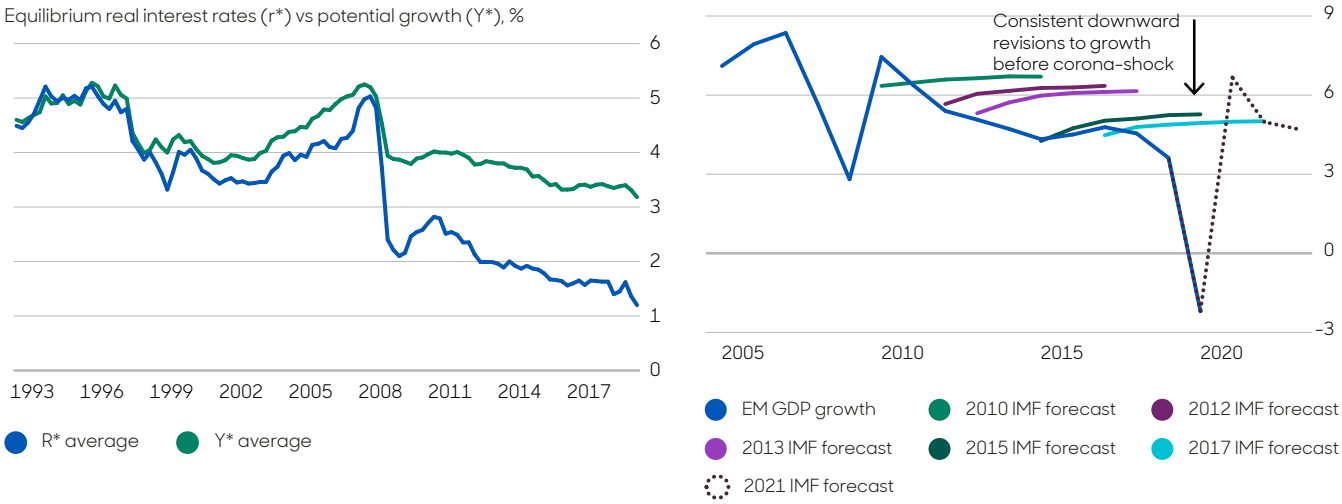
In standard economic theory the equilibrium interest rate is the real interest rate that would prevail when the economy is operating at potential with stable inflation. Therefore, when economic slack turns out to be greater than expected it implies that the estimate of r* at a given point in time should be lowered slightly. This process continues iteratively through the data until an estimate of r* is constructed for every point in time.

Our estimates for equilibrium real interest rates vary quite widely across the EM landscape. Taking a bird's eye view though a few trends are clear:

i. The average r* in EM has clearly shifted down since the GFC in 2008 (see Chart 2, left-hand panel).
ii. r* and potential growth (Y*) had moved very closely together before the GFC, but r* has subsequently diverged from potential growth, suggesting that other factors beyond growth have become increasingly important.

It is, however, possible that some of the fall in r* represents growth disappointments: for example, IMF forecasts consistently overestimated EM growth post-GFC (see Chart 2, right-hand panel), with much of this growth disappointment coinciding with weaker investment and capital deepening.

Chart 2 – r* has fallen much more than Y*, but growth expectations were repeatedly marked down

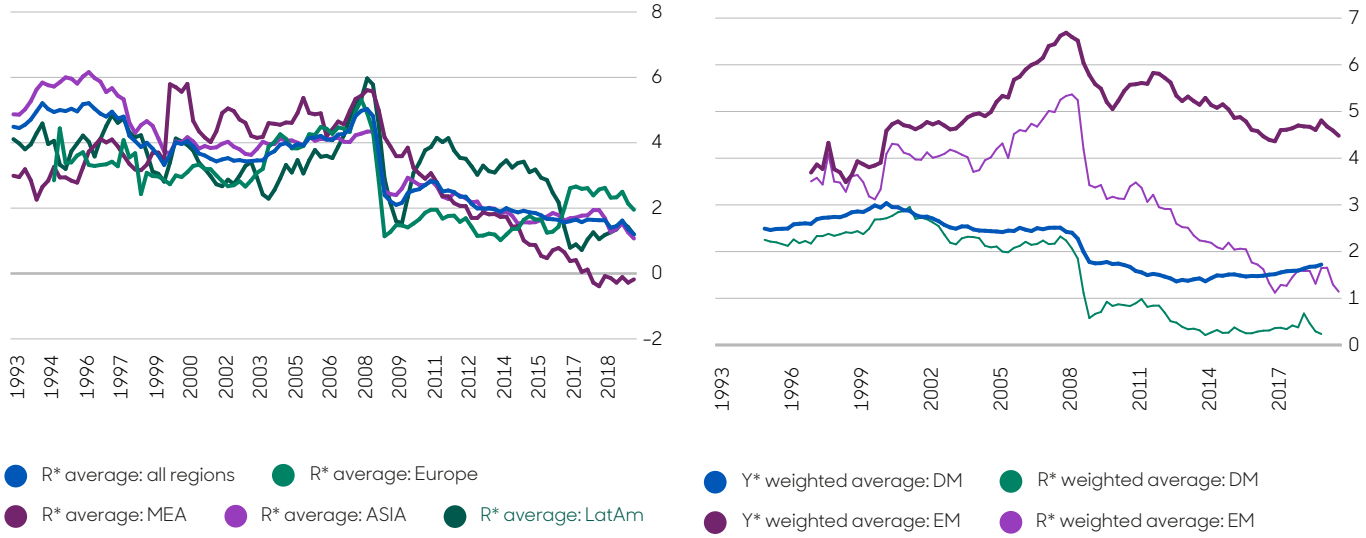


Source: aRI, IMF (June 2021).

