03 April 2009
Economics Research
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A demographic perspective of economic growth

Demographics Research

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Growth Accounting approach: Linking GDP Growth and Demographics

- We examine the links between demographics, labour force and GDP growth and use a version of growth accounting to construct GDP scenarios for selected countries. Recent academic research has highlighted the decomposition of GDP growth into (i) working age population growth (ii) labour productivity growth and (iii) labour utilization growth.

- Historical analysis of the three GDP growth components for selected countries (US, Japan, France, UK, Korea and Turkey) over long periods shows that working age population growth and labour productivity growth have been the important drivers of GDP growth.

- Our US-Japan comparative case-study over 1951-2008 illustrates the varied dynamics of the growth components. While, working age population growth along with labour productivity growth have been important drivers behind US real GDP growth, labour productivity growth has been the most dominant factor underlying Japanese GDP growth (particularly post-1973).

- We believe that emerging market economies will benefit from greater growth potential owing to both higher working age population growth and higher labour productivity growth than developed economies. The experiences of Turkey and Korea 1970-2008 in Exhibit 9 support that.

- The combined interaction of all three labour-force related growth components needs to be evaluated for GDP growth prospects. Growth rates rather than levels of labour productivity and working age population are important for potential GDP growth.

- Historical analysis of growth components for six countries guided us in constructing scenario based projections over 2009-18. Our favoured scenario, conditional on increased working lives through labour reform, yields the following 2009-2013 GDP annualized growth rates: France 1.84%, Japan 1.09% , South Korea 5.13%, Turkey 3.75% , UK 2.37% and US 2.49%

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Demographics and Economic growth

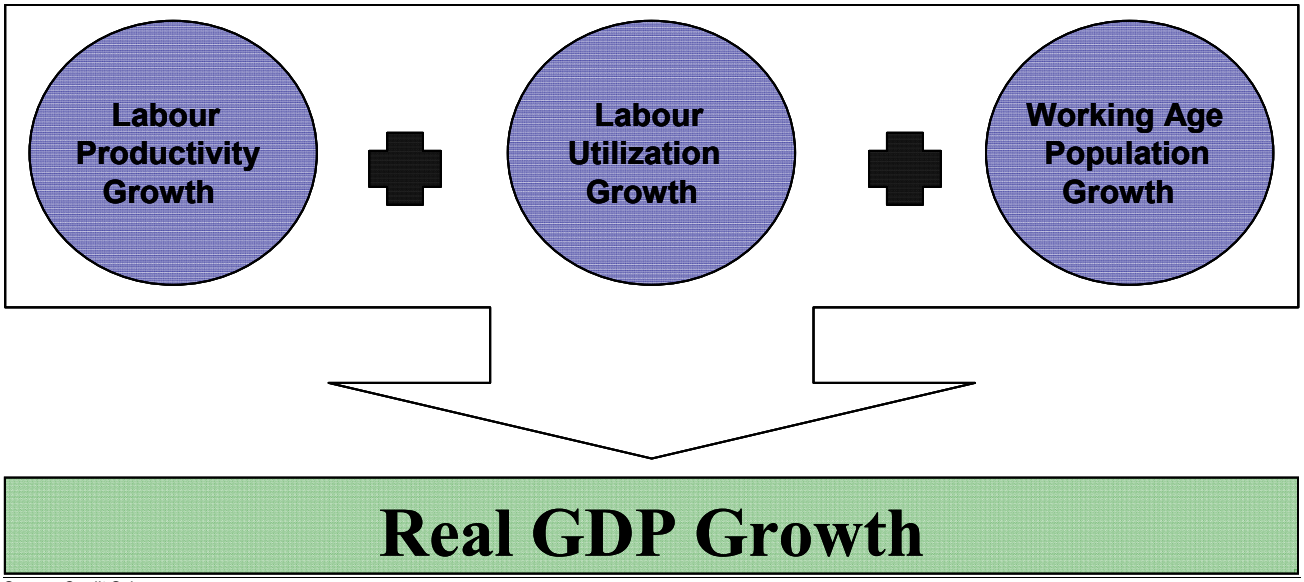
In this paper, we analyze linkages between economic growth and demographics for six countries (US, Japan, UK, France, S. Korea and Turkey). We examine how much of GDP growth can be explained by changes in the labour force structure. We conduct a comparative case study of US and Japan. We use our analysis to provide scenario-based forecasts of real GDP growth rates for countries until 2017.

Linking growth with demographics: Growth Accounting

Growth Accounting is a field of macroeconomics that grew along with the modern growth theory of Solow (1957) with an empirical bias to account for GDP growth by its factor decomposition. The value of growth accounting[1] is to break down aggregate GDP growth into contributions from input growth. It has been used since the 1960s to understand input contributions to economic growth.

Economic historian Angus Maddison[2] who is known for charting very long histories of economic growth across many countries of the globe developed a variant of growth accounting for Asian and Western economies. His version of growth accounting is used to study comparative economic development and growth in a historical context. In fact Maddison states "National Accounting, International Income comparisons and historical demography originated in the 17th century when the art of reasoning by figures on things relating to government" was called Political Arithmetik. Political Arithmeticians were also the pioneers of demography. Maddison attributes the post-1973 US and Europe differences to hours worked and employment policies which affected labour force participation rates too.

Although there are many variants of GDP growth accounting, we base our approach on the ECB paper by Maddaloni et. al. (2006) which decomposes GDP growth into three growth components as given below.



Source: Credit Suisse

[1] See Barro and Sala-i-Martin (1995) classic text on Economic Growth. Growth accounting has been used by OECD, Groningen Center and other macroeconomics centers to understand the contributors to economic growth.

[2] The World Economy (2006) Vol 1: A Millennial Perspective and the Summers-Heston data set (1995) incorporate many of the comparative growth revisions based on Growth Accounting that Maddison conducted .

The flow diagram identifies real GDP growth as the sum of growth in (i) labour force productivity (ii) labour force utilization and (iii) working age population, i.e., demographic factors.

Maddaloni et al[3], state that growth accounting is useful for analyzing medium- to long-term developments in real GDP and supply-side factors. Growth accounting has also received increasing attention from policy makers. The equations underlying the Maddaloni framework are presented in Appendix I.

We believe that understanding past growth patterns provides guidance for an appreciation of the effects of demographics on GDP growth. We use the real GDP series from the Groningen Growth and Development Centre (GGDC)'s Total Economy Database. The GDP numbers are presented at constant 1990 US dollars converted at "Geary-Khamis" purchasing parities. The Geary-Khamis dollar is a hypothetical unit of currency that has the same purchasing power as the US dollar at a given point in time, in this case 1990. It is based on the Purchasing Power Parity (PPP) concept as well as the average level of international commodity prices. It is used to make cross-country and inter-temporal comparisons.

