New Measures of Global Growth Projection for
The Conference Board Global Economic Outlook 2014

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Abstract

This paper presents the methodology for The Conference Board Global Economic Outlook 2014, including projections for 11 major regions and individual estimates for 33 mature and 22 emerging market economies for 2014, 2014-2019, and 2020-2025. The projections are based on a supply-side growth accounting model that estimates the contributions of the use of factor inputs – labor and capital –, and productivity growth to the growth of real Gross Domestic Product (GDP). While labor growth rates are estimated using information on demographic changes, capital and productivity growth are estimated on the basis of a wide range of related variables during past periods. The trend growth rates that are obtained from this exercise are adjusted for possible deviations between actual and potential output.

1. Introduction and Summary

Since 2008, The Conference Board publishes an annual global economic outlook, projecting GDP growth for 55 countries using growth accounting techniques. The basis of the framework is built upon the works of Dale Jorgenson and colleagues, including Jorgenson, Ho and Stiroh (2005) and Jorgenson and Vu (2009b). Over the years we have extended and improved the projection methods, using more information from historical performance and adopting procedures to adjust for cyclical deviations from trend in short term.

This paper describes the methodology and sources underlying the projections of growth of Gross Domestic Product in the 2014 edition of *The Conference Board Global Economic Outlook* (GEO). The projection methodology used in the 2014 GEO remains the same as the one used in the 2013 GEO. In turn, the 2013 GEO was an expanded version of the methods implemented in the 2012 edition, especially by basing the methodology more strongly on variables that have an established economic significance for the projected variables.[1]

The projections in this paper cover the period 2014-2025, with separate projections for the medium term (2014-2019) and for the long term (2020-2025). The outlook covers 55 major economies across 11 global regions, including 33 mature economies (the United States, Europe, Japan and other mature economies) and 22 emerging and developing economies. Section 2 describes how trend growth is estimated on the basis of an extrapolated growth accounting model which projects the various growth components of the production function. The model first estimates the factor inputs – labor quantity, labor composition (the effect of heterogeneity among workers in terms of educational qualification), and capital services –, and total factor productivity. For labor quantity (Section 2.1), the measures are based on projections for the working age population (age of 15-64) from the International Data Base of the U.S. Census Bureau. For labor composition (Section 2.2), we rely on projections of population by level of education attainment by KC et al. (2010). For capital services and total factor productivity

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[1] Vivian Chen, Ben Cheng, Gad Levanon, Ataman Ozyildirim and Bart van Ark, "Projecting Global Growth," The Conference Board Economics Program Working Paper Series, EPWP #12 – 02, November 2012.

(Section 2.3), we use regression models which are largely based on relevant past-period variables. The extrapolated growth accounting estimates are provided for 33 mature economies and 22 major emerging and developing economies. Projections of all input factors are combined to provide projections of GDP growth in Section 2.4.

The projected GDP growth rates, which are based on the growth accounting framework, are to be considered to represent the trend growth of each economy. In the long run, countries grow according to their trend.[2] In the short run, however, countries deviate from their long-run path due to temporary fluctuations primarily due to business cycle dynamics. Occasionally, shocks can also occur which have a deep impact on the structure of the economy, which can permanently change the course of the trend. The 2008-09 recession represents a combination of business cycle dynamics and shock effects, which has led to such a change in the trend growth. Section 3 describes the medium-term adjustments to the trend growth estimates obtained from the extrapolated growth accounts. Section 4 compares our GDP growth projections with those from other studies. Section 5 concludes.

The outlook for 2014 and beyond predicts some effects of an economic recovery in mature economies from the 2008/09 recession (and subsequent 2012/13 recession in the Euro Area), which brings this group of economies to an average growth of 1.9 percent between 2014 and 2019. Among the larger economies, the United States will be outperforming Europe in 2014-2019 by about a full percentage point (2.4 and 1.4 percent annual GDP growth, respectively).

While growth in emerging and developing economies was quite strong in 2010 and 2011 (6 to 7 per cent) it showed a declining trend since then. The growth rate of emerging and developing economies declined to 5.4 percent in 2012 and further to 4.7 percent in 2013. Declining export demand from mature economies and many domestic policy and structural constraints hindered these countries from attaining a higher growth rate. Given the current weak conditions in the global economy, and the time lag by which reforms pay off in terms of faster growth, there is little scope for emerging economies to much accelerate their growth performance in the next few years. In 2014 the growth rate will remain approximately at the

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[2] Our trend growth rates may be seen as a proxy to the growth rate of potential output, but as our estimates do not explicitly account for a non-inflationary constraint on our growth measure, and our estimates are not accompanied by a measure of potential output, we prefer to use the term "trend growth", as our estimates are essentially derived from past growth trends.

same level of 2013. The economies of China and India begin to show signs of maturing beyond 2012, as their trend growth will begin to slow from 2014-2019 to 2020-2025 (from 5.9 to 3.5 percent in China and 4.8 to 3.6 percent in India). Overall, emerging economies' growth will slow to 3.2 percent on average during 2020-2025 from 4.3 percent during 2014-2019.