Unpacking the r* estimates reveals a similar result to that shown in nominal and real yields: the HLW estimates of r* for DMs show a large degree of co-movement while there is much more dispersion within our estimates for EMs. The regional averages for r* do all shift down after the GFC, but the timing is not particularly synchronised. Additionally, there is also a lot of dispersion within regions, which strengthens the conclusion that more limited financial links between EMs may be acting to reduce the contemporaneous influence of global factors (see Chart 3, LHS).

That said, the gap between EM and DM r* averages was close to an all-time low at the end of 2019 (see Chart 3, RHS), while the gap between potential growth was around the average. One interpretation is that global factors have become increasingly important, but operate over a longer time frame.

Chart 3 – r* has fallen across regions, but is fairly unsynchronised; gap between EM-DM r* narrowed



Source: aRI, Holsten, Laubach & Williams (June 2021)§

Note: Chart shows figures weighted by 2010 real GDP. DM estimates are taken from Holsten, Laubach & Williams (2016).

How have demographics influenced r*?

As noted previously, the Holsten, Laubach & Williams approach calculates r* as a function of potential growth and 'other' factors. We therefore consider the net impact of demographics via both channels.

First, our potential growth estimates from the **first 'in focus' paper** already allow us to decompose potential growth into key demographic factors – specifically, the contributions from labour and human capital.

Second, since the effects via dependency ratios are likely to be operating at a different frequency to those via potential growth, we create a panel data model to investigate how an ageing population and exposure to the global financial system drive the 'other' factors.

We follow an approach taken by IMF staff (Arslanalp et al, 2018), who examined how demographics and the degree of financial integration affected real 10-year yields for major economies. However, we adjust this to focus on real equilibrium rates and consider only emerging markets.

20 emerging markets and data from 2000 onwards forms the backbone of our model. Changing demographic composition is captured by youth and old-age dependency ratios. Aging speed (the expected change in the old-age dependency ratio over the next 20 years) adds a forward-looking dimension, aiming to capture individuals' perceptions of the need to save for retirement. The average DM real yield and interaction terms with measures of capital account openness help to capture the influence of financial integration. For more detail on the modelling approach, please see Appendix 2.

Combining the results from both stages we find that between 2000-2019 (see Chart 4):

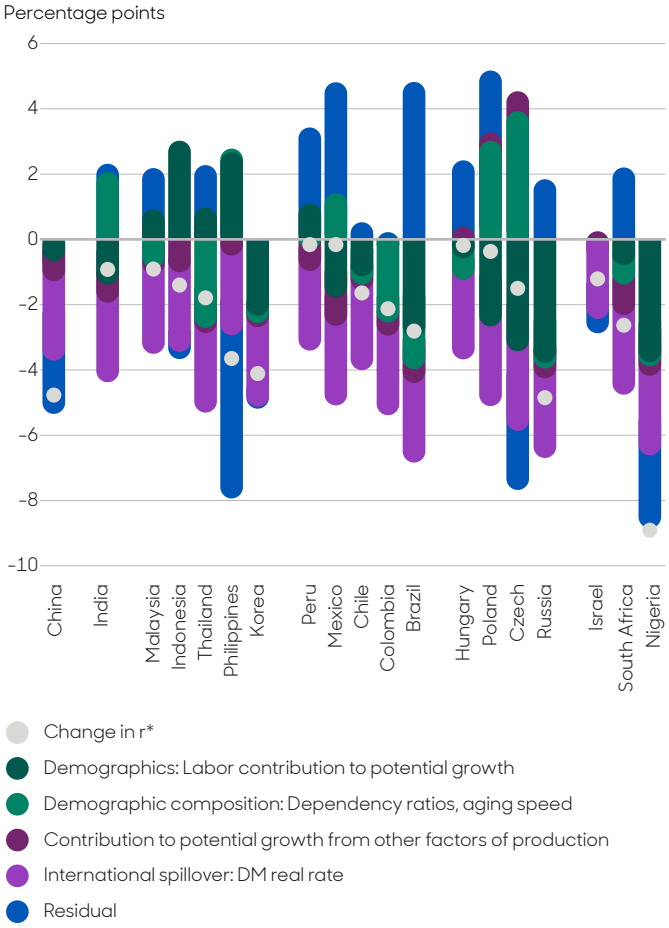
i. The net impact of demographics via both the quantity of (quality-adjusted) labour and the composition of the population (shown in the light and dark green bars respectively) has been negative in all but five countries. Within these five only India, Poland and the Czech Republic have had meaningful upward pressure from demographics on r*.

ii. Decomposing the net demographic impact shows that the changing composition of countries' populations has typically had a smaller influence compared to the influence of the quantity of labour (quality adjusted to account for expanding human capital).

iii. The impact of other factors of production (capital deepening and total factor productivity) via potential growth can be just as important – in many cases more important – than the combined demographic effects. Indeed, outside of developing Asia (ex. China, India) the contribution from other factors has mostly contributed negatively to r*, consistent with other literature noting the weak post-GFC performance in productivity and capital deepening.

iv. International financial linkages matter: emerging markets may not be as linked as developed markets but falling real rates in developed markets have consistently weighed on EM r* across our sample.

Chart 4 – Demographics have played an important role, alongside other components of potential growth and DM real yields, in pushing down equilibrium real interest rates (r*) in emerging markets