It is however important to highlight that growth accounting has several limitations. One of the main ones is that it is a mechanical exercise that decomposes GDP growth into several contributions from inputs and technology. It does not provide a theory of growth as it does not explain how changes in inputs and factor productivity improvements relate to fundamentals such as preferences, technology and government policies.

It is well known that real GDP growth patterns vary across countries and over time. More country-specific details on declining GDP periods, maximum and minimum growth periods as well as standard deviation bands for each of the countries are in Appendix II, Exhibits 17-22. Academic researchers who have studied the GDP growth performance of the "Asian Tiger" countries in the 1990s attribute at least a third of their GDP growth to their favourable demographics. This theory is known as the "demographic dividend"[4] theory.

Basic decomposition of real GDP growth rates yields the following equation[5]:

$$g_Y = g_{WAP} + g_{LP} + g_{LU}$$

where subscripts Y, LP, LU and WAP denote real GDP, labour productivity, labour utilization and working age population.

Case study: US vs. Japan

Takatoshi Ito (1992) states that the period 1950-1973 in Japan was one of 10 percent-plus growth based on exports and productivity increases. But post-1973 Japanese growth averaged half of the previous quarter's growth. Employment and hours contributed 15% of the average growth rate of 8.81% (1953-71) in Japan. Over the same period, in the US employment had a higher percentage contribution (than in Japan) towards GDP growth of 4% while hours worked had a negative growth contribution. The red line in Exhibit 5 tells the same story. Hours worked and allocation of labour from agriculture to manufacturing contributed to Japanese growth in the 1950s and 1960s. Capital accumulation and technological progress were also contributors to Japanese growth and get reflected in labour productivity in Exhibit 3.

Academic studies, notable amongst them Prescott and Hayashi (2002) called the period of 1990s Japan's "lost decade" and attributed the slowdown to declining labour productivity.

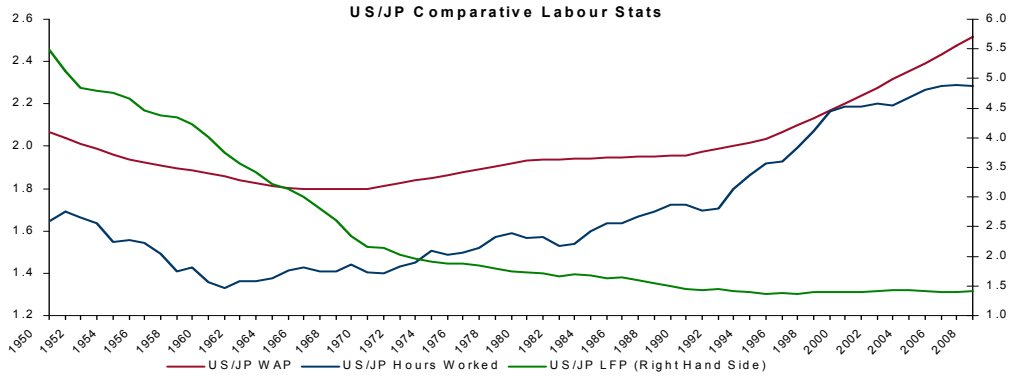
[3] This builds on the Growth Accounting framework paper by Musso and Westerman (2005) which decomposes the factors contributing to GDP growth finding that total factor productivity growth explains more than half of real GDP growth.
[4] Lee & Mason (2006), Bloom, Canning & Sevilla (2005) are two of a few important studies that present evidence of the "Demographic Dividend" across many countries.
[5] Equivalent to the flow chart presented above.

While trend growth was positive, declining contributions towards growth of labour as well as productivity accounted for the 0.5% annual growth of GNP per person in the 1990s.

We compare the GDP growth experiences of US and Japan over the 1950-2008 period. Although the GGDC database for the US and Japan goes back to 1950, there are some gaps between 1950 and 1960 for data on Japanese hours worked. We get around that issue by interpolating the data for the period with gaps.

The evolution of the three underlying factors (in relative terms, US/Japan) which influence the growth components i.e., working age population, hours worked and labour force productivity is displayed in Exhibit 1. It is important to note that these factors are fundamental to deriving growth rates which contribute to real GDP growth but are not identical to them, they are ratios of levels. We argue later that it is growth rates of the contributing factors that are more important to understand relative to GDP growth trends.

Exhibit 1: Comparative Labour Ratios: US/Japan (1950-2008)



Source: Credit Suisse, GGDC & Conference Board

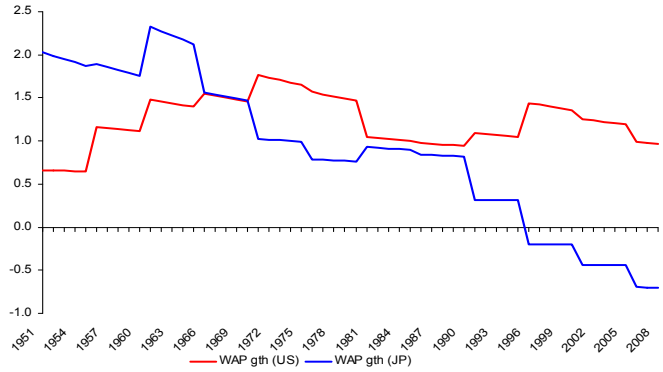
The upward trend in working age population and hours worked in the US relative to Japan and the downward trend of labour force productivity are very clear since the mid-1960s. The ratio of hours worked in the US relative to Japan troughs in the early 1960s whereas the working age ratio troughed in the late 1960s.

The working age population ratio lags the fertility rates of 20 years prior; the sharp drop in fertility rates in Japan in the 1950s at a time that the US was experiencing a baby-boom is reflected in the chart above.

We chart the relative differences (US vs. Japan) across real GDP growth and the underlying growth components below.

