

Medium-Term Growth in EMEAP Economies and Some Implications for Monetary Policy

MAS Staff Paper No. 53

July 2015

MEDIUM-TERM GROWTH IN EMEAP ECONOMIES AND SOME IMPLICATIONS FOR MONETARY POLICY*

By

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July 2015

***An earlier version of this paper was prepared for the 20th EMEAP (Executives' Meeting of East Asia-Pacific Central Banks) Governors' Meeting on May 30, 2015. The views in this paper are solely those of the authors and should not be attributed to the Monetary Authority of Singapore or EMEAP members. The authors are grateful to Peter Wilson, Celine Sia and Ng Bok Eng who provided useful comments and suggestions.**

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JEL CLASSIFICATION NUMBER: E52, J24, O47

KEYWORDS: ECONOMIC GROWTH, PRODUCTIVITY, MONETARY POLICY, ASIA-PACIFIC

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EXECUTIVE SUMMARY

EMEAP economies have grown robustly over the last two decades, registering an average growth rate of about 5% per annum.¹ Yet the post-crisis environment has posed new uncertainties over the sustainability of growth in the medium term and brought to the fore important shifts in the supply-side determinants of potential growth. This note examines the factors affecting longer-term growth trends in the EMEAP economies and draws out several implications for the conduct of monetary policy.

Demographic forces have proven to be a key factor behind a gradual slowdown in the growth rate of the more advanced EMEAP economies since 1990, even as productivity performance waned. Labour productivity growth averaged close to 2.4% during the period prior to the financial crisis, but has decelerated to 1.5% in the post-crisis years. In the emerging EMEAP economies, GDP growth improved during 2000–07 on account of stronger productivity gains which offset a mild demographic drag. However, these economies have also experienced a more discernible step-down in both GDP and labour productivity growth since 2008. While these declines can in part be attributed to a reduced pace of capital formation, a more important factor has been the slowing growth of multi-factor productivity.

In the decade ahead, the unfavourable demographics will pose a drag on growth in the advanced EMEAP economies, as well as in China and Thailand, and contribute less to increases in potential output for the rest. Thus, the steady expansion of the underlying working-age population can no longer be relied upon to deliver the trend growth rates seen in the past. Instead, sustainable growth has to come from productivity increases, which are, in turn, critically dependent on behavioural adaptations and policy responses. Across all EMEAP economies, firms would have to innovate and improve managerial practices, while households would need to prioritise the development of their human capital through continued education and a commitment to skills upgrading. There is scope to increase labour force participation through the hiring of women and older workers. Governments can play a key role in facilitating these adjustments by lifting spending on infrastructure, raising school enrolment rates and the quality of education, and enhancing the business climate. Beyond these initiatives, policymakers must seek to reduce barriers to technological absorption by restructuring goods and labour markets, improving the governance and legal infrastructure, and espousing pro-competitiveness policies, including in the services sectors.

A focus on the underlying real factors driving long-term growth does not preclude an enabling role for monetary policy. For economic restructuring to take place, it is critical that the macroeconomic environment remains conducive. Above all, price stability must be preserved to instil confidence in households to work and save, and to provide the assurance for firms to make longer-term investment decisions, change business processes, and engage in new lines of activity. While temporary deviations of inflation and output from their targets may be tolerated, monetary policymakers need to ensure that relative

¹ EMEAP is a cooperative forum of eleven central banks and monetary authorities in the East Asia and Pacific region comprising the Reserve Bank of Australia, the People's Bank of China, the Hong Kong Monetary Authority, Bank Indonesia, the Bank of Japan, the Bank of Korea, Bank Negara Malaysia, the Reserve Bank of New Zealand, Bangko Sentral ng Pilipinas, the Monetary Authority of Singapore and the Bank of Thailand.

price increases (or decreases) attending to the restructuring process do not become generalised and entrenched. Policymakers should also be cognisant of the risks of stoking financial excesses and stifling the process of resource re-allocation by keeping the monetary policy instrument below its equilibrium level. If structural reforms are successful and productivity growth is permanently higher, increases in aggregate demand have to be monitored carefully, given that the long-run equilibrium interest rate will have to rise. Faster productivity growth in the tradable goods sector, relative to the non-tradable sector, will also lead to an appreciation of the real exchange rate, which will need to be optimally accommodated by a combination of nominal exchange rate flexibility and some adjustments to relative costs.

In sum, central banks need to pay close attention to shifts in both supply- and demand-side factors in order to maintain macroeconomic stability, as the economy transits to a new growth regime. A discretionary approach to monetary policy, in which central banks respond pragmatically and flexibly to supply-side developments to attain price stability and growth targets, would appear to be in line with the longer-term equilibrium paths for real interest rates and real exchange rates.

1 INTRODUCTION

1.1 In the aftermath of the Global Financial Crisis (GFC), achieving sustained and balanced growth has emerged as a key preoccupation among policymakers. The recovery in the advanced economies from the crisis has been hobbled by a legacy of debt, resulting in protracted private and public sector deleveraging and sluggish aggregate demand. The attendant reduction in physical and human capital investment could even have lowered potential GDP growth (IMF, 2015). Against this backdrop, the spectre of “secular stagnation” has been raised, with major implications for emerging economies that continue to rely on exports to the industrialised countries (Summers, 2014).

1.2 Policymakers in this region have been acutely aware of the need to cultivate new engines of growth. In recent years, domestic demand has been given a boost by low interest rates and strong credit expansion, which helped to compensate for weaker exports and a decline in the terms of trade for primary commodities. Nonetheless, an over-reliance on domestic spending is unsustainable, even as the credit cycle in the region appears to have run its course, with impending monetary policy normalisation in the US.

1.3 The interaction of demand and supply forces in determining growth outcomes requires policymakers to consider factors affecting potential output growth. In this regard, neoclassical growth theory predicts that poorer countries with lower initial levels of per capita income would tend to grow faster than wealthier countries, through a process of catch-up to the technological frontier (Barro and Sala-i-Martin, 2003). Yet Agénor *et al.* (2012) presented evidence of a “middle-income trap”, suggesting that at a per capita income of about US\$16,700 (at 2005 constant prices), an economy’s growth rate typically slows. Eichengreen *et al.* (2012) found that such moderations in emerging economies were primarily caused by falling labour productivity growth, with the rate of multi-factor productivity growth decelerating by much more than capital accumulation. Developed economies are also not immune from growth traps, with many of them failing to close the productivity gap with the frontier (represented by the US). In Germany, for example, the productivity gap widened from 8% in the 1990s to 11% in the 2000s and further to 15% over 2010–13. At the frontier itself, there is a debate about whether technological progress has stalled or the digital revolution is poised to unleash further gains in productivity.

1.4 The increased uncertainty regarding trend growth rates among both advanced and emerging economies has greatly complicated the work of central banks. As a co-determinant of the output gap and inflation, the potential growth rate of an economy, together with aggregate demand, has a direct bearing on the setting of monetary policy in the short and medium run. Consequently, the nature and persistence of shocks on the supply side—such as demographic shifts and productivity disturbances—can alter the optimal path of monetary policy. By the same token, the rate of productivity growth has important implications for the long-run equilibrium exchange rate (for instance, through the Balassa-Samuelson effect).

1.5 Accordingly, this paper aims to shed light on the key supply-side drivers that determine growth potential in the EMEAP economies during the next decade. It provides a systematic assessment of the scope for demographic and non-demographic factors,

including capital deepening and economic restructuring, to contribute to higher GDP growth. The paper also addresses the broad policy priorities that are necessary for fostering future growth, with a particular emphasis on the productivity-enhancing role of human capital formation.

1.6 Section 2 begins with a brief review of recent growth and productivity trends in EMEAP economies, based on a standard growth accounting framework. Section 3 lays out a supply-side perspective on the prospects for potential growth in the medium term, using currently available projections as a basis for further discussion. Section 4 draws out the implications of possible growth trajectories for the conduct of monetary policy, seeking to identify appropriate policy responses as well as the role of monetary policy in providing a conducive environment for sustained growth to take place.

2 RECENT GROWTH AND PRODUCTIVITY TRENDS IN EMEAP

2.1 This section analyses the sources of growth in EMEAP over the period 1990–2014, distinguishing between advanced economies (Australia, Hong Kong, Japan, Korea, New Zealand, Singapore) and emerging economies (China, Indonesia, Malaysia, Philippines, Thailand).² The emphasis will be on presenting the broad stylised facts of growth among these groups, by leveraging off the comprehensive dataset compiled by The Conference Board (TCB).³

2.2 In line with global trends, the EMEAP economies as a whole grew at a relatively robust pace of 5.3% per annum in the last quarter of a century or so. Between the two income groups in EMEAP, the emerging economies have expanded faster—as postulated by standard growth models (7.4% versus 2.2%, respectively). Moreover, compared to the advanced members, the emerging economies have experienced a relatively milder growth pullback in the post-GFC period, following an exceptionally strong expansion in the 2000s.

Sources of Growth

2.3 We first identify the underlying sources of GDP growth from the supply side for individual EMEAP economies and for larger groupings, by decomposing output increases into growth in labour supply (or employment)⁴ and labour productivity growth. (Table 2.1)

Table 2.1
GDP Growth Decomposition, 1990–2014

(% p.a.)