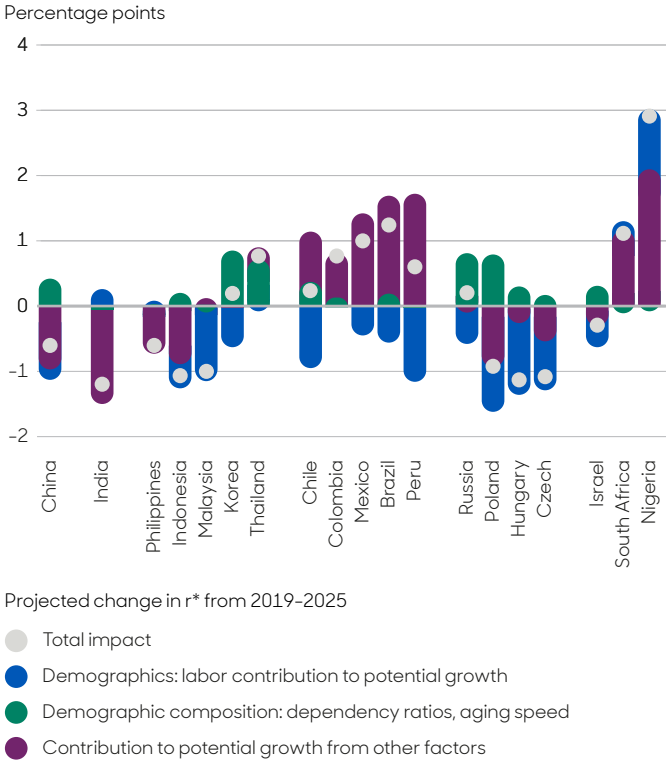


Source: aRI (March 2022)

How is r* likely to evolve in the future?

We can project the likely course of r* for the major emerging markets by combining our potential growth (y*) projections with our estimates of the influence of demographics derived from our panel regressions, holding constant the DM real rate and the degree of financial integration.

Chart 5 – Over the next 5 years the outlook for r* is diverse: the combined impacts from demographics and potential growth push up on r* for half of EMs, and down for the other half.



Source: aRI (March 2022).

As we demonstrated in the **first 'in focus' paper**, potential growth is typically expected to fall, while dependency ratios are generally expected to move adversely (i.e. fewer workers support a larger number of people), with the relative strength of these factors varying considerably across countries.

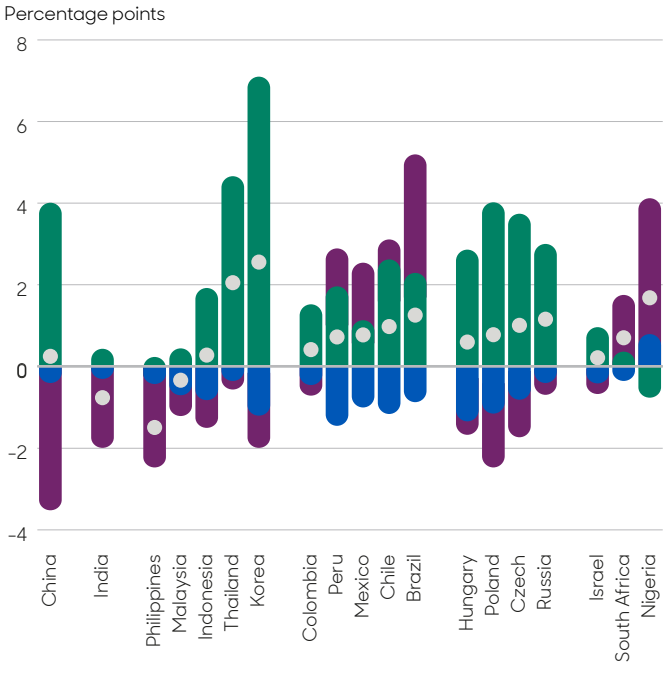
Over the next five years the combination of shifting demographics and differing potential growth trends is likely to push r* in different directions across the EM spectrum: roughly half of major EMs may see r* pushed down overall by these forces and half may see it rise (see Chart 5).

At one end of the spectrum, moderating potential growth (the sum of the blue and green bars in Chart 5) is expected to push r* around 1 percentage point lower by 2025 in most of developing Asia (ex. Thailand, Korea) and Eastern Europe (ex. Russia), more than offsetting the upward pressure from increased dependency ratios and the speed of ageing.

At the other end, the upward pressure from demographic composition is amplified by a recovery in overall potential growth for some EMs. This is not a particularly bullish view on growth, rather it reflects a very poor starting position in 2019. Prior crises actually led to contracting productivity in LatAm and South Africa. Allowing the productivity drag to abate pushes up our estimates of potential growth via other factors (purple bars) which, in LatAm in particular, offsets the drag from fewer workers (blue bars), and subsequently helps to support r*. Given a history of prolonged productivity weakness the risks in LatAm are however skewed to a smaller rise in r*.

Another way to consider the forces acting on r* is to focus on the demographic bars (blue and green), which are often working in opposite directions. Demographic composition effects are typically pushing up on r* or are negligible over the next five years, primarily due to rising old age dependency ratios. But falling labour forces are almost always pulling down on r* by more. Only Korea, Thailand, Russia and Nigeria are likely to see r* pushed up in a significant way by the combined impact of changes in the labour force and demographic composition.

Chart 6 - Over the next 30 years demographic composition plays an increasingly important role



Source: aRI (March 2022).

Over a longer time horizon r* could be more heavily influenced by demographics, although the net effect will vary across countries. On the one hand, slower trend growth (as shown in Chart 9 **in the first 'in focus' paper**) weighs more conclusively on r*, but on the other, the impact of shifting demographic composition potentially creates more meaningful upward pressure (see Chart 6).

Only India, Philippines and Indonesia see r* pushed down on balance by these forces over the next 30 years, while China is little changed as the drag from lower trend growth largely offsets the impacts on the savings-investment balance from an aging society. LatAm and Eastern Europe could find r* pushed up by around 1-2pp, while the pressure could be greater on Korea and Thailand, reflecting much more adverse ageing profiles.

One must be careful not to put too much weight on these long-run projections. Over a 30-year horizon DM real rates and financial openness, which we have not accounted for in these projections, will play a large role alongside growth and demographics. Moreover, other factors which we have not included in our modelling are likely to play increasingly key roles.

What other factors could influence r* in emerging markets?

Analysing, quantifying and projecting all of the potential influences on r* is an exercise that is far beyond the scope of this paper. That said, we think it is worthwhile to briefly consider a selection of them to give a sense of the direction of travel, specifically: the impact of the Covid-19 shock, inequality and the role of technology. To give you the punchlines first, Table 1 below provides a quick overview, suggesting that the balance of risks is for these additional factors to continue to weigh on r*.