Exhibit 2: Working Age Growth: US vs. Japan

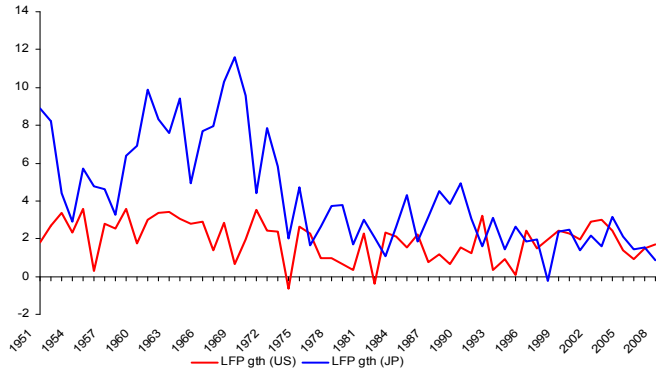
1951-2008 (growth rates)



Source: Credit Suisse, UN

Exhibit 3: Labour Productivity Growth: US vs. Japan

1951-2008 (growth rates)

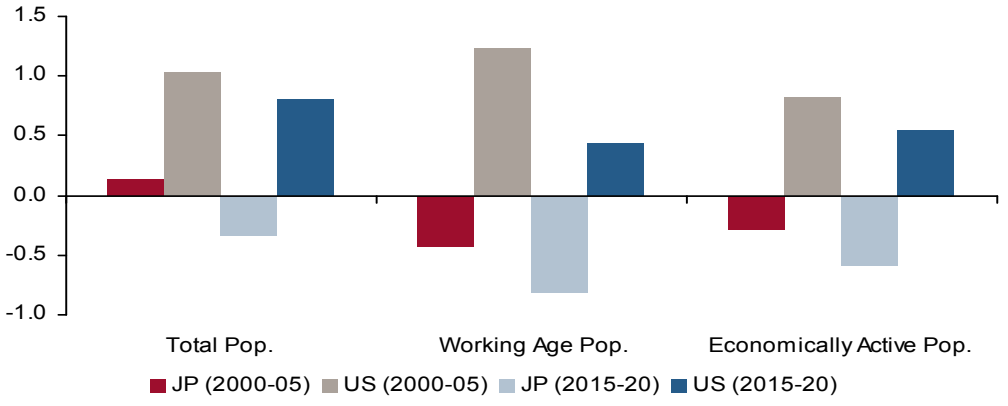


Source: Credit Suisse, GGDC & Conference Board

Note the dramatic divergences between Japan and the US post-1991 in terms of working age population growth in Exhibit 2. Low fertility rates and insular labour markets in Japan explain why the blue line (Japan) trends downwards relative to the red line (US). Labour productivity in Japan had however been consistently higher than that of US until the mid 1990s (Exhibit 3) after which prolonged recessionary and deflationary conditions have impacted on productivity.

Exhibit 4 illustrates that there are differences across growth rates of: total population growth, working age population (15-64 year olds) and economically active population growth (ILO definition). It is therefore important to clarify which growth rate is used.

Exhibit 4: Population & WAP Annual Growth Rates: 2000-20



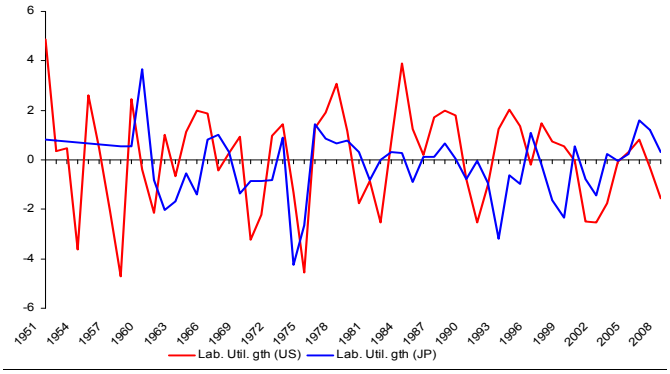
Source: Credit Suisse Demographics Research, UN, ILO

Note that Japan shows negative trends across all three definitions but the numerical differences are not minor.

Exhibit 5 displays the higher volatility of labour utilization growth rates in Japan, swinging between positive and negative growth rates. The volatility of the US labour utilization growth rates has clearly been lower than that of Japan. Exhibit 6 displays the real GDP growth rates highlighting that over the 1950s, 1960s and 1970s Japan exhibited a higher growth rate than the US. Over the entire 58 year period, Japan averaged a real GDP growth rate of 5.01 % versus the US's 3.24 %.

Exhibit 5: Labour Utililization Growth: US vs. Japan

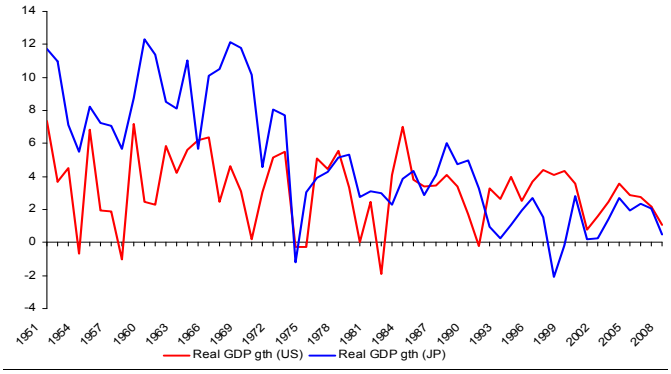
1951-2008 (growth rates)



Source: Credit Suisse, GGDC

Exhibit 6: Real GDP Growth: US vs. Japan

1951-2008 (growth rates)



Source: Credit Suisse, GGDC, UN

We discuss below in greater detail the components of real GDP growth. Exhibit 7 below presents summary statistics for the full period and two sub-periods.

Exhibit 7: GDP Growth components: US vs. Japan

Annual growth rates and percentage contributions

		US				JP			
Period		**WAP**	**LP**	**LU**	**Real GDP**	**WAP**	**LP**	**LU**	**Real GDP**
1951-73	Average Growth Rate (%)	1.26	2.54	0.06	3.86	1.77	7.02	0.10	8.89
	Contribution (%)	*32.6*	*65.8*	*1.6*		*19.9*	*79.0*	*1.1*	
1974-2008	Average Growth Rate (%)	1.21	1.53	0.09	2.83	0.31	2.46	-0.31	2.46
	Contribution (%)	*42.7*	*54.0*	*3.3*		*12.6*	*99.9*	*-12.5*	
1951-2008	Average Growth Rate (%)	1.23	1.93	0.08	3.24	0.89	4.27	-0.15	5.01
	Contribution (%)	*37.9*	*59.6*	*2.5*		*17.7*	*85.2*	*-2.9*	

Source: Credit Suisse, GGDC & Conference Board

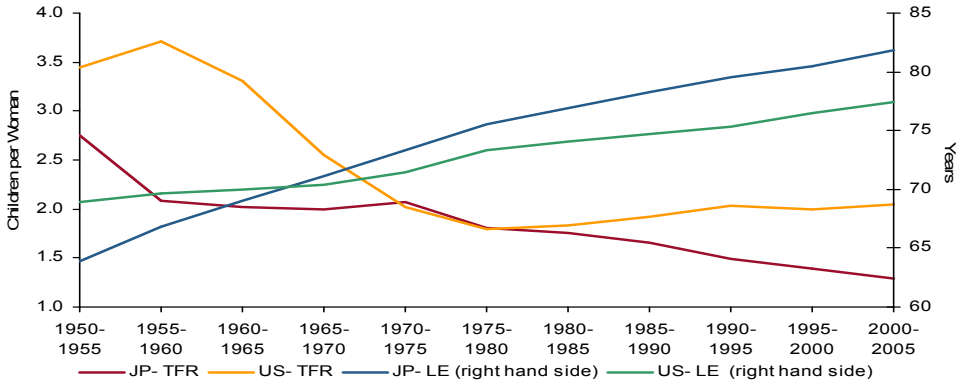
(i) Working Age Population Growth

For the entire period, Japan had a lower working age population growth (0.89%) than the US (1.23%). Note how important the contribution of working age population growth is to US Real GDP growth. Maddaloni et. al. attribute a major portion of US GDP growth difference over the Euro-area growth to this factor too.