	Average Annual Growth 1990–2000			Average Annual Growth 2001–2007			Average Annual Growth 2008–2014		
	GDP	Labour	Productivity	GDP	Labour	Productivity	GDP	Labour	Productivity
United States	3.2	0.9	2.3	2.4	0.2	2.2	1.1	0.0	1.2
EMEAP*	4.2	0.3	3.9	6.6	0.3	6.4	5.6	0.2	5.3
Advanced EMEAP*	2.6	-0.1	2.7	2.5	0.2	2.4	1.3	-0.1	1.4
Australia	3.2	0.8	2.4	3.4	1.0	2.3	2.5	0.7	1.8
Hong Kong	3.8	0.6	3.3	4.8	0.6	4.2	2.5	0.5	2.1
Japan	1.5	-0.5	2.0	1.4	-0.1	1.5	0.1	-0.3	0.4
Korea	6.6	0.7	5.8	4.8	0.2	4.6	3.1	-0.2	3.4
New Zealand	2.7	0.8	1.9	3.5	1.3	2.3	1.6	0.8	0.9
Singapore	7.0	1.6	5.4	5.9	1.0	4.9	4.6	1.4	3.2
Emerging EMEAP*	6.0	0.8	5.2	9.5	0.4	9.2	7.5	0.4	7.1
Emerging EMEAP ex-China*	4.8	1.0	3.8	5.0	1.1	3.9	4.8	0.6	4.1
China	6.8	0.6	6.1	11.6	0.0	11.6	8.4	0.3	8.1
Indonesia	4.5	1.1	3.4	4.9	1.2	3.7	5.6	0.4	5.2
Malaysia	7.1	2.1	5.0	5.0	1.0	4.0	4.5	2.0	2.5
Philippines	2.8	0.5	2.4	4.9	1.1	3.8	5.1	0.6	4.5
Thailand	5.0	0.5	4.6	5.2	0.8	4.4	2.7	0.3	2.4

Source: TCB and EPG, MAS estimates

* Weighted by corresponding EKS GDP 2014 PPP.

² This dual classification matches the World Bank's criteria for high and middle-income countries, respectively. Given China's rapid development over this period, emerging EMEAP economies exclude China, where relevant.

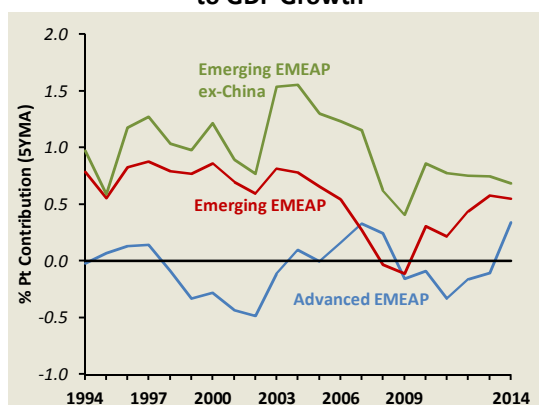
³ The primary source of the data cited in this section is TCB's *Total Economy Database*TM. This database, as well as details on sources and methodologies, is available on TCB's website: <http://www.conference-board.org/data/economydatabase/>.

⁴ In view of the lack of data on hours worked for the emerging EMEAP economies, only increases in labour supply at the extensive margin i.e., the number of workers, are considered.

2.4 Over the period from 1990 to 2014, the contribution of employment increases to GDP growth has been negligible on average for the advanced EMEAP economies and has fallen substantially in the emerging EMEAP economies. (Chart 2.1) This reflects the more rapid pace of population ageing and even labour force declines in the former. Excluding China, however, increases in labour supply still added about 0.6% point to growth in the emerging EMEAP bloc over the latest 2008–14 period.

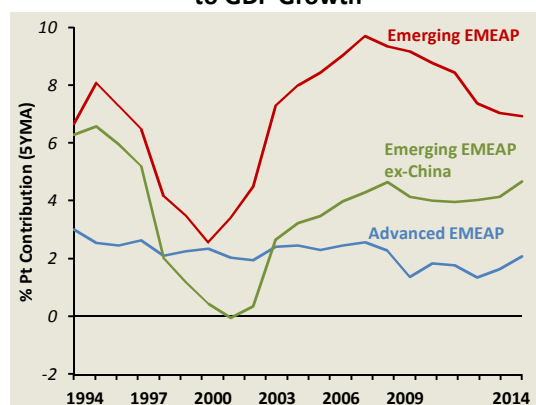
2.5 Hence, the bulk of GDP growth in the EMEAP region has originated from labour productivity improvements. Mirroring the experience of developed countries, its contribution to output growth in the advanced EMEAP members has remained relatively high at about 2½% points per annum until the mid-2000s. (Chart 2.2) Since then, productivity growth has declined, while the productivity level relative to that in the US has stagnated at about the 62% mark. (See Table A.1 in Appendix Tables.) Indeed, relative productivity levels in Australia, New Zealand and Japan have fallen slightly in the past 20 years, after rising significantly in the previous decades. However, other advanced EMEAP economies, such as Korea and Hong Kong, have been able to make steady progress in productivity convergence to the US frontier.

Chart 2.1
Contribution of Employment Growth
to GDP Growth



Source: TCB and EPG, MAS estimates

Chart 2.2
Contribution of Labour Productivity Growth
to GDP Growth



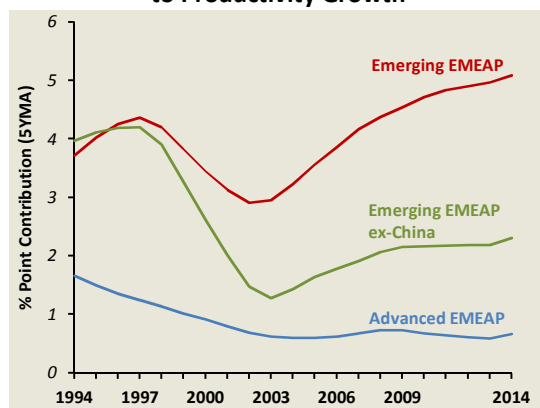
Source: TCB and EPG, MAS estimates

2.6 The emerging EMEAP economies have also generally maintained a moderate pace of convergence. After slowing down in the second half of the 1990s due to the impact of the Asian Financial Crisis (AFC) on near-term output, productivity growth in these economies picked up strongly from the early 2000s. As a result, productivity levels relative to the US improved. In particular, China's productivity rose from a mere 2.5% of the US level in the 1960s to 19% by 2014. The speed of productivity convergence with the US was also rapid in other emerging economies such as Malaysia and Indonesia.

2.7 Labour productivity growth can be further disaggregated into the following components: (i) increasing capital per worker (capital deepening) due to ICT and non-ICT investment; (ii) boosting the stock of human capital through labour quality improvements; and (iii) total factor productivity (TFP) growth. (See Table A.2 in Appendix Tables.) Of these factors, capital deepening provided the most significant contribution to productivity gains in EMEAP economies during the last two decades, with most of it due to non-ICT capital. (Chart 2.3) Nonetheless, ICT capital has emerged as an increasingly important

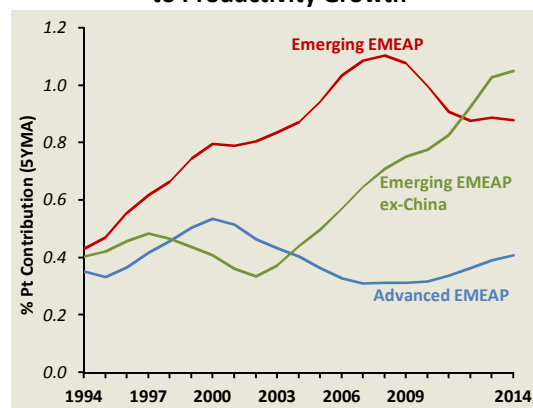
source of productivity growth, with its contribution rising more significantly in the first half of the 2000s. (Chart 2.4)

Chart 2.3
Contribution of Non-ICT Capital Deepening to Productivity Growth



Source: TCB and EPG, MAS estimates

Chart 2.4
Contribution of ICT Capital Deepening to Productivity Growth



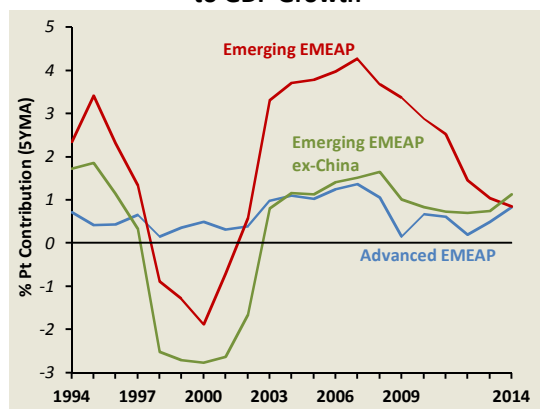
Source: TCB and EPG, MAS estimates

2.8 In emerging EMEAP, a large part of the contribution of both ICT and non-ICT capital deepening can be traced to the high investment rates in China, as the economy opened up to foreign investors and government spending on infrastructure rose. In the other emerging EMEAP economies, the more subdued pace of capital formation following the AFC was a primary factor behind their slower labour productivity growth.

2.9 Turning to multi-factor productivity, the advanced EMEAP economies recorded substantial TFP gains, alongside strong global growth in the years prior to the GFC. (Chart 2.5) In the post-crisis period, however, TFP growth slowed and accounted for only 14% of overall labour productivity growth, from 44% in the few years preceding the GFC. In emerging EMEAP, TFP growth has exhibited sharp swings. There was a significant downshift in the aftermath of the AFC, followed by a strong upturn starting from the early 2000s, which lasted until the GFC. This acceleration in TFP growth was a boon for many economies, accounting for nearly half of the labour productivity growth in China and Malaysia. However, since the GFC, the contribution of TFP growth in the emerging EMEAP economies has fallen from over 4% points to about 1.1% point in 2008–14.

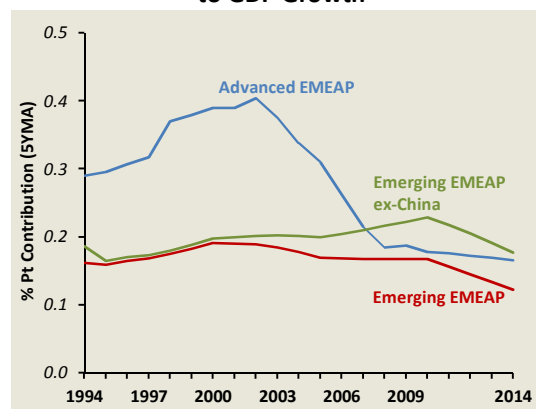
2.10 Changes in labour quality, which capture improvements in the education, skills and health of workers, have played the least significant role in explaining productivity growth in the EMEAP region. (Chart 2.6) After peaking in the late 1990s, its contribution declined in the advanced economies and it provided only a small boost of less than 0.2% point to productivity increases in the emerging economies. These findings are consistent with Jorgenson and Vu (2010), who found that hours worked were the major source of the contribution of labour input to economic growth throughout the period 1989–2008.