In sum, even though growth in the mature economies is expected to recover beyond 2014, there will be major offsetting effects from continued slower growth in the emerging markets. Based on current trends, global GDP is projected to grow at 3.1 during 2014-2019. In the longer run the trend growth rate show a further slowdown to 2.4 percent during 2020-2025. This is the case in almost all regions of the economy; while mature economies show a decline of almost half a percentage point, emerging economies show even larger decline of more than 1%, primarily driven by a decline in Chinese growth rates by 2.4 percent and Indian growth rates by 1.2 percent[3]

2. Medium- and long term projections for 2014-2019 and 2020-2025.

2.1 The growth accounting framework

The medium- and long-term projections which form the basis of The Conference Board Global Economic Outlook are based on the growth accounting framework as developed in Jorgenson, Gollop and Fraumeni (1987) and more recently in Jorgenson, Ho and Stiroh (2005) and Jorgenson and Vu (2009b). The growth accounting methodology is based on a production function, which decomposes output growth into components associated with changes in factor inputs – capital and labor – , and a residual that reflects technological progress and production efficiency, known as Total Factor Productivity (TFP). Assume a production function of the following form:

$$Y = Af(L, Q, K) \tag{1}$$

Where Y is gross value added, L is labor quantity, Q is the composition of the labor force based on different education attainment, K is capital services, A is total factor productivity. Under the

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[3] For a broad analysis of the results, see The Conference Board Chief Economist's analysis in StraightTalk ® "Time to realize the opportunities for growth".

assumption of perfect competitive factor markets where the marginal product of each input equals its price, and constant returns to scale, the above general production function can be transformed into the following growth accounting framework:

$$\Delta ln Y_t = \Delta ln A_t + \bar{v}_{L,t}\Delta ln L_t + \bar{v}_{L,t}\Delta ln Q_t + \bar{v}_{K,t}\Delta ln K_t \qquad (2)$$

In the above equation growth of output in a given year t ($\Delta ln Y_t$) is decomposed into the contributions of total factor productivity growth ($\Delta ln A_t$), labor ($\Delta ln L_t$), labor composition ($\Delta ln Q_t$) and capital services ($\Delta ln K_t$).[4]. The contribution of factor inputs, L, Q and K are obtained as the product of their growth rates over the current and previous periods and their compensation share ($\bar{v}$) in value added averaged over the last two years:

$$\bar{v}_{L,t} = 0.5 * (v_{L,t} + v_{L,t-1}) \text{ and } \quad \bar{v}_{K,t} = 0.5 * (v_{K,t} + v_{K,t-1})$$

where $v_{K.t} = \frac{P_L.L}{P_Y.Y}$ and $v_{K.t} = \frac{P_K.K}{P_y.Y}$, with P_L being the price of labor (wage rate), P_K is the price of capital (rental price) and P_Y is the price of output. Under the assumption of constant returns to scale, the cost shares of labor and capital sums to unity, $\bar{v}_L + \bar{v}_K = 1$.

Equation (2) illustrates that output growth is driven by share weighted input growth and TFP growth, a residual that captures all sources of growth which are left unexplained by labor and capital inputs. Thus, projection of output growth requires projection of each individual input component on the right hand side of equation (2). Our projection covers the medium term period (2014-2019) and a longer term period (2020-2025) for 33 mature economies and 22 major emerging economies.

2.2 Growth in labor quantity

The projection of the growth of labor quantity is approximated by the working age population (age of 15-64) from the International Data Base of the U.S. Census Bureau. The actual growth in employment that enters the production process can of course differ from the working age population due to changes in the employment participation in the labor force. However,

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[4] In this paper, all growth rates are calculated as the difference in the log of the levels of each variable unless otherwise specified.

predictions on labor force participation and employment are subject to high degree of uncertainty as they are affected by unpredictable factors such as policy changes like retirement plans, cultural changes, such as preferences for work vs. leisure, as well as cyclical fluctuations. Therefore, we only use the more stable measure of working age population.

At an annual rate of 0.4 percent, the United States has one of the fastest growth rates in working age population among mature economies during 2014-19. Working age population growth in many European countries, as well as in Japan and Russia, is already negative between 2014 and 2019, putting downward pressure on output growth.

Among the emerging economies, China, Russia and South Africa have already fallen in the group of countries that witness a contraction in their working age population during 2014-2019. China, where economic growth has thus far been fueled by cheap and abundant labor, will see its working age population growth decline at a faster rate (-0.3) between 2020 and 2025. India, another important player in driving global economic growth, on the other hand, still enjoy a demographic dividend, registering more than 1.5% annual growth in its working age population during 2014-2019. Most other emerging countries still enjoy the demographic dividend as their working age population continues to grow though the pace of the growth will slow from 2014-2019 period to 2020-2025 period.