Over the 1974-2008 period, the US had higher working age population growth (1.21%) than Japan (0.31%). This was in contrast to the 1950-73 period when Japan had a higher working age population growth. This factor is a big determinant of growth differences between the two countries. The sharp differences are more noticeable over the over 1974-2008 where Japan's working age population growth declines dramatically relative to the first sub-period 1951-1973 whereas the US's declines negligibly. This reflects the effects of the dramatic fertility declines and life expectancy increases shown in Exhibit 8 combined with open immigration policies.

Exhibit 8: Total Fertility Rate (TFR) and Life Expectancy (LE)

US vs. Japan: 1950-2005



Source: Credit Suisse Demographics Research, UN

(ii) Labour productivity Growth

For the whole period 1951-2008, Japanese Labour Productivity growth (4.27%) was more than double the rate of the US (1.93%). Also, note the higher contribution of labour productivity to GDP growth over the whole period and the overwhelming contribution over the 1974-2008 period. Over the 1974-2008 period, Japan (2.46%) exhibited higher labour productivity growth than the US (1.53%).

(iii) Labour utilization growth

Labour utilization is defined (see Appendix I for equations) as hours worked divided by working age population. Its growth rate can be negative because of a combination of a decrease in hours worked or increase in working age population. An alternative characterization expresses labour utilization as (average hours worked) times (1-unemployment rate) times (participation rate). Therefore, a decrease can come about due to a combined net decrease across the three multiplicative factors.

For the whole period, Japanese labour utilization growth was slightly negative (-0.15% p.a.) compared to slightly positive for the US (0.08% p.a.). This factor has the smallest contribution of all the three.

Over the 1951-73 sub-period, Japanese labour utilization growth (0.10%) was slightly higher than US's (0.06%) but in the next sub-period it dropped dramatically. Over the 1974-2008 period, US labour utilization growth is positive (0.09%) in contrast to Japan's which was negative (-0.31% p.a.). The average hours worked per person in the US has been uniformly lower than in Japan from the 1970s onwards. There has been some recent convergence over the last few years.

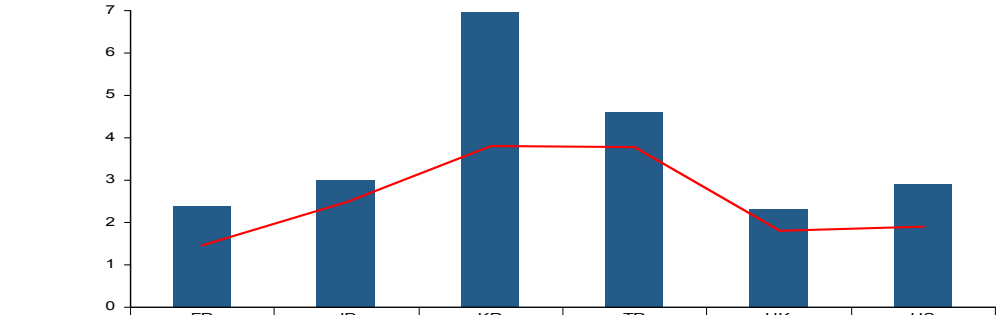
A very recent academic working paper (Casey Mulligan, 2009) looking at the 2008 recession finds that neither productivity shocks or wealth and intertemporal substitution effects can explain the recession as well as a reduction in labour supply and/or an increase in labour market distortions. The paper suggests sticky real wages as a possible cause. The 2008 recession was different from previous severe recessions as productivity growth was normal while labour supply shifted to the left. Tax distortions, wealth effects and intertemporal substitution effects are important determinants of relative shifts in skilled and unskilled labour supply. While analyzing five recessions since the 1970s, Mulligan notes that both the quarterly and monthly changes in the consumption-leisure ratio show a larger and more severe decrease in the 2008 recession.

Understanding Historical Growth patterns

We wish to see how past economic growth data conforms to the growth accounting framework presented above over 1970-2008. As Exhibit 9 shows the average growth rates of the two emerging markets countries (Korea[6] and Turkey) are clearly very different than those of the four advanced economies. Their standard deviations too are also nearly an order of magnitude larger. Note that the world's largest two economies, the US and Japan grew faster since the 1970s than the UK and France. Also, Turkey experienced much lower and more volatile growth than Korea over the full sample period.

Exhibit 9: Real GDP growth summary statistics (1970--2008)

Annual averages (%),



	FR	JP	KR	TR	UK	US
Mean	2.40	3.00	6.95	4.60	2.33	2.90
Std. Dev.	1.47	2.48	3.82	3.77	1.79	1.90

Source: Credit Suisse Demographics Research, GGDC & Conference Board

Exhibit 10 presents basic statistics showing differences in summary statistics of real GDP growth components across these countries, including their trend, volatility and skew.

Exhibit 10: Growth rates-- Working age population, Labour productivity & Labour utilization

Summary statistics: each decade & full sample

Period	Statistics	WAP	LP	LU	WAP	LP	LU	WAP	LP	LU
			FR			JP			KR	
1970-79	Mean	0.82	3.91	-1.13	0.96	4.62	-0.48	3.03	4.60	1.56
1980-89	Mean	0.87	2.81	-1.48	0.87	2.82	0.01	2.51	4.88	0.10
1990-99	Mean	0.30	1.89	-0.36	0.16	2.26	-0.97	1.24	5.41	-0.65
2000-08	Mean	0.53	1.27	0.12	-0.50	1.87	0.21	0.58	4.16	0.19
1970-2008	Mean	0.63	2.50	-0.73	0.40	2.92	-0.32	1.87	4.77	0.30
1970-2008	Std. Dev.	0.29	1.61	1.42	0.63	1.87	1.25	1.02	2.75	2.94
1970-2008	Skweness	0.32	0.74	-0.99	-0.46	1.66	-1.15	-0.04	-0.02	-1.10
			TR			UK			US	
1970-79	Mean	2.64	4.13	-1.23	0.24	3.34	-1.23	1.61	1.71	-0.14
1980-89	Mean	2.73	3.25	-1.72	0.38	2.27	-0.25	1.05	1.30	0.64
1990-99	Mean	2.45	1.66	-0.29	0.24	2.33	-0.50	1.20	1.56	0.29
2000-08	Mean	1.89	4.15	-1.25	0.63	2.13	-0.25	1.16	2.01	-0.85
1970-2008	Mean	2.44	3.28	-1.12	0.37	2.53	-0.56	1.26	1.64	0.01
1970-2008	Std. Dev.	0.34	4.72	1.78	0.24	1.41	1.93	0.26	0.98	1.87
1970-2008	Skweness	-0.76	-1.15	-0.21	-0.20	-0.23	-0.31	0.47	-0.38	-0.36

Source: Credit Suisse Demographics Research, UN, GGDC & Conference Board

[6] It is worth noting that the major country index providers are divided about whether Korea is an emerging market country or a developed one from an investment perspective. Korea has OECD status though.