Chart 2.5
Contribution of TFP Growth
to GDP Growth



Source: TCB and EPG, MAS estimates

Chart 2.6
Contribution of Labour Quality Growth
to GDP Growth



Source: TCB and EPG, MAS estimates

Common Factor Analysis

2.11 The synchronisation of GDP and productivity growth amongst the emerging EMEAP economies, in particular, suggests the presence of common underlying drivers. Hence, a statistical factor analysis was performed to identify shared influences across the different groups of economies.⁵

2.12 A secular downtrend over the last few decades is evident in the estimated common factor for GDP growth in the advanced economies, consistent with the slowdown in population and productivity growth. (Chart 2.7) In comparison, the common component of GDP growth in the emerging economies appeared to have fluctuated in tandem with cyclical downturns in aggregate demand during the mid-1980s, the AFC and, more recently, the GFC.

2.13 Chart 2.8 shows that the common factor estimated for labour productivity growth differs in important ways from that for GDP growth. This factor plausibly captures the pace of global technological progress, which has declined since the GFC, as noted above.⁶ Further, the downshift in productivity growth in the emerging EMEAP economies occurred sometime around 1998, corresponding to the outbreak of the AFC.⁷ In comparison, the estimated common factor for GDP growth recovered somewhat in 2009, implying that the strong expansion witnessed after the GFC may have been supported by credit-fuelled demand rather than supply-side TFP improvements.⁸

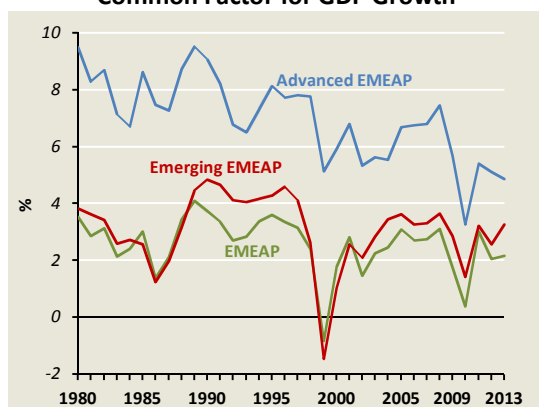
⁵ The factor model and results are described in Annex 1.

⁶ Fernald and Wang (2015), for example, identified the slowdown in TFP growth in the US as pre-dating the GFC, and attributed it almost wholly to the dissipation of ICT productivity gains.

⁷ The Bai-Perron (2003) method of testing for L+1 versus L sequentially determined breaks was used together with a 15% trimming parameter. The break in 1998 was found to be significant at the 5% level.

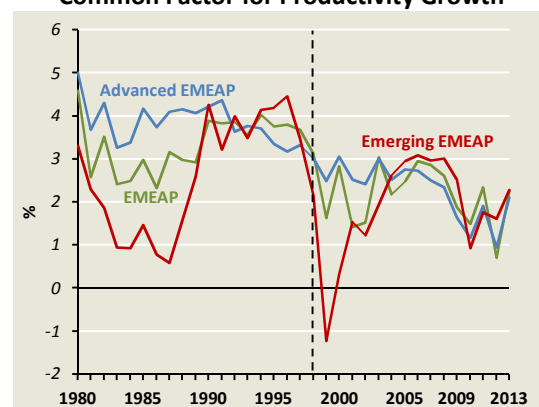
⁸ On average, the common factor for GDP growth explained 63% of the variation in growth rates in individual EMEAP economies, compared to 39% for the productivity growth common factor. In addition, both factors accounted for a larger fraction of the variation observed in small and open economies, which can be attributed to their stronger trade and investment links with the rest of the world.

Chart 2.7
Common Factor for GDP Growth



Source: EPG, MAS estimates

Chart 2.8
Common Factor for Productivity Growth



Source: EPG, MAS estimates

3 MEDIUM-TERM GROWTH POTENTIAL IN EMEAP ECONOMIES

Growth Projections

3.1 This section presents TCB's medium-term potential growth forecasts for the EMEAP economies, derived from the same accounting framework used in the previous section. (Table 3.1) Table A.3 in Appendix Tables provides the detailed projections for the various components of labour productivity growth. For the projection methodology, see Erumban *et al.* (2013).

Table 3.1
Potential GDP Growth Projections, 2015–25

(% p.a.)

	Average Annual Growth 2008–2014			Average Annual Growth 2015–19			Average Annual Growth 2020–25		
	GDP	Labour	Productivity	GDP	Labour	Productivity	GDP	Labour	Productivity
United States	1.1	0.0	1.2	2.4	0.5	2.0	1.9	0.2	1.6
EMEAP* [^]	5.6	0.2	5.3	4.5	0.1	4.4	3.4	0.0	3.5
Advanced EMEAP*	1.3	-0.1	1.4	2.2	0.0	2.2	1.8	-0.1	2.0
Australia	2.5	0.7	1.8	3.5	0.6	2.9	3.5	0.5	3.0
Hong Kong	2.5	0.5	2.1	2.1	-0.1	2.2	1.3	-0.3	1.6
Japan	0.1	-0.3	0.4	1.4	-0.3	1.8	1.1	-0.3	1.4
Korea	3.1	-0.2	3.4	3.1	0.3	2.7	2.2	-0.2	2.5
New Zealand	1.6	0.8	0.9	3.2	0.5	2.7	3.3	0.3	2.9
Singapore	4.6	1.4	3.2	2.8	0.6	2.2	2.5	0.2	2.3
Emerging EMEAP* [^]	7.5	0.4	7.1	5.3	0.1	5.2	3.9	0.0	3.9
Emerging EMEAP ex-China* [^]	4.8	0.6	4.1	4.4	0.6	3.9	4.0	0.5	3.6
Ageing*	8.0	0.3	7.7	5.4	0.0	5.4	3.9	-0.1	4.0
China	8.4	0.3	8.1	5.5	0.0	5.5	3.9	-0.1	4.0
Thailand	2.7	0.3	2.4	4.2	0.0	4.2	3.2	-0.1	3.3
Youthful* [^]	5.3	0.7	4.6	4.6	0.8	3.9	4.3	0.6	3.6
Indonesia	5.6	0.4	5.2	4.9	0.7	4.2	4.5	0.6	3.9
Malaysia	4.5	2.0	2.5	3.7	1.0	2.7	3.3	0.7	2.6
Philippines	5.1	0.6	4.5						

Source: TCB and EPG, MAS estimates

* Weighted by corresponding EKS GDP 2014 PPP.

[^] The Philippines is excluded as TCB does not provide projections for the Philippines.

3.2 Potential GDP growth for EMEAP as a whole⁹ is projected to decline gradually over the coming decade, from 5.6% p.a. in 2008–14 to 4.5% in 2015–19 and 3.4% in 2020–25. However, there are divergent trends within the region. Potential growth in the advanced EMEAP economies is expected to pick up slightly from 1.3% p.a. in 2008–14 to 2.2% in 2015–19, and stabilise thereafter. Although employment growth is expected to subtract from GDP growth in view of the ageing populations in these countries, improvements in labour productivity will more than offset this. However, the contribution from labour quality will stay stagnant as the scope for further improvements in educational attainment

⁹ The discussion on potential GDP and productivity growth in this section excludes the Philippines as TCB does not provide these projections.

of the workforce is limited. Consequently, GDP growth will be increasingly reliant on enhancements to the stock of physical capital, as well as TFP growth.

3.3 In comparison, the potential growth rate in the emerging EMEAP economies is projected to come down by 3.7% points from 2008–14 to 2020–25, reflecting several forces at play. First, a sharp decline in birth rates in the 1960s and 1970s is translating into successively smaller additions to the workforce. In particular, the demographic dividends in China and Thailand have faded, with the contribution from labour force growth expected to turn negative in 2020–25. The other emerging economies are set to see continued, albeit smaller, increases in their working-age populations (aged 15 and above). Second, there is likely to be a sharp slowdown in productivity gains in China relative to the past decade. While labour productivity growth will either be maintained or even rise in the rest of the emerging EMEAP economies, largely due to continued investment in physical capital, the impact from China will lead to a 3.3% point fall in overall labour productivity growth for the region. Third, the contribution from human capital is projected to remain small in most emerging economies, ranging from zero to 0.3% point. Finally, the contribution of TFP growth is expected to decline from 1.1% points in 2008–14 to 0.6% point in 2020–25.

3.4 TCB's projections above provide only one possible scenario for the future growth landscape in EMEAP. There are inherent uncertainties in any long-term forecasting exercise, given the difficulties in projecting the behaviour of households, firms and governments, not to mention the pace of technological progress. In a recent study, the IMF (2015) projected that the potential growth rate in emerging economies, in general, will decline further due to less favourable demographics and a slowdown in capital accumulation. Other papers, such as Lee and Hong (2010), Johansson *et al.* (2013) and Jorgenson and Vu (2010) also show significant variation in their medium-term projections, although this was due, in part, to different forecast horizons. (See Table A.4 in Appendix Tables.)

Policies to Enhance Supply-side Factors

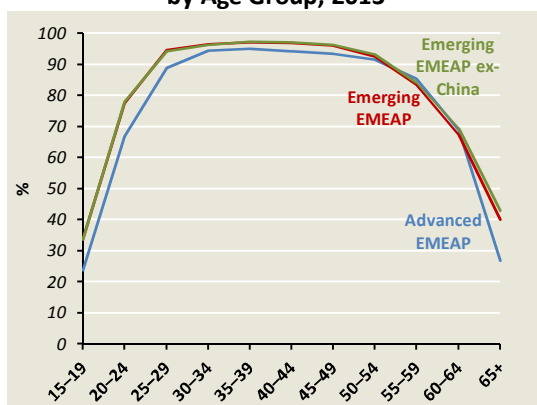
3.5 While population growth will be a key factor shaping an economy's longer-term prospects, countries facing a demographic drag can make conscious efforts to mitigate its impact. Indeed, policy measures can help to enhance supply-side factors, and thus raise potential growth rates. This section reviews these policies in the context of the EMEAP economies, with a special emphasis on the potential for human capital to boost growth.