2.3 Growth in Labor Composition

In addition to the change in labor quantity, an adjustment for changes in the composition of the labor force in terms of different skill-levels is needed to measure labor's effective contribution to output growth. The change of labor composition is constructed on the basis of weighted measures of different skill-level groups (low, medium and high skilled workers based on educational attainment) in the labor force:

$$\Delta lnQ_t = 0.5 * \sum_i (v_{i,t} + v_{i,t-1})(lnh_{i,t} - lnh_{i,t-1}) \qquad \textbf{(3)}$$

where v_i is the compensation share of ith labor type (where i=low, medium and high skilled) in total labor compensation and h_i is the share of ith labor type in total hours worked. For a detailed

methodology describing the construction of the labor composition data, please refer to Bonthuis (2011).

The projection data used in equation (3) are mainly based on the projection of population by level of educational attainment by KC et al. (2010). In general, labor composition is relatively stable over the time. The average growth rate across all 55 countries in our projection sample is around 0.3 percent for two projection periods. Consequently, the direct contribution from the growth of labor composition to total output growth is quite small. However, a well-educated labor force can improve productivity by enabling better utilization of equipment, adoption of advanced technology, and improvement of production process, thereby contributing to output growth. There is also a likely complementarity with investment in intangible capital, such as R&D and organizational changes, which will also enhance productivity.

In order to establish the contribution of labor quantity and composition to GDP, and in accordance with the growth accounting model, we need to assign weights relative to the contribution of capital, discussed in the next section. According to Gollin (2002), labor shares are approximately constant across time and countries within a range of 0.65-0.80. We therefore use the average labor share for individual countries in 2006-2013 for the projection years. On average labor shares are lower in emerging economies because capital is scarcer and expensive while labor is cheaper compared to mature economies. Our data (see Table 1) confirms this pattern: Mexico, Turkey and China, have the lowest labor share (between 0.32-0.42) among our projection countries while labor shares in Switzerland, Denmark, South Korea, Hong Kong, and Singapore are 0.7 or more.[5]

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[5] For countries that we do not have labor share data for, we use 0.7 for advanced countries and 0.5 for emerging economies.

Table 1: Growth of working age population, growth of labor composition, and labor share for 2014-2019, 2020-2025

Country	Region	Growth of working age population (%)		Growth of labor composition (%)		Labor share (%)
		2014-2019	2020-2025	2014-2019	2020-2025	2014-2025
Mature Economies						
United States	United States	0.42	0.31	0.25	0.22	0.60
Austria	Europe	-0.33	-0.72	0.12	0.13	0.65
Belgium	Europe	-0.32	-0.57	0.34	0.31	0.68
Cyprus	Europe	0.97	0.51	0.30	0.25	0.66
Czech Republic	Europe	-0.91	-0.68	0.20	0.15	0.62
Denmark	Europe	0.03	-0.17	0.11	0.14	0.70
Finland	Europe	-0.75	-0.65	0.32	0.28	0.67
France	Europe	-0.11	-0.04	0.25	0.26	0.63
Germany	Europe	-0.57	-0.91	0.17	0.16	0.65
Greece	Europe	-0.23	-0.39	0.51	0.45	0.57
Hungary	Europe	-0.84	-0.72	0.37	0.30	0.59
Ireland	Europe	0.83	0.93	0.20	0.20	0.58
Italy	Europe	0.01	-0.19	0.09	0.10	0.66
Luxembourg	Europe	0.94	0.68	0.29	0.27	0.51
Malta	Europe	-0.50	-0.58	0.38	0.34	0.59
Netherlands	Europe	0.03	-0.21	0.12	0.15	0.67
Norway	Europe	0.07	-0.17	0.17	0.16	0.47
Poland	Europe	-0.99	-1.05	0.21	0.18	0.47
Portugal	Europe	-0.06	-0.23	0.88	0.94	0.66
Spain	Europe	0.63	0.46	0.45	0.45	0.60
Sweden	Europe	-0.25	-0.21	0.15	0.10	0.65
Switzerland	Europe	0.39	0.18	0.11	0.12	0.72
United Kingdom	Europe	0.17	0.20	0.19	0.16	0.69
Japan	Japan	-1.07	-0.63	0.27	0.29	0.56
Australia	Other Mature	0.63	0.56	0.27	0.24	0.60
Canada	Other Mature	0.08	-0.13	0.16	0.13	0.57
Hong Kong	Other Mature	-0.61	-1.35	0.21	0.18	0.70
Iceland	Other Mature	0.30	0.01	0.43	0.43	0.67
Israel	Other Mature	1.43	1.32	0.27	0.27	0.56
New Zealand	Other Mature	0.46	0.31	0.29	0.29	0.61
Singapore	Other Mature	1.54	0.94	0.42	0.34	0.70
South Korea	Other Mature	-0.03	-1.01	0.38	0.32	0.70
Taiwan	Other Mature	-0.18	-0.89	0.44	0.44	0.57