The three components of GDP growth—working age population growth, labour productivity growth and labour utilization—vary over periods and across countries. The last row of means lists the full-sample mean and we can observe differences across the US, UK and Japan. There are significant divergences of means across the decades and countries. The data suggest that the dynamics of not only GDP growth but also the components of economic growth varies across countries and over time.

(A) Working age population growth: High in the US and emerging countries, all of which have benefited from high fertility rates. The US has also benefited from increased immigration.

Higher fertility rates, labour market and pension reform, selective immigration policy can all enhance or contribute to working age population growth. Average fertility rates as well as life expectancy determine the potential working age population. Fertility rates of a given year operate with a lag of nearly 20 years allowing for a transition from birth to working age. Retirement age, tax and benefit policies also influence the working age population. Openness to immigration has helped some economies deal with decreasing population and work force pressures e.g. Germany, Italy and Switzerland.

(B) Labour productivity growth: Korea in line with the demographic dividend theory saw labour productivity grow faster than in the other five countries. Turkey also displays a high productivity growth contributing to the increased growth rates over last eight years. There are notable divergences across countries and different periods. Education, learning by doing, training programmes, technological advances, skills transfers can all contribute towards higher labour force productivity growth.

(C) Labour utilization growth: This factor shows the most divergence in terms of growth rates. Over the full sample, US and Korea have positive growth rates with the rest of the countries experiencing negative growth rates.

Conclusions from this section for all the countries: Labour market growth components are important to gauge potential growth and thereby relative economic competitiveness of countries. EM countries have higher potential growth starting from low levels on all three labour components—working age population, productivity and utilization.

Scenario Analysis

Having examined the past trends for the three components of real GDP growth, our interest was in using the past trends as guidance to look at certain medium-term scenarios over the next 10 years. We constructed three scenarios to generate real GDP growth rates by aggregating the three components to arrive at real GDP growth rates over 2009-2018. We caution against using our numbers on a short-term basis without reflecting forecasts of each component on a much shorter time horizon.

Labour market policies, inflation, asset prices, exchange rates, technology policy etc are just few of the factors that would influence shorter term growth numbers. Credit Suisse's regional economics teams may provide better guidance on short run growth numbers. An alternative approach that might work during trending periods is forecasting statistically the three components and then aggregating to get real GDP growth numbers. Our scenarios are listed below. The values of growth inputs vary across each country but our assumptions are common across all the countries.

- Scenario I: We take the average growth rate(s) for labour productivity and labour utilization over the 19-year period (1990-2008) in combination with interpolated forecasts of working age population growth to create projections of GDP growth for 2009-2018.
- Scenario 2: We assume labour productivity and labour utilization growth numbers (from the last year of negative GDP growth) hold true in 2009 with working age population growth same as in Scenario 1. For 2010 and 2011, we take the labour utilization and

productivity growth numbers to be the same as for the two-years after the last year of negative GDP growth for that country. From 2012 onwards, the labour utilization and productivity growth numbers are identical to those used over same period in Scenario 1.

- Scenario 3: We assume that working age population growth numbers now pertain to an extended working life of 15-69 years instead of 15-64. The labour productivity growth and labour utilization growth numbers are identical to those in Scenario 1.

Our results are presented in Exhibit 11 below. We also present the past growth rates alongside for comparison. For Scenario 1, note that Japan and Turkey are projected to grow much slower, at an annual rate lower by 1% than their average growth over 2001-08.

The other countries exhibit a slight slowdown in their 5-year average growth rates. The Scenario 2 growth rates are uniformly lower than Scenario 1 reflecting our assumption of a global slowdown in 2009 and a negative GDP growth recession in these countries.

We acknowledge that while this is a simple overall assumption it may not be very appropriate for Korea and Turkey which see a slowdown but not negative GDP growth.

Scenario 3 is a definite improvement on Scenario 1 as it allows for extended work lives and higher working age population growth. Scenario 3 relies on the concept of increased working lives, a concept that has been advocated by Credit Suisse (2000), Munnell et al (2008), Taylor (2008), OECD (2006), Reday-Mulvey (2005) and the European Commission (2006).

Finally, we caution that policies may influence immigration, taxes, benefits in the short term as well as the medium term. Therefore monitoring and assessing the policy impact on components would be important from an investment perspective.

Exhibit 11: Real GDP Growth – actual and scenarios

Average Annual Numbers (percentage)

	Actual							Scenarios					
	1971-75	1976-80	1981-85	1986-90	1991-95	1996-00	2001-08	2009-13			2014-18		
								I	II	III	I	II	III
FR	3.31	3.04	1.50	3.14	1.15	2.77	1.68	1.52	1.18	1.84	1.36	1.36	1.60
JP	4.44	4.29	3.32	4.52	1.51	0.97	1.42	0.72	0.46	1.09	0.72	0.72	0.77
KR	9.35	6.82	7.78	9.56	7.52	4.28	4.53	5.04	3.75	5.13	4.48	4.48	4.70
TR	7.21	2.75	4.66	5.78	3.16	4.04	4.56	3.69	2.33	3.75	3.33	3.33	3.44
UK	2.12	1.79	1.93	3.27	1.64	3.17	2.35	2.18	1.23	2.37	2.06	2.06	2.08
US	2.64	3.70	3.10	3.22	2.45	4.02	2.16	2.28	1.87	2.49	2.03	2.03	2.23

Source: : Credit Suisse Demographics Research, UN, GGDC & Conference Board

For historical and future decomposition of the factors (using Scenario 1) please see Exhibits 12 - 17 below for the selected countries that we examine. The bar charts present the factor growth rates for each of the three factors over the following periods: 1970-1979, 1980-89, 1990-1999, 2000-2008 and Scenario 1 based forecasts 2009-2018. The black line connects the GDP growth averages over the same periods. One observation is that labour utilization growth has not been a positive contribution for most countries and most periods. We also see that labour force productivity growth and working age population growth contributed in a major way to GDP growth.