Labour Supply

3.6 Among the various supply-side factors, trends in labour supply can be projected with a reasonable degree of confidence, as they are determined by slow-moving demographic processes. From Table 3.1, it is clear that unlike in previous decades, additions to labour will no longer play a key role in driving economic growth in most EMEAP economies in the medium term, and hence productivity improvements must take on a more prominent role. Nevertheless, there is still scope for economies facing labour shortages to supplement their workforce by encouraging behavioural changes, or through net migration.

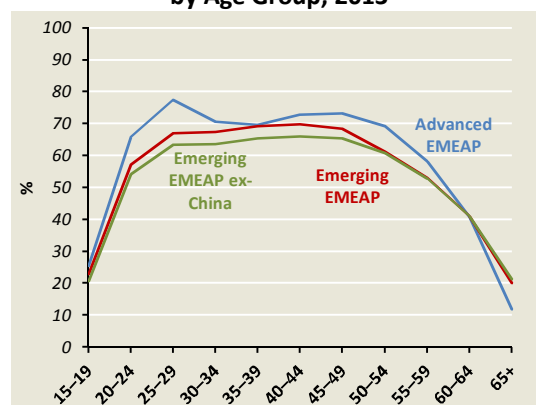
3.7 In both advanced and emerging EMEAP economies that are ageing, the key behavioural changes that can be effected pertain to human resource practices and female participation in the labour force. Policymakers have an important role to play with regard to the former—by encouraging the hiring of older and more experienced workers, for example—but more critically, through increasing the number of working years. As life expectancy continues to lengthen, there is scope to augment the labour force by raising the retirement age, particularly in Hong Kong and Australia, where labour force participation rates have fallen off sharply for workers aged 65 years and older. (Charts 3.1 and 3.2) In South Korea and Japan, there is leeway to encourage more women to join the workforce, given relatively low female participation rates, especially during child-bearing years. Both countries have recently taken steps to provide more childcare and other support for working mothers.

Chart 3.1
Male Labour Force Participation Rate
by Age Group, 2013



Source: ILO and EPG, MAS estimates

Chart 3.2
Female Labour Force Participation Rate
by Age Group, 2013



Source: ILO and EPG, MAS estimates

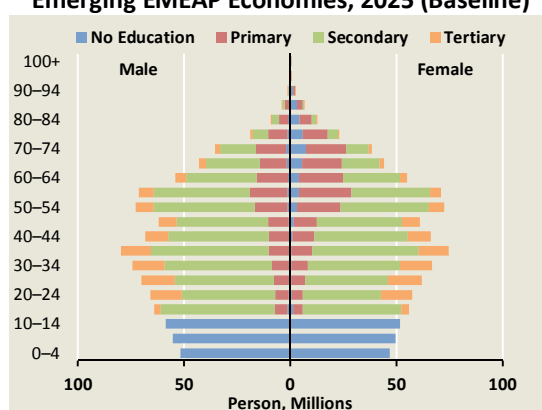
3.8 Other countries, such as Singapore, Australia and New Zealand have boosted their pool of labour through immigration, achieving net immigration rates averaging 20%, 9% and 5%, respectively, over the 2000–10 period, although Singapore has seen slower growth of foreign labour in recent years. (See Table A.5 in Appendix Tables.) In other advanced EMEAP economies, net immigration rates are low at below 1½%, while net outflows have occurred in labour-deficient emerging economies. Meanwhile, China’s move to delay its retirement age, in conjunction with *hukou* reforms, will help to raise participation rates in the near term, while the relaxation of its one-child policy last year will boost labour supply about twenty years down the road.

Human Capital

3.9 Recent research suggests that standard measures of human capital may have understated the variation in labour quality across countries and, hence, its contribution to growth. (See Annex 2.) Human capital is a key factor of production that enhances labour productivity, enables technological innovations and raises the returns to capital. In addition, the ADB found that education facilitates industrial upgrading, as a well-educated workforce is better able to assimilate the knowledge needed for the production of higher value-added goods and services (Felipe *et al.*, 2013).

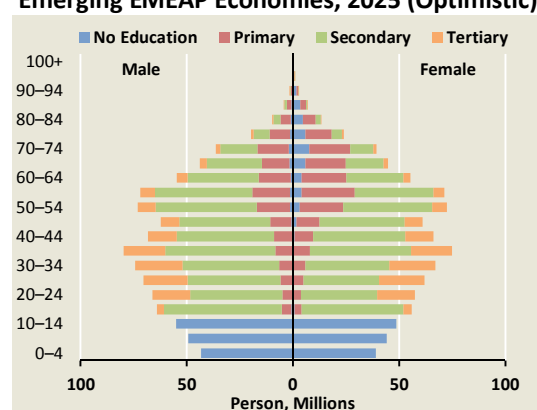
3.10 A more detailed breakdown by educational level shows that in 2010, tertiary-educated individuals accounted for 38% of the labour force in advanced EMEAP economies, compared with just 10% for the emerging EMEAP economies. Thus, the difference in human capital endowments between the two groups is even larger once schooling quality is taken into account. Projections by the International Institute of Applied Systems Analysis show that the proportion of tertiary-educated individuals in the emerging EMEAP workforce will rise to 15% on average in 2025 in the most likely scenario¹⁰, compared with 51% for the advanced economies (Samir *et al.*, 2010). (Chart 3.3) Under a more optimistic scenario¹¹ of accelerated development, the proportion of tertiary-educated workers in the emerging economies rises more quickly to 19% in 2025. (Chart 3.4)

Chart 3.3
Education Profile of Workers in
Emerging EMEAP Economies, 2025 (Baseline)



Source: Wittgenstein Centre and EPG, MAS estimates

Chart 3.4
Education Profile of Workers in
Emerging EMEAP Economies, 2025 (Optimistic)



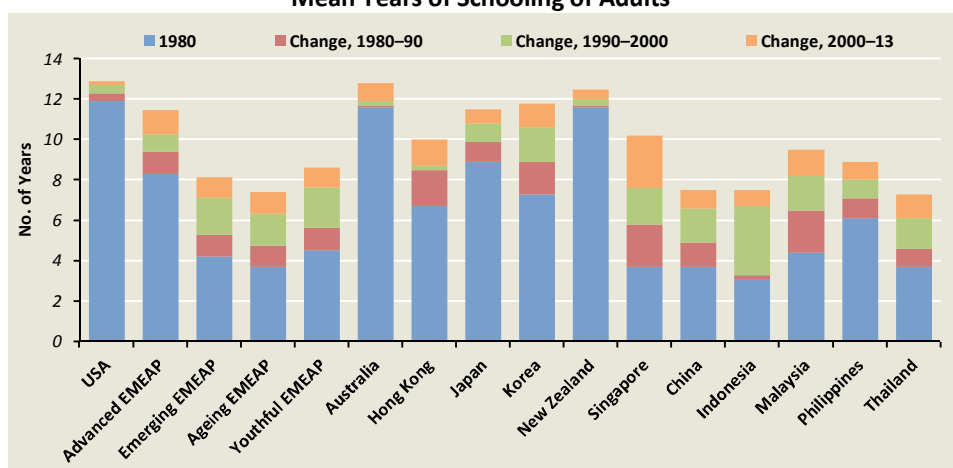
Source: Wittgenstein Centre and EPG, MAS estimates

3.11 Although the advanced economies in EMEAP have already achieved a high level of educational attainment, some of the middle-income countries have continued to lag significantly behind. (Chart 3.5) In 2013, workers in the advanced EMEAP economies have 11.5 years of schooling on average, an increase of 3.2 years from 1980. Over the same period, the emerging EMEAP economies saw a slightly more rapid increase of 3.9 years, to 8.1 mean years of education.

¹⁰ The most likely scenario assumes that a country's educational expansion will converge to a growth trajectory based on the historical global trend. Educational attainment is modelled using cubic splines, taking the rough form of an "S curve".

¹¹ The scenario of accelerated development is based, in part, on a more optimistic projection that assumes the achievement of certain milestones by all countries. The milestones are: (a) the attainment of 99% primary school education by 2015; (b) lower secondary schooling reaches 50% of each cohort by 2030 and 90% by 2050; and (c) tertiary education reaches 60% of each cohort by 2050.

Chart 3.5
Mean Years of Schooling of Adults*

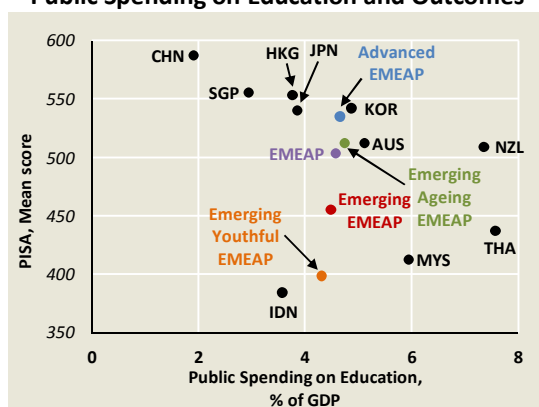


* Average number of years of education received by people aged 25 and older.
Source: UN and EPG, MAS estimates

3.12 Caselli and Ciccone (2013) report that the potential upper bound returns from raising schooling levels in developing countries to developed country standards are sizeable, with average and median income gains of 60% and 45%, respectively. Psacharopoulos and Patrinos (2004) also found that the social returns to education are higher for basic education, followed by secondary education, with countries in the middle-income bracket benefitting more than high-income countries across all education levels. In Asia, the rate of social return is about 16% for primary education and 11% for secondary and tertiary education. (See Table A.6 in Appendix Tables.)