Table 1 – The influence of the Covid-shock, inequality and technology on r*

	Impact on r*	Channels
Covid-19 shock	↓	Potential growth is likely to be impacted by lower human and physical capital accumulation, while EM productivity may be damaged by de-globalisation pressures. Greater uncertainty may push up precautionary savings balances, while austerity risks pushing up national savings.
Income inequality	↔	Income inequality is unambiguously negative for r*, but it is already very high in EMs and it is unclear whether it will rise significantly further. Reform of taxation systems could reduce inequality and be consistent with development, but there is little sign of this so far.
Technology	↓	Automation makes low-income workers vulnerable to displacement, increasing inequality. The falling relative price of capital seems likely to continue, weighing on r* by reducing investment expenditure.

(i) The impact of the Covid shock on r*

The Covid shock initially pushed up national savings, as increased savings by households and firms more than offset borrowing and spending by governments. Current account balances rose correspondingly. Some emerging markets face a longer-duration shock, partly reflecting slower vaccination, and while this may generate a more persistent effect it should still abate.

Long-run effects on r* may however still come through a combination of supply-side damage and structural changes that alter the savings-investment balance.

First, human capital is likely to be damaged in emerging markets as children's links to formal education are strained and potentially broken altogether, weighing on growth and exaggerating inequality.

Greater uncertainty could restrain investment by pushing up hurdle rates, as future cash flows become harder to assess for some businesses, particularly consumer-facing services. Households may also want to increase precautionary savings, particularly in EMs with weak social safety nets.

Public balance sheets are also under strain, suggesting that governments may prematurely tighten fiscal policy before private sector demand is ready to take up the baton. More generally, weak public and private investment slows capital deepening and growth, while pushing up national savings.

Finally, domestic and international politics are a potential headwind. Pandemic-related concerns have piled on top of existing issues, increasing the risk of a shift away from policy orthodoxy and market-friendly governments. Covid-19 has also amplified US-China tensions, contributing to de-globalisation pressures which could weigh on productivity growth by shortening supply chains and lowering the cross-border diffusion of both people and knowledge.

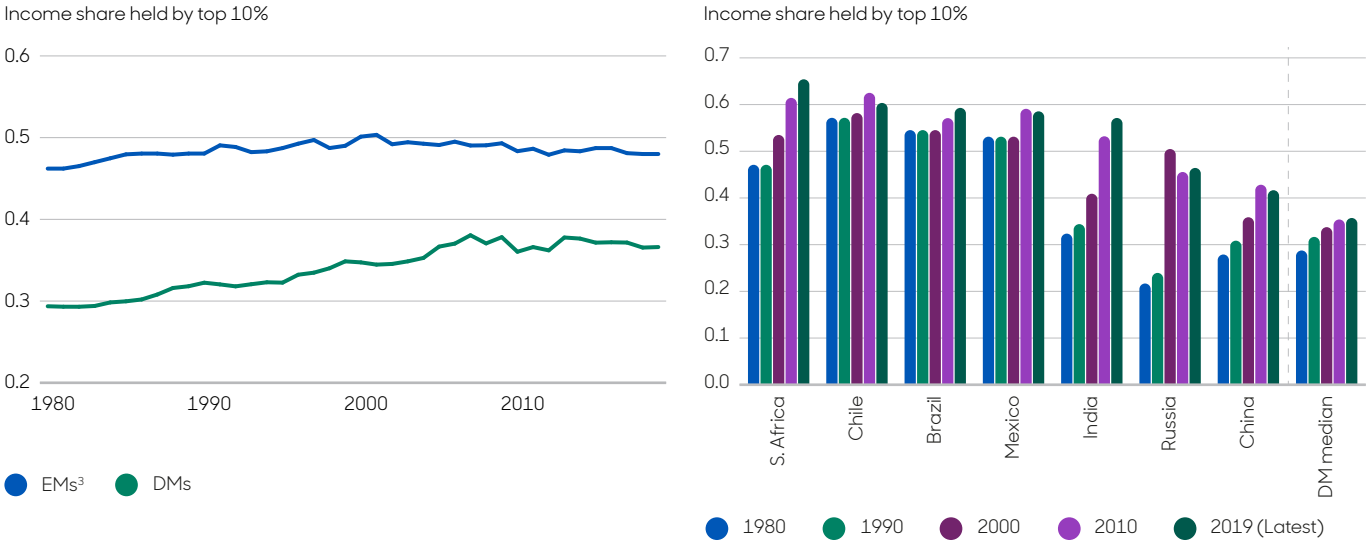
Our long-run growth projections incorporate a headwind from the Covid shock which weighs on the level of potential GDP by around 3-5% on average across major EMs and correspondingly this weighs on y* and r* as described in the previous section. But as outlined here, there are reasons to think that the shock could weigh on r* beyond the impacts on potential growth already incorporated.

(ii) The impact of inequality on r*

Income inequality may be an important driver of r* in the coming decades. High income households tend to have a lower marginal propensity to consume, higher income inequality therefore tends to increase aggregate savings, bearing down on r*.

Inequality rose markedly in both developed and emerging markets in the 1980s and 1990s, before settling at a high level in the 2010s (Chart 7). The degree of inequality varies much more widely in EMs than DMs. China is somewhat closer to the DM average while the share of income captured by the top 10% in South Africa is almost twice as high as the DM median.

Chart 7 – EM inequality rose sharply between 1980 and 2000, but has since stabilised at high levels



Sources: World Inequality Database, aRI (March 2022).

[3] Emerging market sample matches major EMs used in analysis across the paper.

It is difficult to know whether inequality will remain around current levels. Traditional economic theory (Kuznets, 1955) suggests that inequality could rise alongside development and then subsequently decline as countries attain higher income levels. However, it is perhaps telling that inequality has not in fact declined in many middle- and high-income EMs.