Conclusion

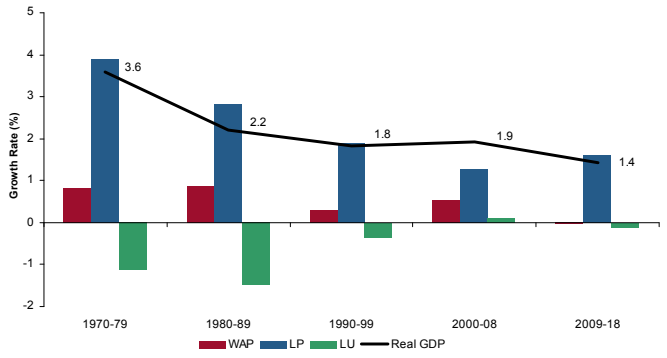
The contribution of this paper is methodological and is intended to clarify simple components of real GDP growth that can be monitored by analysts and investors. We emphasize that growth rates, rather than levels, of labour productivity, working age population and labour utilization are important to monitor. This can help make better absolute and relative forecasts of real GDP growth rates in the medium term and with incorporation of short-term outlook and variables, also in the shorter term 1-2 year horizon. As we go through the recent credit crisis, labour and consumer characteristics of workers and people need to be monitored better. These in turn are influenced by demographics.

Emerging markets have higher potential contributions from labour force due to their higher unemployment rates, growth in working age populations as well as the productivity gains resultant from the transition from agriculture to first manufacturing and then the services sector. Japan and other aging countries with low fertility rates combined with increased life expectancy (Germany, Italy, Switzerland) need to increase the contributions towards growth of labour productivity and working age population. An objective towards stable labour force utilization would also help the short- and medium-term growth prospects.

Tax policy, labour market flexibility, immigration policies, and legislative actions are also important in helping countries achieve a stable GDP growth path.

Exhibit 12: France (2009-2018 Projections)

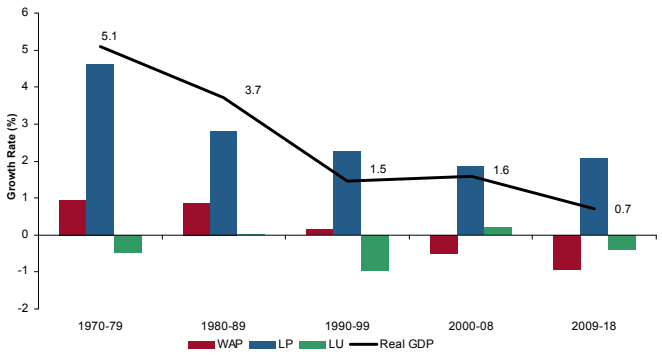
Projections based on Scenario I



Source: Credit Suisse Demographics Research, GGDC & Conference Board, UN

Exhibit 13: Japan (2009-2018 Projections)

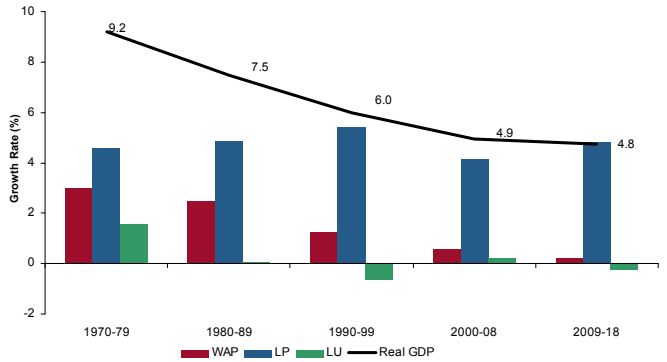
Projections based on Scenario I



Source: Credit Suisse Demographics Research, GGDC & Conference Board, UN

Exhibit 14: S. Korea (2009-2018 Projections)

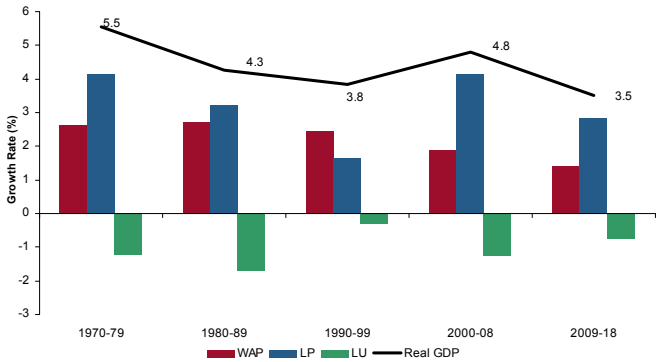
Projections based on Scenario I



Source: Credit Suisse Demographics Research, GGDC & Conference Board, UN

Exhibit 15: Turkey (2009-2018 Projections)

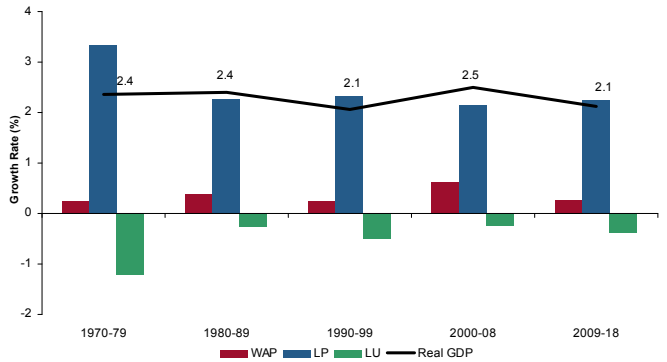
Projections based on Scenario I



Source: Credit Suisse Demographics Research, GGDC & Conference Board, UN

Exhibit 16: UK (2009-2018 Projections)

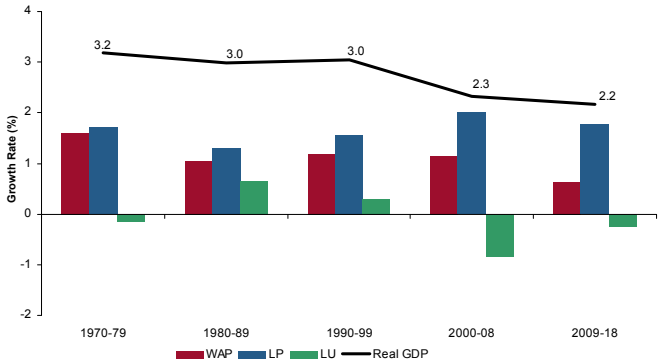
Projections based on Scenario I



Source: Credit Suisse Demographics Research, GGDC & Conference Board, UN

Exhibit 17: US (2009-2018 Projections)