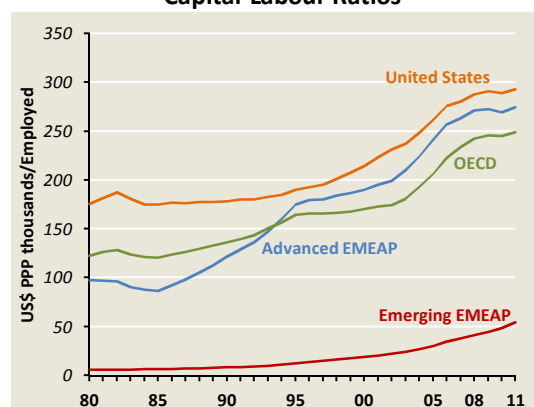
3.13 The benefit of human capital accumulation is thus especially pertinent for emerging EMEAP economies that are catching up to the technology frontier. Since the accumulation of human capital is a lengthy process, governments would need to take measures well in advance to raise secondary and tertiary enrolment rates and improve the quality of education systems and the efficiency of educational outcomes. (Chart 3.6) Although some countries have stepped up public spending on education and implemented measures to up-skill the workforce, a considerable gap in the quality of human capital remains between the advanced and emerging EMEAP economies.

Chart 3.6
Public Spending on Education and Outcomes



Source: UNESCO, OECD and EPG, MAS estimates

Chart 3.7
Capital-Labour Ratios



Source: Penn World Table and EPG, MAS estimates

3.14 Vocational education and training can play a complementary role in improving labour quality and economic growth by helping to ensure that the adult workforce, as well as each new cohort of workers, has skills relevant to an evolving economy. Research has shown that vocational education is often at least as beneficial as general education.¹²

Capital Deepening

3.15 Complementing labour inputs, physical capital accumulation has historically been a key driver of growth. Investment in machinery, equipment and buildings raises productive capacity and efficiency through embodied technology. The advanced economies in EMEAP (except for New Zealand, which has a sizeable agricultural sector) have seen substantial capital deepening over the past few decades and currently have capital/labour ratios that are close to or exceed the OECD average of US\$248,921 per worker as at 2011 (in 2005 dollars, PPP terms). In comparison, the emerging EMEAP economies have experienced much less capital deepening, with an average capital/labour ratio that is just one-fifth that of the advanced group. (Chart 3.7)

3.16 In a world of integrated capital markets, differences in the marginal return to capital should drive cross-border investment flows and facilitate convergence of capital/labour ratios. In reality, however, convergence depends critically on policy regimes, including a country's openness towards FDI and the attractiveness of the overall business climate. The average investment rate in the emerging EMEAP economies (excluding China, where it has remained high) has fallen from a peak of 36% prior to the AFC to a low of about 21% in 1999 before recovering in recent years to around 26%. There is thus considerable scope for these economies to catch up with the advanced bloc by encouraging investment from domestic and foreign firms. According to theories of endogenous growth, an accelerated pace of capital formation can sustain a permanent rise in the rate of productivity growth, and hence in GDP growth.

3.17 Governments can play an active role in raising investment in infrastructure, such as roads and ports, given their "public good" nature. Public spending on infrastructure can help to crowd in private investment by generating positive externalities, expanding investment opportunities and raising the return to capital. Infrastructural development also directly facilitates economic activity by upgrading transportation and communication links, and through the provision of power and other utilities. This, in turn, lowers production costs and increases firms' access to both domestic and external markets.

3.18 New research shows that public spending on infrastructure generates positive effects on growth, in contrast to earlier findings that it has negative effects in low- and middle-income countries.¹³ The IMF (2011) reported that increases in public capital stock are associated with higher economic growth, especially after controlling for the initial level of public capital. Additional spending has the highest impact on growth in countries where

¹² In a review of five major vocational systems around the world, Eichhorst *et al.* (2012) found evidence of the benefits associated with vocational education, including lower incidence of unemployment and increased wages, with the effects being most significant for low-ability youths and workers in low-skill jobs. Patrinos *et al.* (2006) highlighted that the return to vocational/technical qualifications exceeded the return to general secondary qualifications in some countries and that the difference could be substantial.

¹³ For instance, see Devarajan *et al.* (1996).

the public capital stock is less than 60% of GDP, with the impact diminishing beyond that threshold and falling to about zero for countries with very high public capital stock. Brooks and Go (2011) suggested that the type of infrastructure that offers the greatest contribution to growth differs according to a country's income level. This implies a hierarchy of investment priorities—communications for low-income countries, transport for middle-income ones, and a greater emphasis on energy for high-income economies.

ICT Investment

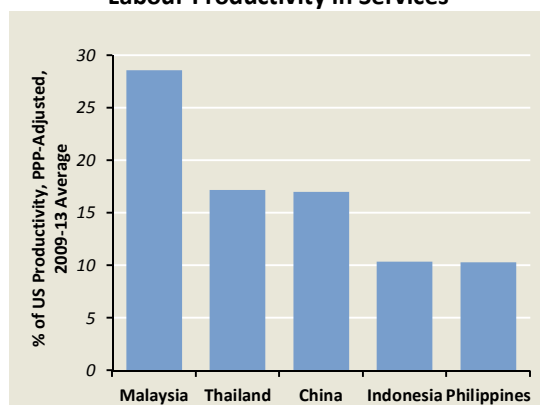
3.19 Capital deepening that is associated with the more intensive use of ICT embedded in computer hardware, software, and telecommunications equipment plays a special role in boosting labour productivity and GDP growth. Indeed, ICT is the latest example of a “general purpose technology”, or a basic enabling technology that is used in many sectors of the economy. As such, it can potentially raise productivity, not only in ICT-producing industries, but also in many ICT-using sectors in both advanced and emerging EMEAP economies.

3.20 Initially, advancements in ICT tend to induce strong productivity and output growth in industries that manufacture ICT goods. For instance, Jorgenson, Ho, and Stiroh (2002) and Oliner and Sichel (2002) attributed part of the post-1995 surge in US productivity growth to faster TFP growth in ICT-producing industries. This has the effect of lowering unit costs and prices, thus encouraging other sectors of the economy to invest in ICT equipment and software. To leverage on ICT successfully, however, firms in these sectors must typically make large complementary investments and innovations in business organisation, workplace practices, human capital, and intangible capital (Brynjolfsson and Hitt, 2003). These adjustments take time and, as such, the full impact of technological advancements percolates through to IT-using industries only after many years.

3.21 While the more mature economies in the EMEAP region have already accumulated a substantial stock of ICT assets, indicators of ICT penetration suggest that the emerging economies still lag behind. Consequently, there is scope for boosting productivity growth through increasing ICT capital inputs and accelerating the diffusion of ICT into the broader economy. This is especially true for services industries, such as retail & wholesale trade and education services, where productivity levels have remained low *vis-à-vis* the US. (Chart 3.8) Some emerging countries, such as China, have made considerable progress over the past several years, as can be seen from broadband penetration rates. (Chart 3.9) Together with increasing usage of smartphones with data plans, this could translate into a leap forward in ICT adoption in the next decade.¹⁴

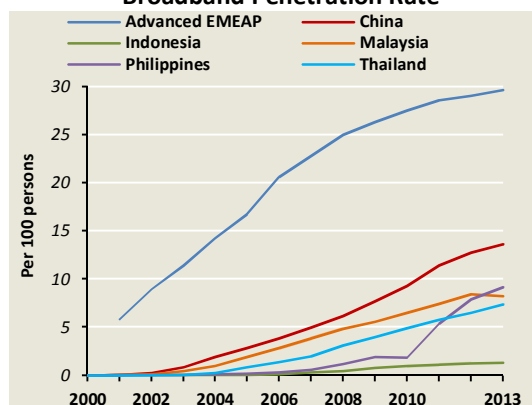
¹⁴ The recent entry of Chinese technology firms Alibaba, Lenovo, Xiaomi and Netease into the country's agricultural sector is an example of the potential of ICT to raise farm productivity. As concerns about food safety have grown among Chinese consumers, these firms are seeking to inject modern food technology into their new farming ventures. The accumulated expertise of these firms in running highly-controlled production lines, marketing and supply-chain management could potentially help to modernise Chinese agriculture and raise its productivity.

Chart 3.8
Labour Productivity in Services



Source: CEIC, Penn World Table and EPG, MAS estimates

Chart 3.9
Broadband Penetration Rate



Source: World Bank and EPG, MAS estimates

3.22 Looking ahead, policy priorities can help to enhance ICT penetration and adoption in EMEAP economies, which would generate strong externalities by improving the availability of information and fostering innovation. The government can play a key enabling role, such as in facilitating the provision of ICT infrastructure and creating a conducive business environment that encourages firms to undertake ICT investment.

Total Factor Productivity

3.23 In the next decade, gains in TFP will play an increasingly important role in driving GDP growth, especially in the advanced EMEAP economies where the labour force is shrinking and a substantial stock of human capital already exists. To sustain economic growth, these economies would have to adopt advanced technologies from the frontier, and engage in product and process innovation. The latter requires increased spending on research and development, as well as the cultivation of an ecosystem in which creativity thrives.

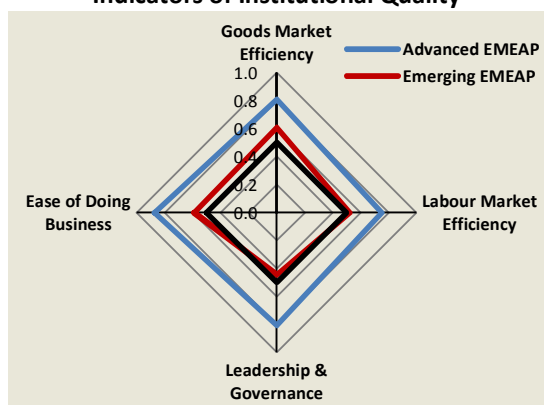
3.24 Firm-level data provides some corroboration of the complex interactions between TFP growth and other factor inputs. Studies such as Lieberman, Lau and Williams (1990) and Lazear, Shaw and Stanton (2012) found that scale factors and differences in management capabilities can be important determinants of productivity. Employing an innovative survey, Bloom and Reenen (2007) developed indicators of managerial best practices for more than 700 firms in the US, UK, France and Germany which showed that “better” management practices are strongly associated with improved firm-level performance, including productivity, profitability, Tobin’s Q and survival rates. In a subsequent paper, Bloom and Reenen (2010) extended the survey methodology to nearly 6,000 firms in 17 countries, including China, India and Brazil. Although the results were broadly similar, an important new finding is that the bulk of the difference in the average management score of a country is due to the size of the “long tail” of very badly managed firms. Accordingly, the authors highlighted the importance of enhancing product market competition, which would help to reduce the ranks of the badly-managed firms.