Work by the likes of the OECD, World Bank and Piketty (2014) suggests that other factors may supersede the influence of development. A non-exhaustive list would include: the tax system structure, i.e. preventing income redistribution; large and persistent informal sectors, combined with gaps in access to education, which make it difficult to move to higher skilled and better paid jobs; and new technologies, which can raise inequality by substituting machinery and equipment for low-skilled workers, but complementing high-skilled workers.

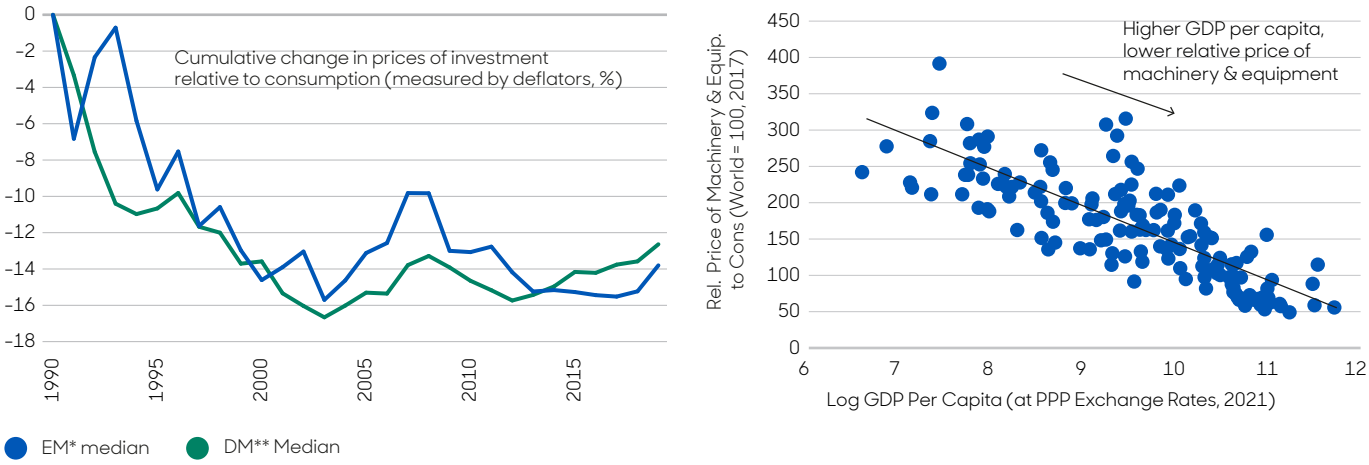
Looking ahead, while it appears that inequality may have peaked in many major EMs, we doubt that it will fall significantly over the coming decades. On the one hand, we do think that educational attainment will continue to rise, even if our growth projections are consistent with only fairly modest degrees of economic convergence (see 'in focus' paper 1). But on the other, technological development and diffusion are likely to continue. Our judgement on net is that it is unclear whether inequality will be a significant driver of equilibrium real interest rates over the long-run in emerging markets.

(iii) The impact of technology on r*

Technological change is generally thought to have contributed to a decline in r* and it seems likely that this could continue to lower r* in the future too. Automation makes low income workers vulnerable to displacement, increasing inequality. For example, the OECD finds that a large share of workers in Slovakia and Poland are vulnerable to automation, reflecting their large auto sectors focused on lower value-added tasks such as assembly and production. More generally, technological progress challenges many EMs' traditional comparative advantage in the global trading system: a surfeit of cheap labour.

The falling relative price of capital is a potentially powerful force. The prices of investment goods have fallen dramatically, reducing firms' relative expenditure on machinery & equipment (Chart 8).

Chart 8 – Relative prices of machinery & equipment have fallen sharply globally, while relative prices fall alongside economic development



Sources: Penn World Tables 10.0, aRI (March 2022).

Despite the rich literature on this subject for DMs, there is less analysis on trends within EMs. A closer look reveals that the picture is more nuanced than in DMs. Since 1990, relative prices of capital have fallen in most major EMs. But there is a wide range of outcomes and in some cases relative prices have risen. Lingering trade barriers, weaker technology adoption and the smaller weight of R&D (prices of which have fallen very sharply) in total investment appear to explain some of the diffusion across EMs.

Looking ahead, the relative price of capital for EMs is likely to decline, for two reasons. First, relative prices of machinery & equipment are still much higher than in DMs (see Chart 8), suggesting scope for further convergence alongside development. Second, as EMs develop and become more "capital light", a rising share of R&D and intangibles in total investment should further reduce overall relative investment prices. Further, intangible investments such as software are more scalable, potentially contributing to income inequality if a smaller proportion of firms (such as 'big tech') dominate the business landscape.

Investment implications

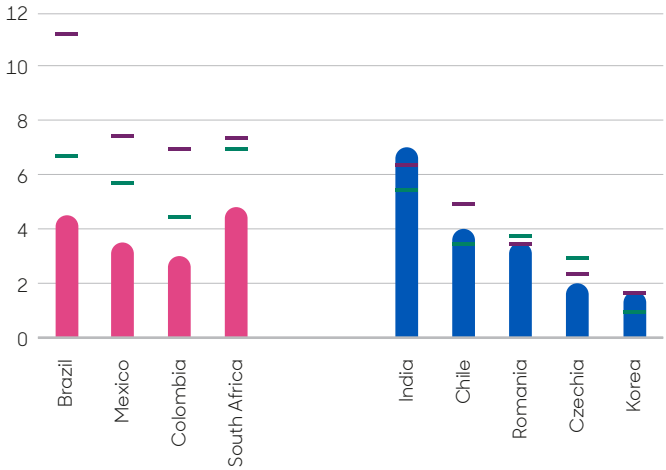
The demographic outlook has major implications for a wide range of asset prices both via economic growth and also interest rates, due to the discounting of future cash flows. Long-term investors who can more accurately gauge the influence of secular trends on r* have the potential to improve their returns performance. The liberalisation of financial markets over time may increase interest rate correlation across countries, but emerging markets are likely to open to different degrees and at different paces. Moreover, the fracturing of DM-EM real rates since 2013 suggests that international convergence is likely to ebb and flow over time.