Country	Region	Growth of working age population (%)		Growth of labor composition (%)		Labor share (%)
		2014-2019	2020-2025	2014-2019	2020-2025	2014-2025
Emerging and Developing Economies						
China	China	-0.15	-0.29	0.23	0.22	0.42
India	India	1.54	1.21	0.31	0.30	0.51
Indonesia	Other Developing Asia	1.21	0.77	0.30	0.30	0.46
Malaysia	Other Developing Asia	1.56	1.25	0.31	0.30	0.50
Pakistan	Other Developing Asia	2.35	1.83	0.32	0.30	0.50
Thailand	Other Developing Asia	0.14	-0.16	0.53	0.50	0.50
Argentina	Latin America	0.95	0.90	0.35	0.34	0.50
Brazil	Latin America	1.03	0.57	0.34	0.36	0.59
Chile	Latin America	0.64	0.21	0.28	0.25	0.50
Colombia	Latin America	1.18	0.71	0.34	0.33	0.50
Mexico	Latin America	1.25	0.85	0.38	0.37	0.32
Venezuela	Latin America	1.56	1.17	0.64	0.64	0.50
Iran	Middle East & Northern Africa	1.06	0.85	0.26	0.25	0.50
Saudi Arabia	Middle East & Northern Africa	1.99	1.44	0.36	0.33	0.50
United Arab Emirates	Middle East & Northern Africa	2.36	1.71	0.00	0.00	0.50
Algeria	Middle East & Northern Africa	1.15	1.38	0.39	0.39	0.50
Egypt	Middle East & Northern Africa	1.90	1.78	0.36	0.34	0.50
Morocco	Middle East & Northern Africa	1.22	0.78	0.35	0.36	0.50
Nigeria	Sub-Saharan Africa	2.91	2.85	0.28	0.30	0.50
South Africa	Sub-Saharan Africa	-0.03	0.12	0.27	0.25	0.54
Russian Federation	Russia, Central Asia and Southeast Europe	-0.82	-0.73	0.23	0.17	0.50
Turkey	Russia, Central Asia and Southeast Europe	1.26	0.95	0.36	0.35	0.38

Note: Labor share is assumed to be 0.7 for mature economies and 0.5 for developing economies, if actual data is not available.

2.4 Growth in Capital Services and Total Factor Productivity

Compared to the projections for labor inputs, the development of capital services and total factor productivity (TFP) are subject to a higher degree of uncertainty. They are estimated by a system of equations for which we have applied some standard variables and some economic variables. We estimate three endogenous variables: TFP growth, the savings rate, and capital services growth. The savings rate is an important addition, because it is closely related to investment capital that determines the growth of capital services. All other variables are either exogenous or predetermined.

The three equations are specified as follows:

$$\Delta \ln TFP_t = \alpha_0 + \alpha_1 \Delta \ln TFP_{t-1} + \alpha_2 lnLP_{t-1} + \alpha_3 lnlife_t + \alpha_4 open_t + \alpha_5 edu_t + \varepsilon_{1t} \quad \textbf{(4)}$$

$$Saving_t =$$
$$\beta_0 + \beta_1 dep\_old_t + \beta_2 dep\_young_t + \beta_3 lnKD_{t-1} + \beta_4 open\_fin_t + \beta_5 depreciation_t +$$
$$\beta_6 inflation_t + \beta_7 services_t + \varepsilon_{2t} \qquad \textbf{(5)}$$

$$\Delta lnKSvc_t = \gamma_0 + \gamma_1 saving_{t-1} + \gamma_2 \Delta lnpop_t + \gamma_3 depreciation_t + \gamma_4 \Delta lnTFP_t + \gamma_5 lnKD_{t-1} +$$
$$\gamma_6 open\_fin_t + \gamma_7 inflation\_s.d_t + \gamma_8 manufactuirng_t + \varepsilon_{3t} \quad \textbf{(6)}$$

where ΔlnX denotes the log growth rate of variable *X* over period t and t-1, *lnX* indicates the log level of the variable *X*. The definition of the variables and the data sources are listed in Table 2 below and a discussion of the actual versus expected signs follows below.

The above three equations constitute a simultaneous equation system which is estimated using three-stage least squares. We use this approach, firstly because the capital services growth equation contains endogenous variables (TFP growth) among the explanatory variables, thus instrumental variable estimation is needed to produce consistent estimates; secondly, since some of the explanatory variables are the dependent variables of other equations in the system, the

three error terms are expected to be correlated, thus generalized least squares should be used to account for the correlation among the error terms across equations.

To implement our regressions, we restrict our sample to 33 mature economies and 22 major emerging economies from 1972 to 2013 to ensure the high quality of the data. We divide the 41 years into six time periods: (1) 1972-1978; (2) 1979-1986; (3) 1987-1992; (4) 1993-1998; (5) 1999-2005, and (6) 2006-2013. These divisions are designed to distribute the number of years to each period as equally as possible. More importantly, we choose divisions so that the initial and end years do not fall on recession years.[6] All annual variables from the data sources are averaged for each defined period.

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[6] Recession years vary across countries. However, we choose divisions based on U.S. recession years because the U.S. is the largest economy throughout the period under study.