3.25 As for the emerging economies in EMEAP, there exists significant room to boost TFP growth through technological catch-up, given their considerable distance from the world frontier. Consequently, the focus of policy should be on reducing barriers to technological

absorption, and on using available technologies and inputs more effectively.¹⁵ Successful technology transfer usually requires upfront investment to adapt production techniques to a new environment, in addition to employing skilled manpower capable of operating them. The reduction of regulatory and legal barriers, social disorder, rent-seeking activities and corruption will also facilitate technology absorption (Parente and Prescott, 1994).

3.26 In this regard, the “reform dividend” will rise in importance even as the demographic dividend fades in most emerging EMEAP economies. Synthetic indicators show that these economies have considerable scope for making improvements in labour market efficiency, goods market efficiency, leadership and governance, and the ease of doing business. (Chart 3.10) Opening up protected industries to investment, including from foreign firms, and regulatory changes that raise competition are tremendously beneficial for growth (Manyika *et al.*, 2014). Although the impact of structural and institutional reforms on TFP growth may be weak, or even negative, in the short term due to adjustment costs, they have significant positive effects in the long run (Salgado, 2002).

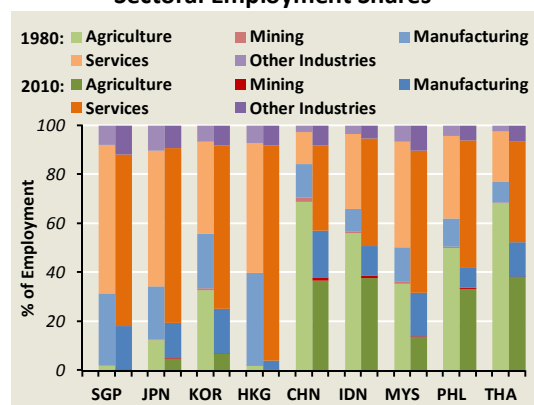
Chart 3.10
Indicators of Institutional Quality



Source: World Bank, World Economic Forum and EPG, MAS estimates

Note: The black line indicates a score of 0.5, which is the median score.

Chart 3.11
Sectoral Employment Shares



Source: Groningen Growth and Development Centre and EPG, MAS estimates

3.27 Another potential source of TFP gains in the emerging economies comes from economic restructuring. In particular, countries with a sizeable agricultural sector, such as Thailand and Indonesia, can achieve productivity gains by reallocating labour from agriculture to more productive sectors, such as manufacturing. (Chart 3.11) Although agricultural employment has already fallen markedly over the past two decades in these countries, its share in total employment remains high compared to advanced economies, such as Korea and Japan.

¹⁵ Comin *et al.* (2006) constructed direct measures of technology adoption for approximately 75 different technologies, and showed that the cross-country differences in technology are approximately four times larger than cross-country differences in income per capita.

4 MONETARY POLICY IMPLICATIONS

4.1 The future trajectory of potential output in EMEAP economies has important implications for the conduct of monetary policy, since the balance between aggregate demand and supply capacity will ultimately determine inflation outcomes over the medium run. However, as discussed earlier, considerable uncertainty exists as to the magnitude and direction of aggregate supply shifts at any point in time arising from ongoing developments in the economy, including technological changes as well as structural reforms and other capacity building measures undertaken by the region's governments. As these ongoing developments can impact productivity growth with a lag, they may pose particular challenges for the conduct of monetary policy during the transition stage.

4.2 We will make some tentative observations on how monetary policy can facilitate non-inflationary growth as an economy undertakes structural reforms to raise supply capacity. It is important to note that during the transition phase, shifts in aggregate demand can arise as expectations of future income are revised. The optimal responses of monetary policy to permanent aggregate supply shocks driven by productivity or demographic shifts are then examined.

Role of Monetary Policy During Transitions (Aggregate Supply Shifts)

4.3 In an economy undergoing restructuring, unfolding shifts in supply-side factors underpinning growth, and their persistence, are difficult to ascertain. Nonetheless, monetary policy plays an important role in providing a stable macroeconomic environment during the transition towards sustained productivity-driven growth, so that microeconomic structural reforms that enhance the efficiency of the economy can be carried out more effectively and smoothly. There is a widely-held belief that "reforms tend to make things worse before they make them better," although empirical evidence suggests that the short-run costs were often overstated (Rodrik, 1996). Measures to break up monopolies and raise competition in product and labour markets, for example, can lead to a temporary rise in unemployment and fall in inflation as inefficient firms are weeded out. Other reforms that involve cutbacks in subsidies or lifting of price controls can entail a transitional period of higher costs and inflation.

4.4 Although the long-term benefits are unambiguous, the short-term macroeconomic impact of structural reforms depend critically on how they are implemented—namely, the credibility of reforms, the type of reforms and their interaction with other policy measures. Well-designed reforms can in fact have a "largely neutral, if not positive impact on short-term demand," even under adverse cyclical conditions (Draghi, 2015). In general, it is important for central banks to instil confidence in households and businesses that overall price stability will continue to prevail in the medium term. This will provide much needed assurance to private agents so they can go about making the appropriate savings and investment decisions.

4.5 It is inevitable that relative prices will adjust during a period of reform. Price changes serve as important signals that facilitate the reallocation of resources and should thus be allowed to filter through to the rest of the economy. In the interim, output gaps could emerge and inflation may deviate from its target. While the central bank should

“look through” these shorter-term developments and not aim to bring inflation back to its historical level immediately, vigilance is needed to ensure that consumer price increases or decreases do not become entrenched through “second-round” effects, and that inflationary expectations remain anchored.

4.6 The pragmatic approach to monetary policy described above can be encapsulated in a Taylor rule. In response to a negative supply shock that raises inflation but lowers output, for example, the Taylor rule prescribes a policy path that ultimately restores inflation to its long-run target, but does so only gradually to avoid sharp swings in output. In essence, the same principle applies to a transitory and positive supply shock, such as a one-off rise in productivity, which may temporarily reduce inflationary pressures.¹⁶

Role of Monetary Policy During Transitions (Aggregate Demand Shifts)

4.7 If structural reforms turn out to be successful, the economy may experience a rise in productivity and output growth. What should be the response of monetary policy in the transitory period before such a scenario fully materialises? A case in point was the surge in productivity (positive supply shock) in the US during the late 1990s, following the widespread adoption of IT in the workplace. Blinder and Yellen (2001) suggested that the Federal Reserve, under Greenspan, had recognised higher productivity growth, and thus held interest rates steady despite a booming economy and falling unemployment that normally would have triggered a tightening of monetary policy—what they termed as “forbearance”. In retrospect, this policy proved to be appropriate as the positive productivity shock raised potential output and hence reduced the output gap, thus lowering the path of inflation.

4.8 However, Buiter (2000) argued that an increase in the growth rate of trend productivity has no straightforward implications for inflation and the path of nominal interest rates consistent with the inflation target, even in the short run. While higher productivity growth may indeed raise potential output, lower inflation is expected only if current output remains constant. But stronger productivity growth often raises aggregate demand as well, and thus the inflation outcome ultimately depends on whether current output or potential output moves more.

4.9 Once an improvement to the supply side is anticipated (whether or not it is realised), demand is likely to be boosted, at least in the near term. This happens through higher investment in new technology, without which the supply-side improvement is unlikely to be realised, or an increase in consumer demand in anticipation of future income gains, such as via the positive wealth effects stemming from higher stock market valuations. Thus a positive supply-side shock could expand demand by more than supply initially (i.e., current output increases more than potential output), so policymakers need to be vigilant to short-term inflationary pressures that may arise, as a standard Taylor rule would dictate.

¹⁶ Note that, unlike a demand shock, Blanchard and Gali’s (2007) “divine coincidence” does not hold in the case of a transitory supply shock, which compels the central bank to stabilise either economic activity or inflation, but not both.

Longer-term Monetary Policy Issues Amid Permanent Shifts in Productivity Growth

4.10 In standard growth models of the Solow-Swan or Cass-Koopmans varieties, a sustained increase in productivity growth would lead to a permanent rise in the equilibrium real interest rate because the higher returns arising from the increase in productivity will raise the marginal product of capital. From the loanable funds perspective, a higher real interest rate is required to bring about a rise in savings to meet the increase in demand for capital assets. Hamilton *et al.* (2015) found that the equilibrium real interest rate is indeed positively linked to potential output growth, although the correlation is not strong and varies over time. The equilibrium real interest rate is also impacted by other factors, such as changes in the rate of time preference, financial regulation, and asset price bubbles.

4.11 A permanent decline in potential output growth presents more of a challenge to monetary policy-makers. If the economy is confronted with a demographic drag or a slowdown in TFP growth, for example, the equilibrium long-run real interest rate falls. Depending on the extent of the decline, such an event could pose a problem for the operation of monetary policy due to the zero lower bound (ZLB) on nominal interest rates. In order for policy to be effective, the central bank would need to lower the policy rate to a level below the natural rate, but it would ultimately run into the ZLB constraint. This dilemma has led some observers to suggest that central banks consider raising their inflation targets if secular stagnation materialises (Blanchard *et al.*, 2010).

4.12 Long-lasting supply-side shocks also have implications for equilibrium exchange rates. A positive and sustained productivity shock could imply a stronger equilibrium real exchange rate in the long run, alongside a larger current account surplus. The Balassa-Samuelson framework is useful here, especially when non-tradable sectoral developments become an important adjunct to demand rebalancing in EMEAP economies.¹⁷ In this model, stronger productivity growth in the tradable sector drives up aggregate wage growth in the overall economy. Rising wage costs in the non-tradable sector, amid lagging productivity gains, may then exert upward pressure on the overall rate of inflation. In the absence of a pick-up in productivity growth in the non-tradable sector, or a compensating supply-side shock, monetary tightening may be needed to moderate the impact on inflation. More generally, an appreciation of the real exchange rate, while helping to facilitate the demand rebalancing process, may lead to other effects such as a loss of export competitiveness that policymakers might be concerned about. Further, policymakers need to decide how to optimally accommodate the real appreciation through a combination of nominal exchange rate changes and relative cost adjustments.