Projections based on Scenario I



Source: Credit Suisse Demographics Research, GGDC & Conference Board, UN

LU: Labour Utilization, LP: Labour Productivity, WAP: Working Age Population

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Appendix

I. Growth Accounting: Technical Details

Basic decomposition of Real GDP levels:

Y = (Y/Hrs Worked) * (Hrs. Worked/ WAP) * (WAP/Total Pop. * Total Pop)

LP LU DF

$$= \underbrace{\left(\frac{Y}{H}\right)}_{LP} * \underbrace{\left(\frac{H}{P_{WA}}\right)}_{LU} * \underbrace{\left\{\left(\frac{P_{WA}}{P_{TOT}}\right) * P_{TOT}\right\}}_{DF}$$

Decomposition of demographic factors:

$$dr = \frac{P_{TOT} - P_{WA}}{P_{WA}} \equiv \frac{P_{TOT}}{P_{WA}} - 1 \Rightarrow \frac{P_{WA}}{P_{TOT}} \equiv \frac{1}{1+dr}$$

Also, $g_{P_{WA}} \equiv g_{P_{TOT}} + g\frac{1}{1+dr} \approx g_{P_{TOT}} - \Delta dr$

Basic decomposition of real GDP growth rates:

$$g_Y = g_{LP} + g_{LU} + g_{DF} \approx g_{LP} + g_{LU} - \Delta dr + g_{TOT}$$

$$\Rightarrow g_Y = g_{LP} + g_{LU} + g_{P_{WA}}$$

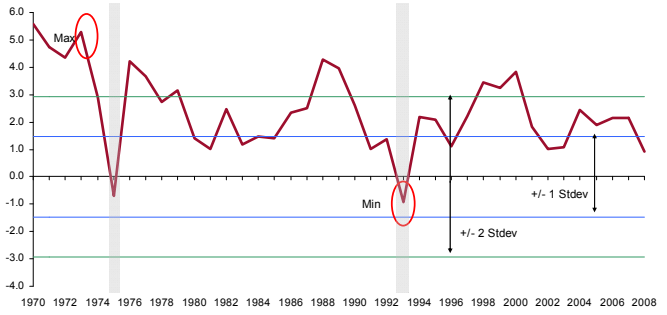
Variables:
Y = Real GDP
LP = Labour Productivity
LU = Labour Utilisation
DF = Demographic Factor
H = Total Hours Worked
WAP or P_{WA} = Working Age Population
P_{TOT} = Total Population

Source: ECB Occasional Paper 55 (Maddaloni et. Al.), Credit Suisse Demographics Research

II. Real GDP Growth (1970-2008)

Exhibit 18: France - Historical GDP Growth

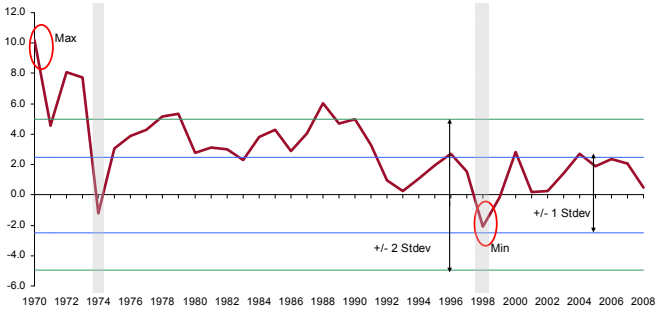
Percentages. GDP decline(s) marked in gray, Max & min rates in red.



Source: Credit Suisse Demographics Research, GGDC & Conference Board, UN

Exhibit 19: Japan - Historical GDP Growth

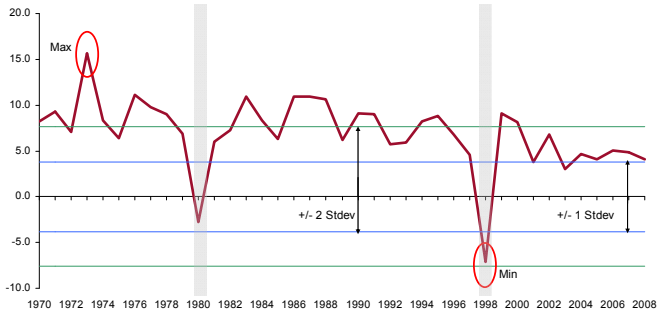
Percentages. GDP decline(s) marked in gray, Max & min rates in red.



Source: Credit Suisse Demographics Research, GGDC & Conference Board, UN

Exhibit 20: S. Korea - Historical GDP Growth

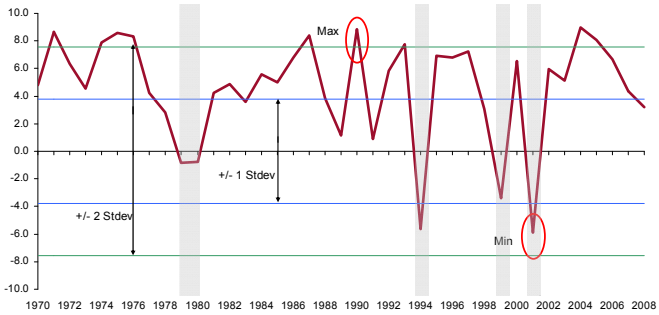
Percentages. GDP decline(s) marked in gray, Max & min rates in red.



Source: Credit Suisse Demographics Research, GGDC & Conference Board, UN

Exhibit 21: Turkey - Historical GDP Growth

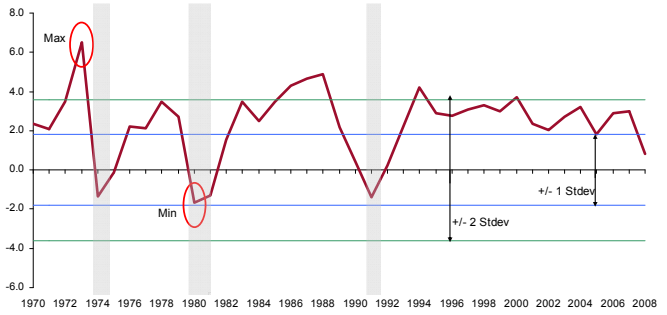
Percentages. GDP decline(s) marked in gray, Max & min rates in red.



Source: Credit Suisse Demographics Research, GGDC & Conference Board, UN

Exhibit 22: UK - Historical GDP Growth

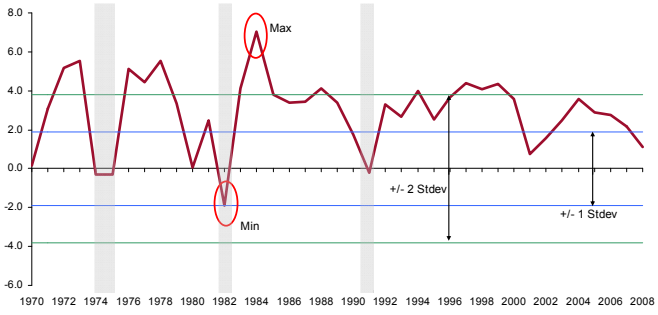
Percentages. GDP decline(s) marked in gray, Max & min rates in red.