Table 2: Definition of variables and data sources:

Variable Name	Definition	Data Source
ΔlnTFPt-1	log growth of TFP in period t-1	Total Economy Database, The Conference Board (september 2013)
ΔlnTFPt	log growth of TFP in period t	Total Economy Database, The Conference Board (september 2013)
ln(LPt-1)	log level of labor productivity (output and employment ratio) in period t-1	Total Economy Database, The Conference Board (september 2013)
ln(lifet)	log level of life expectancy at birth in period t	World Development Indicators, World Bank (august 2013)
opent	trade openness at current price in period t (share of import and export among GDP)	Penn World Table 8.0
edut	educational attainment for population aged 25 and over in period 6	Barro-Lee data, 2012 version
Old Dependencyt	old age dependency ratio in period t, (population above 64 over working age population)	International Data Base, US Census Bureau
Young Dependencyt	youth age dependency ratio in period t, (population below 15 over working age population)	International Data Base, US Census Bureau
ln(KDt-1)	log level of the average capital deepening (capital stock-employment ratio) in last two years of the previous peirod	Total Economy Database, The Conference Board
Depreciationt	weighted depreciation rate across 6 asset types in period t	Author's own calculation
open_fint	financial openness in period t	Chinn-Ito Index (2013 data update)
Inflationt	inflation rate in period t (average consumer prices, percent change, standardized)	World Economic Outlook Database, IMF (october 2013)
Inflation_s.dt	standard deviation of inflation rate in period t	World Economic Outlook Database, IMF (october 2013)
Savingt-1	saving's rate in period t (100 - consumption share of PPP converted GDP per capita at current prices)	Penn World Table 7.0
Δlnpopt	log growth of working age population in period t	International Data Base, US Census Bureau
Manufacturingt	manufacturing share in period t, value added as percentage of GDP	World Development Indicators, World Bank (august 2013)
Servicest	services share in period t, value added as percentage of GDP	World Development Indicators, World Bank (august 2013)

Table 3: Estimation results of simultaneous equations

	TFP Growth	Saving	K Services Growth
$\Delta \ln TFP_{t-1}$	0.0697		
	(1.25)		
$\ln(LP_{t-1})$	-1.275***		
	(-6.90)		
$\ln(life_t)$	4.545***		
	(3.21)		
$open_t$	0.004**		
	(2.34)		
edu_t	0.163***		
	(3.21)		
Old Dependency$_t$		-0.725***	
		(-6.17)	
Young Dependency$_t$		-0.109**	
		(-2.12)	
$\ln(KD_{t-1})$		6.732***	-1.541***
		(8.59)	(-8.81)
Depreciation$_t$		1.581***	0.425***
		(2.96)	(3.56)
open_fin$_t$		1.902***	0.0762
		(4.14)	(0.73)
Inflation$_t$		-0.690	
		(-0.89)	
Services$_t$		-0.479***	
		(-7.03)	
$\Delta \ln TFP_t$			-0.143*
			(-1.81)
Saving$_{t-1}$			0.0672***
			(5.23)
$\Delta \ln pop_t$			0.249*
			(1.78)
Inflation_s.d$_t$			-0.00271***
			(-2.68)
Manufacturing$_t$			0.0839***
			(3.89)
Constant	-7.654	-13.84	14.69
	(-1.48)	(-1.40)	(7.16)

The system of equations is estimated by the 3SLS (three-stage least squares) method.
Number of observations: 236
* $P<0.1$; ** $P<0.05$; *** $P<0.01$

Table 3 reports the results of the simultaneous equation system using the three-stage least squares estimation. The results are largely consistent with theoretical expectations. Specifically, the lagged labor productivity variable in TFP growth equation and the lagged capital deepening variable in the capital services growth equation are specified to test the convergence hypothesis.[7] Both variables are significantly negative, lending support to the convergence hypothesis as the country with higher labor productivity (or capital deepening) level will have slower growth of total factor productivity (capital services) in the next period. In addition to the convergence effect, three other results are worth noting.

In the TFP growth equation, the coefficients of life expectancy, trade openness and education level are all significantly positive. Longer life expectancy is closely related to better health conditions, a foundation for faster productivity growth. A better educated labor force is equipped with the necessary knowledge and skills to unravel the productivity in the production process. Trade openness may improve TFP growth via a number of channels, including the channel of specialization[8], increased competitive pressure, increased access to better technology and spillover effects.

In the savings equation, both old and youth dependency ratio have a negative effect on the savings rate as population in these age cohorts mostly do not have income and are major consumers of education and health care. Inflation also has a negative effect, but is not significant. The negative relationship between the share of the services sector in an economy and the savings rate probably results from the larger presence of government funded social services, education and health care, causing people to have less precautionary savings. On the other hand, depreciation and financial openness have significant positive effect on savings. A higher depreciation rate requires higher investment (from savings) to maintain the current capital stock levels. Higher financial openness encourages savings probably because once people have access to more and better financial instruments, they are motivated to save more of their current income to invest in various financial products to increase their wealth.