At the time of writing, the recovery of the global economy from the Covid shock remains a fragile, halting and divergent process, driven by differences in re-opening strategies and struggles with maintaining policy support in the face of high inflation. Quite where policy rates and government bond yields will settle as economies move post-pandemic remains highly uncertain.

If we consider the major EMs where we believe our estimates are most robust (i.e. output gaps derived from HLW closely match those created by production functions) and where external estimates of r* are also available, a few interesting results emerge.

Our estimates of nominal equilibrium interest rates (i.e. r* plus inflation expectations) for 2019 are significantly lower than equivalent central bank or international institutions' estimates for half the EMs considered (see Chart 9, red bars vs blue lines). This could suggest a risk that some central banks view the neutral policy rate as being higher than it is, and could set policy too tight.

Chart 9 - Our 2019 estimates of nominal equilibrium interest rates are below those of central banks for half of the EMs considered, while market pricing is well in excess of either estimates.

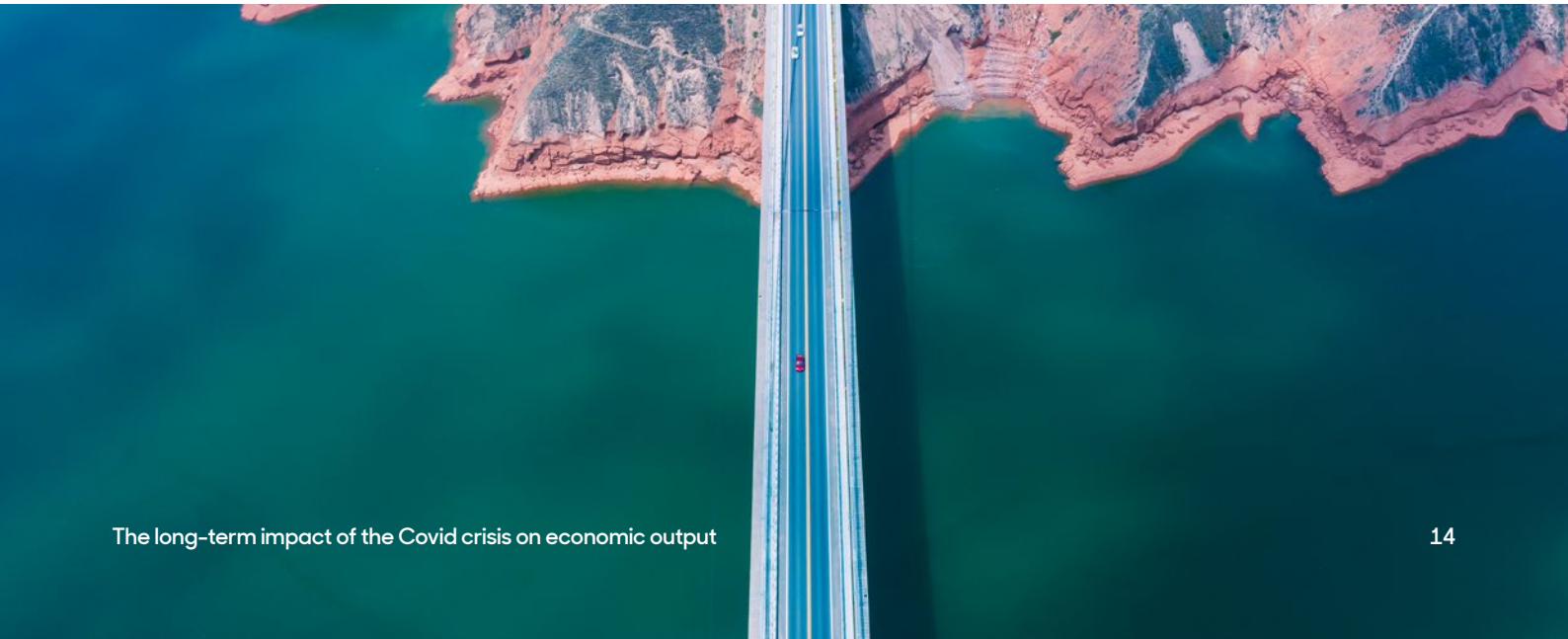


Big gaps between 3y swap and average nominal equilbrium rates, plus dispersion in equilibrium estimates

Small gaps between 3y swap and nominal equilbrium rates and small dispersion in r*

aRI estimate: nominal equilibrium rate (big gap)
aRI estimate: nominal equilibrium rate (small gap)
Central bank/other estimate: nominal equilibrium interest rate
3 year swap rate

Source: aRI, National central banks, IMF, Bloomberg, Haver (March 2022).



One caveat is that interpreting the gap between our estimates and those of central banks is not easy: it is not always clear what time horizons the r* estimate refers to, and estimates are also sometimes tailored rather than calculated using a consistent methodology as we have.

As we showed in Chart 5, for most EMs in Asia and Eastern Europe, demographic factors over the coming years would imply downwards pressure on r*. But for four out of the five countries with significant r* gaps (Brazil, Mexico, Colombia and South Africa), recovering potential growth could close between a third and a half of the gap between our estimates of r* and those of the central banks' 2019 estimates.

That said, central banks' views on what constitutes a neutral policy rate now or what it could be once economies move post-pandemic are likely to be in flux.

Regardless of which view of equilibrium interest rates is used, the current market pricing – as illustrated by the 3-year swap rates – appears to imply a much higher level of equilibrium policy rates and/or a large persistent risk premium for Brazil, Mexico and Colombia. Given the potential gap to neutral policy rates - which arguably face downside risks from additional drags from the Covid crisis and other factors - this could imply that equilibrium rates may provide support to long-dated local currency bonds and stock market valuations.