4.13 The setting of the nominal policy instrument plays an important role in accommodating the shift in the equilibrium value of the real interest rate or real exchange rate. Nevertheless, monetary policy settings interact in complex ways with relative price changes in the economy to bring about the required shifts in equilibrium real rates. Such shifts will only come about if central banks respond optimally to developments in their

¹⁷ On equilibrium exchange rates, Choudhri and Khan (2004) found strong evidence of the Balassa-Samuelson effect based on a panel of 16 economies including Malaysia, Singapore, Korea and the Philippines. Using the US as the reference country, the authors concluded that US-EME country differences in the relative prices of non-traded goods and the terms of trade are significant determinants of the real exchange rate in the long run.

target variables over time as the economy transits to its supply-side determined steady-state growth path. Conversely, attempting to substitute an under-valued currency for real productivity growth in a small open economy setting, for example, will not be optimal, either in transition or in the long run. The appreciation of the currency not only caps inflation but provides an important inducement for firms to increase productivity and to change structurally.

4.14 Finally, the GFC vividly illustrates that suppressing the interest rate at below its equilibrium level for an extended period can lead to a build-up of speculative excesses and asset price bubbles even though inflation may not rise appreciably. Low borrowing costs could also divert resources away from productive uses and reduce the efficiency of investments. The subsequent bursting of the bubble can hamper investment due to the debt overhang, heightened risk aversion and an impaired financial system. A very low interest environment can thus have the perverse effect of lowering potential growth by channelling investment into speculative activities during the credit boom phase and depressing investment overall after the bubble had burst.

4.15 Further, some have argued that another channel through which excessively loose monetary policy may lower potential growth is by perpetuating the survival of inefficient firms. In the absence of comprehensive structural reforms, a prolonged period of monetary accommodation may give rise to “zombie” firms, while discouraging the formation of new and more productive companies. Thus, the undesirable mix of firms in the distorted economy—with inefficient firms crowding out more efficient ones—can lead to a collapse of TFP growth (Hoshi and Kashyap, 2004).

Sum-up: A Pragmatic Approach to Monetary Policy Responses

4.16 In general, the optimal response of monetary policy in the short term to supply-side changes is not straightforward due to the difficulty in discerning the nature and persistence of shocks. The effects of demographic and productivity forces on potential output can work in opposite directions, complicating the monetary policy response. In addition, these uncertainties are compounded by interaction effects between supply shifts and components of aggregate demand, such as investment and consumption spending. Accordingly, it is important for central banks to continuously monitor a wide range of high-frequency indicators, given the potential for incorrect assessments of the economy’s potential.

4.17 A judicious combination of supply-side accommodation and demand-side management is often needed. A policy that “looks through” temporary supply shocks is not without risks, as persistent accommodation of relative price adjustments could lead to an unhinging of inflation expectations. In addition, a positive productivity shock, even if transitory, is often associated with rising corporate profits and a strong asset market response, with an accompanying surge in credit. Thus, the authorities need also be alert to potential financial stability risks, which may require a complementary response from macroprudential tools. Similarly, for the emerging economies in EMEAP, improved growth prospects may attract large capital inflows, resulting in rapid appreciation of the exchange rate in the short run. Again, this presents challenges for central banks.

4.18 While Mankiw (2001) noted that “how best to handle supply shocks is a topic about which economists disagree”, mainstream economic thought has shifted towards a mix of tolerance and calibrated action. Consideration of the specific type and persistence of a supply shock matters, as does whether they are “pure” or accompanied by demand changes, when formulating the appropriate monetary policy response. A discretionary approach to monetary policy, in which central banks respond pragmatically to supply-side developments to attain their price stability and growth targets, would appear to be in line with the longer-term equilibrium path for real interest rates and real exchange rates. In other words, a period-by-period optimisation strategy would appear consistent with the achievement of a dynamically optimal monetary policy.

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Appendix Tables

Table A.1
Labour Productivity Levels Relative to the US

(% of US)

	1963–70	1980–89	1990–99	2000–09	2010–14
United States	100.0	100.0	100.0	100.0	100.0
EMEAP*	30.3	43.6	42.7	35.6	33.0
Advanced EMEAP*	39.0	56.5	64.2	63.3	63.9
Australia	75.7	81.1	81.0	79.9	78.6
Hong Kong	25.4	46.0	62.9	63.6	69.7
Japan	32.3	57.2	67.5	65.5	63.5
Korea	9.4	18.8	30.4	40.2	48.9
New Zealand	74.1	65.6	67.6	62.4	59.1
Singapore	38.6	63.4	74.1	81.3	87.9
Emerging EMEAP*	7.4	9.7	11.7	13.2	18.3
China	2.5	3.7	5.3	9.5	16.9
Indonesia	10.8	14.0	16.5	16.0	18.8
Malaysia	25.5	36.7	45.1	47.0	47.0
Philippines	17.4	16.9	13.2	12.8	14.2
Thailand	8.2	13.2	19.8	20.8	22.5

Source: TCB and EPG, MAS estimates

Note: Figures for overall EMEAP and the advanced EMEAP economies are based on GDP per hour, while those for emerging EMEAP economies are based on GDP per employed person.

* Weighted by corresponding EKS GDP 2014 PPP.

Table A.2
Productivity Growth Decomposition, 1990–2013

(% Point Contribution)

	Average Annual Growth 1990–2000				Average Annual Growth 2001–2007				Average Annual Growth 2008–2014			
	Labour Quality	ICT	Non- ICT	TFP	Labour Quality	ICT	Non- ICT	TFP	Labour Quality	ICT	Non- ICT	TFP
United States	0.2	0.9	0.7	0.6	0.2	0.6	0.7	0.8	0.1	0.4	0.3	0.3
EMEAP*	0.3	0.5	2.4	0.7	0.2	0.7	2.5	2.9	0.1	0.7	3.7	0.8
Adv EMEAP*	0.3	0.4	1.3	0.6	0.3	0.3	0.7	1.1	0.2	0.4	0.7	0.2
Australia	0.3	0.6	0.7	0.8	0.2	0.9	1.4	-0.2	0.2	0.7	1.9	-1.0
Hong Kong	0.1	0.5	3.0	-0.3	0.1	0.4	1.3	2.5	0.1	0.3	1.1	0.5
Japan	0.3	0.3	1.2	0.1	0.2	0.2	0.3	0.8	0.1	0.3	0.1	0.0
Korea	0.7	0.6	1.3	3.3	0.5	0.4	1.0	2.6	0.2	0.4	1.0	1.7
New Zealand	0.4	0.8	0.4	0.2	0.4	0.6	1.3	0.0	0.3	0.7	0.7	-0.8
Singapore	0.5	0.9	3.1	0.8	0.4	0.5	1.0	3.0	0.3	0.4	2.7	-0.2
Emerg EMEAP*	0.2	0.6	3.7	0.8	0.2	1.0	3.8	4.2	0.1	0.9	5.0	1.1
China	0.2	0.7	3.8	1.4	0.2	1.2	4.8	5.5	0.1	0.9	5.8	1.2
Indonesia	0.2	0.2	3.3	-0.2	0.2	0.5	2.2	0.9	0.2	1.1	2.9	1.0
Malaysia	0.3	1.3	3.0	0.3	0.2	0.8	1.0	1.9	0.2	0.9	1.5	0.0
Philippines	0.1	0.4	1.8	0.1	0.2	0.6	1.6	1.3	0.2	1.0	2.0	1.4
Thailand	0.2	0.4	4.7	-0.7	0.3	0.5	1.5	2.0	0.3	0.7	1.5	0.0

Source: TCB and EPG, MAS estimates

* Weighted by corresponding EKS GDP 2014 PPP.

Table A.3
Contribution of Productivity to GDP Growth, 2015–25*

(% Point Contribution)

	Contribution to Annual Growth 2008-2014			Contribution to Annual Growth 2015-2019			Contribution to Annual Growth 2020-2025		
	Labour Composition	Capital Services	TFP	Labour Composition	Capital Services	TFP	Labour Composition	Capital Services	TFP
United States	0.1	0.7	0.3	0.2	1.0	0.2	0.1	1.4	0.1
EMEAP*^	0.1	4.4	0.8						
EMEAP ex Phl*	0.1	4.4	0.8	0.1	5.0	0.9	0.1	2.8	0.6
Advanced EMEAP*	0.2	1.1	0.2	0.2	1.4	0.6	0.2	1.3	0.6
Australia	0.2	2.6	-1.0	0.2	2.7	0.3	0.2	2.3	0.5
Hong Kong	0.1	1.4	0.5	0.1	1.9	0.3	0.1	1.5	0.0
Japan	0.1	0.4	0.0	0.2	0.7	0.8	0.1	0.6	0.7
Korea	0.2	1.5	1.7	0.2	1.4	0.4	0.2	2.0	0.3
New Zealand	0.3	1.4	-0.8	0.3	2.1	0.9	0.3	1.5	1.1
Singapore	0.3	3.1	-0.2	0.3	3.4	0.5	0.3	1.4	0.6
Emerging EMEAP*	0.1	5.9	1.1						
Emerging EMEAP ex Phl*	0.1	6.0	1.1	0.1	6.3	1.1	0.0	3.2	0.6
Ageing*	0.1	6.4	1.1	0.1	6.7	1.2	0.0	3.3	0.7
China	0.1	6.7	1.2	0.1	7.0	1.2	0.0	3.3	0.7
Thailand	0.3	2.1	0.0	0.4	2.1	0.3	0.3	2.9	0.1
Youthful*^	0.2	3.6	0.9	0.2	4.0	0.6	0.2	3.0	0.4
Indonesia	0.2	4.1	1.0	0.2	4.1	0.7	0.2	3.2	0.5
Malaysia	0.2	2.3	0.0	0.2	3.5	0.1	0.2	2.4	0.0
Philippines	0.2	2.9	1.4						

Source: TCB and EPG, MAS estimates

* Weighted by corresponding EKS GDP 2014 PPP.

^ There are no projections for the Philippines.