Source: Credit Suisse Demographics Research, GGDC & Conference Board, UN

Exhibit 23: US - Historical GDP Growth

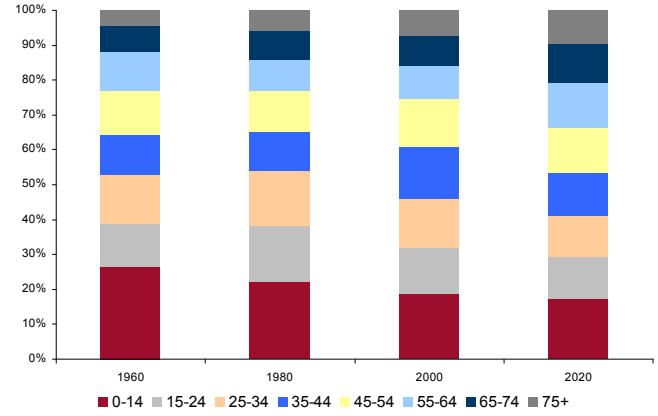
Percentages. GDP decline(s) marked in gray, Max & min rates in red.



Source: Credit Suisse Demographics Research, GGDC & Conference Board, UN

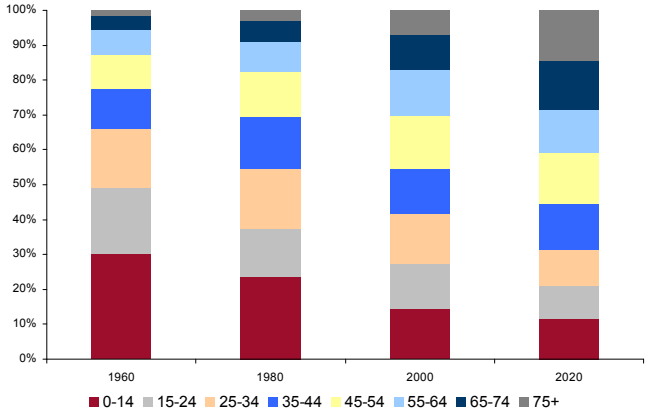
III. Population age distribution:1960, 1980, 2000 & 2020

Exhibit 24: France Population Distribution



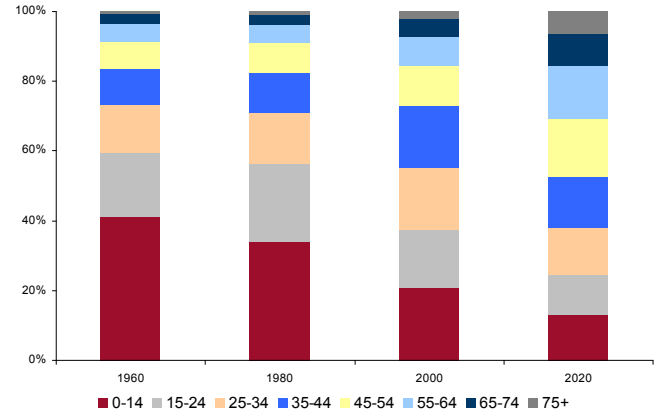
Source: Credit Suisse Demographics Research, UN

Exhibit 25: Japan Population Distribution



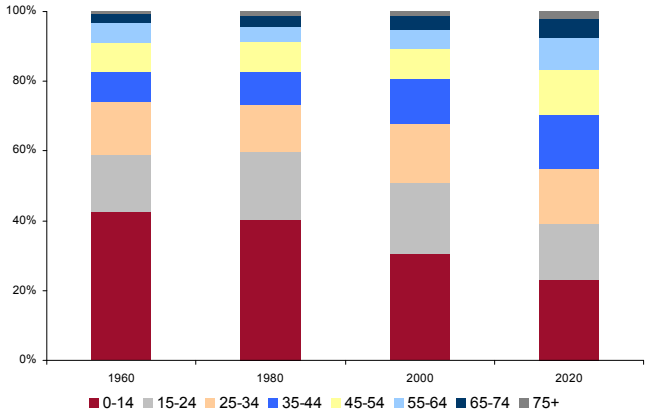
Source: Credit Suisse Demographics Research, UN

Exhibit 26: S. Korea Population Distribution



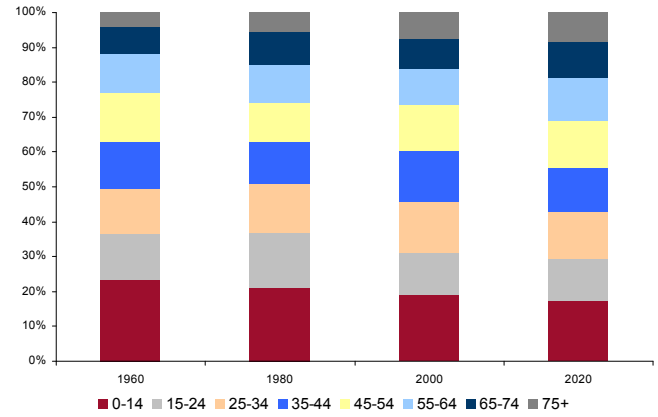
Source: Credit Suisse Demographics Research, UN

Exhibit 27: Turkey Population Distribution



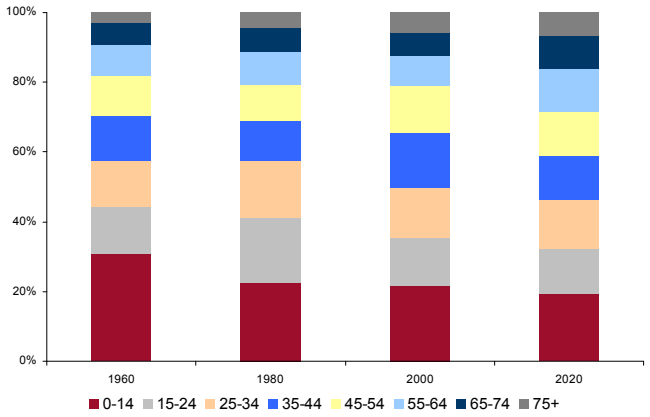
Source: Credit Suisse Demographics Research, UN

Exhibit 28: UK Population Distribution



Source: Credit Suisse Demographics Research, UN

Exhibit 29: US Population Distribution



Source: Credit Suisse Demographics Research, UN

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