In contrast, we have some concerns that market pricing is not high enough in India. Indeed, core inflation remains uncomfortably high in India and the RBI stands out as having done little to lean against inflation. This raises the risk that the RBI may have to tighten more aggressively at a later date.

Conclusions

In the first paper of the EM demographics 'in focus' series we showed how demographics are set to drive dramatic changes in growth and its composition. EMs may face shrinking and ageing labour forces but rising labour force participation and more educated workers suggest that the growth outlook is one of cautious optimism.

Of course, as we showed in this paper, the influence of demographics on growth is just one way in which demographics will have a major bearing on the economic and investment landscape. Demographics also affects real interest rates which, combined with the degree of integration into the global financial system and policy choices, will shape debt dynamics and help determine the sustainability of social welfare models.

Indeed, the fracturing of EM-DM real yields - which had moved in near lockstep until 2013 – imply that domestic policy choices may have become increasingly important.

Overall, we reject the notion that ageing by itself will drive interest rates higher, compounding the Covid shock. Indeed, while demographic trends are becoming more adverse as populations age, the impact on real equilibrium rates from higher dependency ratios and faster ageing continue to be offset in many countries by downward pressure from slower growth in working age populations.

Additionally, while we have incorporated damage to trend growth from the Covid shock, we think that the balance of risks from economic scarring, inequality and technology give further weight to our estimates which suggest that r* will rarely face upward pressure.

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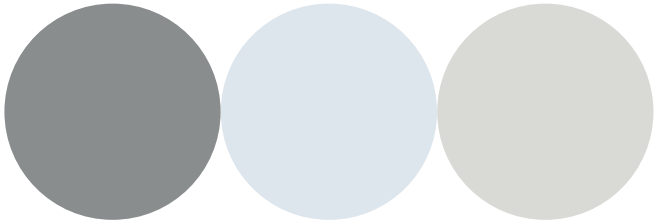


Appendix 1: r* methodology and challenges in an EM context

HLW approach this using a state space model which moves r* with potential growth (y*) and a time-varying unobserved component (z):

$$r^* = y_t^* + z_t$$

The level of potential output (l) follows a random walk with drift, while the growth rate of potential output (y) and that of the other determinants (z) both follow a random walk. Together these form the transition equations:

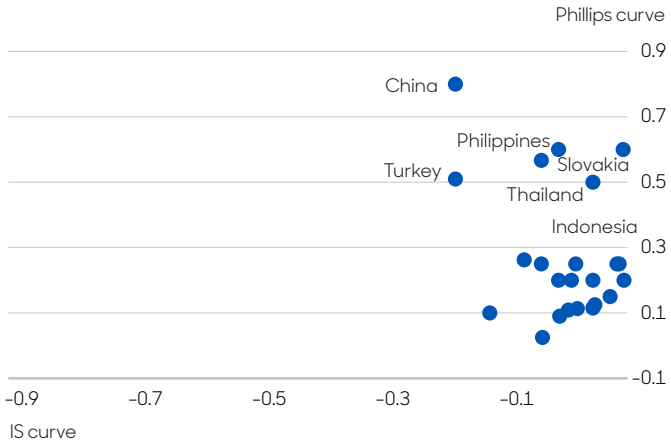
$$l_t^* = l_{t-1}^* + y_t + \varepsilon_{l*,t}$$
$$y_t = y_{t-1} + \varepsilon_{y*,t}$$
$$z_t = z_{t-1} + \varepsilon_{z,t}$$

IS and Phillips curves are used to pin down the unobserved variables using the Kalman filter, while constraints are imposed to ensure that the slope of the IS curve is negative and the Phillips curve is positive.

In the original modelling, which focuses on the US, euro area, UK and Canada, the constraints needed for the model to solve (facilitating numerical convergence) are fairly close to 0, i.e. they are more akin to sign restrictions. However, in an EM context we need to be more specific. First, we deem it more appropriate to use headline inflation rather than core as the basis of the policy variable since EMs often lack sufficient institutional credibility to look through transient price level shocks. Second, EMs face higher rates of inflation - the variance of Brazilian headline inflation is around 8 times that of core US PCE, for example. Putting these together, the initial constraints must be scaled up. Separately for China, given the multitude of policy levers and their complex evolution, we map a new long-run version of the aRI China Financial Conditions Index into policy rate space.

For most EMs the constraints and subsequent coefficients are reasonably closely grouped together: the IS curve coefficient is usually around -0.1, while for most the Phillips curve is between 0.1 and 0.3. China and Turkey stand out with much higher coefficients in both, while some countries in emerging Asia and Slovakia also record relatively high coefficients for the Phillips curve (Chart A).

Chart A – IS and Phillips curves appear to be steepest in Turkey and China

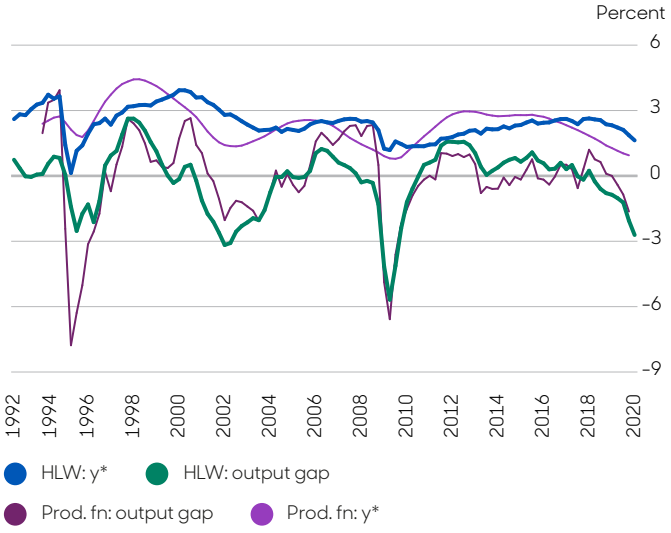


Source: aRI (March 2022).