In the capital services growth equation, the savings rate, depreciation, and manufacturing share all lead to higher growth in capital services as one would expect. Intuitively, the growth

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[7] Ideally, we want to use TFP and capital services level of the initial year to test convergence. Since we do not have the level data for TFP and capital services for all countries, labor productivity and capital deepening levels are used instead in the specification.

[8] Alcala and Ciccone (2004) find the causal effect of trade on productivity across countries is statistically and economically significant as well as robust.

accounting identity imposes a negative relationship between TFP and capital services growth because TFP growth is calculated as a residual in the equation. However, if TFP growth is pure exogenous, it can affect capital services positively probably by pushing out the productivity frontier. The significant positive relationship between capital services and TFP growth according to the simultaneous equations show that faster TFP growth promotes growth in capital services probably via increased efficiency in the production process. This result contracts the single equation estimation result, in which TFP growth has a negative (though not significant) effect on capital services growth. The difference arises because TFP growth is affected by some of the same unobserved factors that affect capital services growth, such as institutional factors. This endogeneity problem is taken care of in the simultaneous equation system by the 3SLS estimation method. The positive effect from manufacturing sector is very significant as the manufacturing sector is the most capital intensive. The standard deviation of inflation is used as a proxy for the stability of the macroeconomic environment. The significant negative effect indicates that unstable macro conditions may deter investment and consequently growth in capital services.

2.5 Growth Projections

Equations (4) – (6) are estimated using the actual data from periods 1 to 6. The estimated coefficients are then used to derive projections for TFP and capital services growth. To project TFP and capital services growth for both medium-term (2014-2019, period 7) and long-term (2020-2025, period 8), we also need to know all the exogenous variables in the system, which can be divided into three categories.

The first category includes variables whose values of medium- and long-term are given: old and youth dependency ratios, as well as growth in working age population are provided by International Data Base of the US Census Bureau.

The second category includes lagged variables whose long-term values need to be calculated based on medium-term projection: lagged TFP growth, lagged savings rate, lagged labor productivity and lagged capital deepening. The period 8 value of the first two lagged variables can be obtained by the projected value of period 7. The lagged labor productivity level in period 8 is calculated through labor productivity growth, which is obtained from the difference between GDP growth and employment growth. GDP growth in period 7 is obtained using

projected capital services and TFP growth as explained above. Employment growth is approximated by the growth of the working age population available from the International Data Base of the US Census Bureau. The lagged capital deepening in period 8 is calculated based on the projected growth of capital services in period 7 together with the growth of working age population.

The third category includes contemporary variables whose period 7 and 8 values are subject to judgment: inflation, standard deviation of inflation, manufacturing and services share in total value added, life expectancy, trade and financial openness, education attainment. Shares of manufacturing and services sectors reflect the structure of the economy; inflation rate and the standard deviation of inflation characterize the macro condition. The period 7 and 8 values of all these four variables are assumed to remain the same as period 6. Life expectancy, trade and financial openness and education attainment are considered as policy oriented variables, whose values are subject to change depending on a country's economic condition and development strategy. As a base scenario, we assume all these four policy oriented variables to remain the same as their period 6 value for period 7 and 8.[9]

Table 4 lists GDP projections for periods 7 (2014-2019) and 8 (2020-2025) for all 55 economies as well as the growth contributions of labor, capital and TFP. The average actual GDP growth between 2007 and 2013 is also reported in the table for comparison purpose.[10]

Among the mature economies, GDP growth in the U.S. and most European countries are projected to recover between 2014 and 2019 from the period of 2007 – 2013, which includes the Great Recession and the on-going European crisis. The recovery will be most noticeable in those troubled European economies, such as those of Greece, Ireland, Italy, Portugal and Spain. On the other hand, Poland will see a significant growth slow-down from 3.6 percent during the 2007-2013 period to 1.5 percent during the 2014-2019 period. Outside the U.S. and Europe, most other mature economies will experience a decline in GDP growth during the 2014-2019 period, with the only exceptions being New Zealand and Israel. The decline will be most evident in the four Asian tigers. However, Japan will gain half a percentage growth on average in the next six years.

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[9] As the coefficients of these four policy oriented variables are all positive, a positive deviation from the base case will increase the projected capital services and TFP growth, and consequently GDP growth; and a negative deviation from the base case will reduce the projected growth.

[10] To evaluate the accuracy of our projection, we carried out out-of -sample tests on capital services growth, TFP growth and GDP growth to measure the deviation of the forecast value from the actual value for period 5 (1999-2005) and 6 (2006-2012). Please see the Appendix for details.

The projected long-term trend growth of GDP will further slow down during the 2020-2025 period in almost all mature economies. The majority of the emerging economies in our sample experienced higher average GDP growth during 2007-2013 than the projected GDP growth in the following period (2014-2019). China, India and Russia ranked the top three in terms of their extraordinary performance during 2007-2013 compared to the projected growth in 2014-2019. The high speed economic growth in emerging countries will abate across the board after 2019 with the projected trend growth of 2020-2025 ubiquitously lower than, if not equal to, that of 2014-2019.