Table A.4
Comparisons of Potential GDP Growth

(%)

	Conference Board		ADB		OECD		Jorgenson & Vu (2010)
	2015–19	2020–25	2011–20	2021–30	2015–19	2020–25	2009–19
China	5.5	3.9	6.1	5.0	6.3	4.5	7.5
Hong Kong	2.1	1.3	4.4	2.8			3.3
Korea	3.1	2.2	4.4	3.4	3.6	2.9	4.8
Singapore	2.8	2.5	5.2	3.3			2.2
Indonesia	4.9	4.5	4.7	4.1	5.7	5.5	4.0
Malaysia	3.7	3.3	5.5	4.8			5.5
Philippines			6.0	5.5			3.8
Thailand	4.2	3.2	4.0	3.6			2.7
Australia	3.5	3.5			3.4	3.4	1.9
New Zealand	3.2	3.3			2.6	2.6	0.9
Japan	1.4	1.1			0.8	1.1	0.1
Asia	4.3	3.9					6.1
OECD					2.5	2.3	
World	3.3	2.7			3.7	3.3	3.0

Source: TCB, ADB, OECD and Jorgenson and Vu (2010)

Table A.5
Net Migration Rate

(%)

	1980–85	1985–90	1990–95	1995–2000	2000–05	2005–10
Advanced EMEAP*	3.6	3.8	4.8	6.3	5.6	6.0
Australia	6.0	8.1	4.0	5.6	6.7	10.6
Hong Kong	3.2	5.7	5.2	18.5	–1.2	1.3
Japan	0.4	–1.0	0.7	0.0	1.0	0.7
Korea	1.6	2.1	–2.9	–2.3	–0.4	1.4
New Zealand	–0.2	–0.6	6.7	2.3	6.7	2.9
Singapore	10.8	8.4	15.3	13.8	20.7	18.8
Emerging EMEAP*	0.5	1.1	–0.7	0.6	0.8	–0.2
China	–0.1	0.0	–0.1	–0.1	–0.4	–0.3
Thailand	1.4	1.9	–3.8	2.0	3.4	–2.2

Source: UN and EPG, MAS estimates

*Computed as the simple average of the economies in the grouping.

Table A.6
Returns to Investment in Education

(%)

	Social Returns			Private Returns		
	Primary	Secondary	Higher	Primary	Secondary	Higher
World	18.9	13.1	10.8	26.6	17.0	19.0
Asia*	16.2	11.1	11.0	20.0	15.8	18.2
Industrialised Countries**	8.5	9.4	8.5	13.4	11.3	11.6
Per Capita Income Group						
Low-income	21.3	15.7	11.2	25.8	19.9	26.0
Middle-income	18.8	12.9	11.3	27.4	18.0	19.3
High-income	13.4	10.3	9.5	25.6	12.2	12.4

Source: Psacharopoulos and Patrinos (2004b)

* Non-OECD countries.

** Industrialised countries include Japan and exclude the Republic of Korea.

Annex 1: Dynamic Factor Model

The dynamic factor model (DFM) adopted in this note is based on Stock and Watson (1989). DFMs are flexible models for multivariate time series in which unobserved factors have a vector autoregressive structure. Generally, a DFM decomposes the dynamics of the dependent observable variables, $y_{i,t}$, into the sum of two unobservable components: one that affects all the y 's (the factors f) and the other that is idiosyncratic or specific to each i , as shown below:

$$y_{i,t} = a_i + b_i f_t + \varepsilon_{i,t}$$

In this equation, a_i is the constant and b_i is the exposure or loading of the variable to the common factors. By construction, all co-movements in the data arise from these unobserved factors.

In the DFM, both the factor and idiosyncratic components in the model follow autoregressive processes of order q and p , respectively, as given in the following equations:

$$f_t = \phi_{0,1} f_{t-1} + \dots + \phi_{0,q} f_{t-q} + u_{0,t}$$

$$\varepsilon_{i,t} = \phi_{i,1} \varepsilon_{i,t-1} + \dots + \phi_{i,p_i} \varepsilon_{i,t-p_i} + \mu_{i,t}$$

The innovations from these equations are independent and identically distributed over time and across i , and are uncorrelated with each other. Estimation of the DFM is via maximum likelihood, in which the log-likelihood function is implemented in state-space form and derived using the Kalman filter.

To gauge how well the estimated common factors explain GDP and labour productivity growth in individual EMEAP economies, the results from linear regressions are shown in the table below. It is apparent that a larger proportion of output growth can be explained by the common factor, compared to productivity growth. In addition, both factors account for a larger fraction of the variation observed in small and open economies, due to their stronger trade and investment links with the rest of the world. In comparison, the output and productivity growth of large economies, such as China, Japan and Indonesia, seemed to be more influenced by domestic idiosyncratic factors.

Explanatory Power of Common Factors

(%)

	GDP Growth		Productivity Growth
Australia	75.0	Australia	59.8
Singapore	73.7	Japan	57.4
Malaysia	71.4	Hong Kong	52.4
Thailand	68.4	Malaysia	50.8
Hong Kong	64.1	Thailand	47.5
Philippines	60.0	Singapore	47.2
Indonesia	57.7	China	31.2
Japan	56.1	Indonesia	24.2
China	51.0	New Zealand	12.8
New Zealand	48.9	Philippines	10.3
Average	62.6	Average	39.4

Note: The figures are the uncentred coefficients of determination in regressions of GDP and productivity growth on the estimated common factors.

Annex 2: Recent Studies on the Contribution of Human Capital to Growth

Early growth accounting studies found that differences in the growth rates of capital accumulation do not account for the most significant part of cross-country income differences (Solow, 1956). In a seminal paper, Lucas (1988) extended the definition of capital to include both physical and human capital as key inputs to output growth. Following Lucas' lead, an empirical study by Mankiw, Romer and Weil (1992) concluded that human capital made a far larger contribution to explaining the differences in income levels across countries.

In recent years, researchers have yet again attempted to resuscitate the view that variations in capital stock are central to income differences by exploring alternative ways of modelling the effects of schooling on growth, while taking into account potential feedback effects. This box provides a brief summary of the results of three recent papers in this vein. Notably, they arrive at the same conclusion: once indirect effects and heterogeneity are taken into account, human capital is still a significant force in the determination of economic growth.

The first paper by Madsen (2014) is based on an extended version of the Nelson-Phelps (1966) model, which treated the accumulation of human capital as a means through which technology advancement translates into productivity increases and economic growth. In the model, two main components drive productivity growth. The first is the gap between the "technology frontier" and the current level of productivity in a given country—the bigger the disparity, the more room for the country to catch up to the frontier and hence the faster the rate of productivity growth. However, this catch-up is conditional on countries having the second component—sufficient human capital, or "absorptive capacity", to adopt new technologies.

Using a newly constructed data set for 21 industrialised countries over the period 1870 to 2009 and controlling for the endogeneity between schooling and growth, Madsen finds that education has played a significant role in increasing productivity, albeit mostly through the second channel of raising the absorptive capacity of human capital. This finding lends support to the existence of an indirect benefit from education in aiding countries to catch up to the technology frontier. On average, this indirect effect contributes 0.59% point to annual productivity growth, which translates into a 127.4% rise in labour productivity levels over the period 1870 to 2009. In comparison, the direct growth effect of improvements in educational attainment is more modest compared to the frontier catch-up effect. Changes in educational attainment only contributed 0.12% point per annum to labour productivity growth, or a compound increase of 18.9% between 1870 and 2009.

The second paper by Manuelli and Seshadri (2014) constructs a general equilibrium model that explicitly models the process of human capital accumulation as a standard income-maximization problem, following the framework established by Becker (1964) and Ben-Porath (1967). In their model, individuals choose the optimal level of schooling, or the quantity of human capital (measured by number of years of schooling), as well as the quality of human capital (measured by schooling and post-schooling training expenditures as a fraction of output) in response to broader macroeconomic conditions. The authors find that, holding measures of innate ability and schooling levels constant, the elasticity of

human capital quality with respect to TFP may be sizeable. The parameters of the model are then calibrated such that the steady-state features of the model are consistent with those observed in the United States. Although the model over-predicts educational attainment for wealthier countries and is less successful at explaining schooling expenditures for very rich or very poor countries, its predictions generally fit the empirical data well. As an additional robustness check, the wage return to education predicted by the model of 7.3–9.0% for each additional year of schooling is close to previous estimates obtained from Mincerian regressions (approximately 10%). The relative success of the calibrated model in matching real-world data leads the authors to conclude that “a large fraction of the cross-country differences in output are due to differences in the quality of human capital”.

The third paper by Jones (2014) relies on the “development accounting” approach as the framework of analysis, but constructs the measure of human capital stock in such a way that it differentiates between skilled workers and unskilled workers. The development accounting method traditionally expresses the entire human capital stock in terms of “unskilled worker equivalents”, which requires converting each worker type into an equivalent amount of unskilled labour using their relative wages. This in turn imposes several assumptions, chief among which is the condition that the output of unskilled workers is a perfect substitute for other workers’ output. Jones points out that this assumption is problematic for two reasons: (a) it rules out the possibility that the marginal product of unskilled workers might be higher when they are scarce; and (b) it ignores the existence of complementarities between unskilled and skilled workers, whereby the presence of skilled workers could increase the marginal product of the unskilled worker. The exclusion of these effects may result in a downwardly biased measure of the human capital stock and hence, underestimation of true human capital differentials between countries.

To address the problem, Jones constructs a “Generalized Division of Labor” (GDL) measure of human capital stock which allows for imperfect substitution between different types of human capital, thereby making the marginal product of a worker vary with relative supply and the size of complementarities with other worker types. Using the GDL measure, Jones found that physical and human capital inputs played a substantially bigger role in accounting for income differentials, with most configurations of the model showing that factor inputs explained more than half of the variation in income across countries. However, he cautions against interpreting these results as lending support to the notion that raising educational levels will be a panacea for low-income countries, since the quantity of education *per se* may not be the crucial factor in raising productivity. Without raising the productivity of skilled workers, increasing their numbers through more schooling may not boost (and could even reduce) aggregate income, since the resulting decline in the relative price of skilled services could outweigh the benefits of increased output.