In practice there is some sensitivity to the r* estimates produced, depending on the initial constraints chosen. We can however reduce this problem by iterating to ensure consistency with the production function estimates of (y*) and the output gaps which we produced in the first 'in focus' paper.

Indeed, we have taken comfort from the fact that the estimates for potential growth produced by these two distinct approaches produce similar results. For almost all countries the HLW estimates of potential growth and those we produced via production functions are very close, particularly after the first couple of years of estimation. For most countries, the output gaps are also a reasonable match. In the case of Mexico the output gap opens by more in 1995 in the production function approach, but the overall pattern produced by both is very similar (Chart B).

Chart B – HLW estimates for y* and the output gap for Mexico are close to the production functions



Source: aRI (March 2022).

Appendix 2: Modelling the influence of demographics on r*

The HLW approach creates estimates of the influence of potential growth (y*) - which we can break down into the contribution from labour using our production functions – and then other factors (z) on r*. We therefore seek to understand how the demographic shifts influence r* beyond their impact on potential growth, and focus on how demographics are driving the estimate of other factors (z) derived during the HLW modelling.

A fixed effects panel data model - following the work of Arslanalp et al (2018) - is our preferred approach.[4] Data from 2000 on 20 countries provides the backbone, from which we decompose the influence of demographics and open economy factors on 'other factors' (and correspondingly r*).

The explanatory variables pick up a range of demographic and open economy influences via: youth and old age dependency ratios; ageing speed (the expected 20-year change in the old age dependency ratio); interactions with capital account openness, as measured by Chinn-Ito indices; the weighted DM real yield; and control variables, such as the capital stock to labour ratio.

In mathematical notation, the model takes the following form:

$$z_{it} = \beta_0 + \beta_1 YD_{it} + \beta_2 OD_{it} + \beta_3 AS_{it} + \beta_4 (YD_{it} * CO_{it}) + \beta_5 (OD_{it} * CO_{it}) + \beta_6 (AS_{it} * CO_{it}) + \beta_7 DM_{it} + \beta_8 Controls_{it} + \varepsilon_{it}$$

Arslanalp et al (2018) do not use the standard definitions for dependency ratios, instead focusing on those aged 30-64 as the most relevant for influencing savings balances and stocks of assets. This is aligned to the life-cycle hypothesis in which these age groups have the highest savings rates and correspondingly drive the largest increases in asset holdings. See Vlieghe (2021) for a discussion on the importance of considering the stock of assets of the whole population, not just the savings patterns of the elderly. As we discussed in the first 'in focus' paper, we prefer worker-based dependency ratios. However, for assessing the impact on r* we stick with the IMF's ratios as these generate estimates that are better aligned to the theoretical priors.

Theoretically, higher dependency ratios should push r* higher while faster ageing speeds should push it down. As discussed previously, fewer prime-age workers relative to dependants reduces savings. On the other hand, a rapidly ageing society may lead to higher saving rates. This may be more pertinent in an emerging market context where life expectancy has risen sharply and has potential to rise further than in developed markets. Moreover, social security may lag behind these shifts, reflecting political and institutional inertia. Ageing speed is therefore a forward-looking variable which captures individuals' expectations and their perceptions of the need to self-insure.

Global factors are potentially very important. If domestic financial markets are deep and highly integrated to global markets, real interest rates and real equilibrium rates could be largely a global phenomenon. Put simply, the impact of demographics could be offset by capital flows.

We first include the weighted DM real (ex-ante) 10-year yield to consider how the global financial system may influence real equilibrium rates in emerging markets. Second, we consider how the degree of capital openness at the country level, as measured by the Chinn-Ito index, may influence the pass-through of global factors. To incorporate these effects, we interact the Chinn-Ito index with the dependency ratio variables. If global factors do indeed offset demographic drivers these interaction variables should have the opposite sign to the demographic variables.

Finally, control variables are utilised to improve the model fit and capture potentially important drivers in an EM setting. We find that the capital stock to labour ratio (K/L) is a useful control variable, helping coefficients in the main variables of interest to align with their theoretical priors. This variable may be useful in an EM context because it could help to pick up periods of particularly strong investment, capturing commodity price booms for example. More details on alternative model set-ups will be provided in a forthcoming CEPR paper.

[4] Attempting to attribute the role of demographics to an unobservable variable of course introduces a large degree of uncertainty about the precision of the estimates and the inference one can take from the model. Before settling on this approach we considered several different model set ups. Using random effects gives similar estimates to those presented here. More detail on robustness and alternative model specifications will be provided in a forthcoming CEPR working paper.

Table 1 shows our preferred set-up. As can be seen, the coefficients broadly align with the theoretical priors: rising dependency pushes r* higher and ageing speed reduces it, while there is a strong influence from DM real yields. In contrast to Arslanalp et al (2018), we find little offset from capital account openness to demographics, perhaps a reflection of our focus on EMs only.

Table 1 – Fixed effects panel regression: demographics, financial openness and r*

Dependent variable:	**Z_t**
C	-5.47***
	(1.06)
Youth dependency ratio	1.30*
	(0.78)
Old age dependency ratio	10.12***
	(3.71)
Aging speed	-3.01*
	(1.56)
Youth dependency* Capital openness	0.16
	(0.12)
Old age dependency* Capital openness	0.40
	(0.70)
Aging speed* Capital openness	0.20
	(0.58)
Developed Market weighted real 10yr yield	0.62***
	(0.12)
Growth capital stock/labour ratio	0.06
	(0.04)
Observations:	380
Number of countries:	20
R-squared:	0.65
Standard errors in parentheses	
*** significant at 1%	
** significant at 5%	
* significant at 10%	

Source: aRI (March 2022).

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