Table 4: Projection of GDP trend growth and its components (%)

Country	Average growth 2007-2013	Average annual growth 2014 - 2019 (trend growth projection)					Average annual growth 2020 - 2025 (trend growth projection)				
		GDP	Labor Quantity	Labor Composition	Capital Services	TFP	GDP	Labor Quantity	Labor Composition	Capital Services	TFP
Advanced Economies											
United States	1.1	1.7	0.3	0.1	1.1	0.2	1.7	0.2	0.1	1.4	0.0
Austria	1.1	1.1	-0.2	0.1	1.0	0.2	0.6	-0.5	0.1	0.9	0.1
Belgium	0.7	2.0	-0.2	0.2	1.2	0.8	1.7	-0.4	0.2	1.0	0.8
Cyprus	-0.3	1.1	0.6	0.2	0.0	0.3	1.3	0.3	0.2	0.4	0.4
Czech Republic	1.0	2.4	-0.6	0.1	1.5	1.3	2.4	-0.4	0.1	1.5	1.2
Denmark	-0.3	1.8	0.0	0.1	1.3	0.4	1.4	-0.1	0.1	1.1	0.3
Finland	0.5	1.0	-0.5	0.2	1.0	0.3	0.8	-0.4	0.2	0.8	0.3
France	0.4	1.0	-0.1	0.2	0.8	0.1	0.9	0.0	0.2	0.7	0.1
Germany	1.1	2.0	-0.4	0.1	1.4	0.9	1.4	-0.6	0.1	1.1	0.7
Greece	-3.2	1.1	-0.1	0.3	0.8	0.1	1.3	-0.2	0.3	1.1	0.2
Hungary	-0.6	2.2	-0.5	0.2	1.4	1.1	2.5	-0.4	0.2	1.6	1.1
Ireland	0.1	3.4	0.5	0.1	2.4	0.4	2.8	0.5	0.1	1.9	0.3
Italy	-0.8	1.1	0.0	0.1	1.0	0.0	0.9	-0.1	0.1	0.9	0.0
Luxembourg	1.1	2.0	0.5	0.2	1.4	-0.1	1.2	0.4	0.1	0.7	0.0
Malta	1.8	1.3	-0.3	0.2	0.8	0.6	1.3	-0.3	0.2	0.9	0.5
Netherlands	0.4	2.0	0.0	0.1	1.2	0.7	1.5	-0.1	0.1	0.9	0.7
Norway	1.2	2.1	0.0	0.1	1.6	0.4	1.3	-0.1	0.1	0.9	0.4
Poland	3.6	1.5	-0.5	0.1	1.3	0.6	1.3	-0.5	0.1	1.4	0.3
Portugal	-0.8	1.5	0.0	0.6	0.8	0.2	1.4	-0.2	0.6	0.8	0.1
Spain	-0.4	1.9	0.4	0.3	1.1	0.2	1.6	0.3	0.3	1.0	0.1
Sweden	1.5	2.0	-0.2	0.1	1.5	0.6	1.7	-0.1	0.1	1.3	0.6
Switzerland	1.6	2.2	0.3	0.1	1.4	0.5	1.8	0.1	0.1	1.1	0.4
United Kingdom	0.3	1.1	0.1	0.1	0.9	-0.1	1.2	0.1	0.1	1.0	-0.1
Japan	0.4	0.9	-0.6	0.2	0.9	0.4	0.6	-0.4	0.2	0.6	0.3
Australia	2.9	2.3	0.4	0.2	1.5	0.3	2.2	0.3	0.1	1.4	0.3
Canada	1.3	2.1	0.0	0.1	1.3	0.6	1.8	-0.1	0.1	1.3	0.5
Hong Kong	3.2	1.7	-0.4	0.1	0.6	1.3	0.4	-0.9	0.1	0.1	1.1
Iceland	0.4	1.4	0.2	0.3	0.4	0.4	1.0	0.0	0.3	0.4	0.4
Israel	4.0	4.0	0.8	0.1	2.2	0.9	4.0	0.7	0.1	2.2	0.8
New Zealand	1.4	2.8	0.3	0.2	1.4	0.9	2.8	0.2	0.2	1.6	0.8
Singapore	5.0	3.6	1.1	0.3	1.5	0.7	2.6	0.7	0.2	1.1	0.7
South Korea	3.3	2.4	0.0	0.3	1.4	0.8	1.2	-0.7	0.2	1.1	0.6
Taiwan	3.3	2.3	-0.1	0.3	1.7	0.5	1.3	-0.5	0.3	1.3	0.3

Emerging and Developing Economies

China	9.7	5.3	-0.1	0.1	3.9	1.4	3.5	-0.1	0.1	2.8	0.7
India	7.1	4.7	0.8	0.2	3.1	0.7	3.5	0.6	0.2	2.4	0.3
Indonesia	5.9	5.0	0.6	0.1	3.2	1.1	4.4	0.4	0.1	3.2	0.8
Malaysia	4.6	4.9	0.8	0.2	3.0	1.0	4.2	0.6	0.1	2.6	0.8
Pakistan	3.6	4.8	1.2	0.2	2.8	0.7	4.5	0.9	0.2	2.7	0.7
Thailand	3.4	4.1	0.1	0.3	2.7	1.1	3.4	-0.1	0.3	2.4	0.8
Argentina	3.7	3.0	0.5	0.2	1.8	0.6	2.7	0.5	0.2	1.7	0.4
Brazil	3.2	3.2	0.6	0.2	1.6	0.8	2.8	0.3	0.2	1.6	0.7
Chile	4.3	2.7	0.3	0.1	1.3	0.9	2.3	0.1	0.1	1.2	0.9
Colombia	4.3	3.3	0.6	0.2	1.9	0.6	3.0	0.4	0.2	1.9	0.6
Mexico	2.0	2.9	0.4	0.1	1.9	0.5	3.1	0.3	0.1	2.3	0.5
Venezuela	2.9	2.9	0.8	0.3	1.7	0.1	2.5	0.6	0.3	1.6	0.0
Iran	2.4	2.2	0.5	0.1	1.5	0.1	2.0	0.4	0.1	1.4	0.0
Saudi Arabia	5.8	3.1	1.0	0.2	2.3	-0.4	1.9	0.7	0.2	1.7	-0.7
United Arab Emirates	2.2	3.3	1.2	0.0	2.1	0.1	3.6	0.9	0.0	2.2	0.6
Algeria	2.8	3.8	0.6	0.2	2.2	0.9	3.4	0.7	0.2	1.7	0.8
Egypt	4.3	4.8	1.0	0.2	3.0	0.7	4.8	0.9	0.2	3.1	0.6
Morocco	4.2	4.7	0.6	0.2	2.9	1.0	3.9	0.4	0.2	2.5	0.8
Nigeria	6.9	5.8	1.5	0.1	3.5	0.8	5.7	1.4	0.1	3.5	0.6
South Africa	2.8	1.5	0.0	0.1	2.0	-0.6	1.5	0.1	0.1	2.1	-0.8
Russian Federation	3.0	1.4	-0.4	0.1	0.9	0.7	1.2	-0.4	0.1	1.0	0.5
Turkey	3.4	1.7	0.5	0.1	1.4	-0.2	1.9	0.4	0.1	1.6	-0.2

Note: The medium-term growth rates for the United States and Japan will be different from what is reported in Table 5, because Table 5 contains final estimates where we have made adjustments for the output gaps. Same is the case with Canada, France and the United Kingdom, and therefore a consequent effect on the relevant country groups where they belong to.[11] Similarly, we adjust the medium term growth rate for many other countries where there is a large gap between the growth rate in 2013 and the projection for 2014-2019. This includes mature economies such as Belgium, Germany and the Netherlands, and emerging markets such as China, Brazil, Russia and Turkey.

3. Adjustments to Trend and Growth Scenarios

The projected GDP growth rates based on the growth accounting framework are to be interpreted as the trend growth rates of an economy. Trends are important for projecting future growth, because they depict how an economy grows on the basis of its potential which is determined by the available labor force, capacity in capital and technology base. In the long run, countries grow according to their trend. In the short run, however, countries deviate from their long-run path due to temporary factors primarily due to business cycle dynamics. Occasionally, shocks can also

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[11] The adjusted growth rates for 2014-2019 are (all in percentages): United States – 2.4; France – 1.9; Japan – 0.9; and the United Kingdom – 1.8.

occur which have a deep impact on the structure of the economy, which can permanently change the course of its long-run trend.

As a prime example, the 2008-09 recession created a large gap between the actual output level and what could have been produced if the economy had stayed on the trend in most mature economies. In contrast, some major emerging economies have grown beyond their growth trend in the past few years. In order to come up with realistic annual estimates between 2014 and 2019, we therefore assumed that economies whose 2013 growth deviated from their trend growth rates in the subsequent period (2014-2019) by more than 1 percentage point only begin to approach their trend growth rates in 2014. We thus assume such countries to gradually approach their trend growth by 2015 and then will stay at the trend growth for the rest of the years in the period, e.g., year 2016-2018. Annual growth for 2014 and 2015 are linearly interpolated using 2013 growth and trend growth of period 2014-2019. As our trend GDP growth is derived via a growth accounting approach, we also adjust the contribution of labor, capital and TFP when the actual projected GDP is modified by the aforementioned method. Specifically, we calculate a ratio of the adjusted actual GDP growth over trend GDP growth, which we then apply to all three input contributions. In the long-run (2020-2025), we assume actual GDP growth coincides with the trend GDP growth.

In addition, for Canada, France, Japan, United Kingdom and the United States for which we have information on potential output, we adjust their medium term growth rates (2014-2019) in such a way that they close their output gap by 2019. Also, for countries where there is a large gap between estimated GDP growth for 2013 and the projected trend growth rate for 2014-2019, we adjust the medium term growth to close part of the gap. This adjustment is applied to countries Belgium, Brazil, Chile, China, Cyprus, Czech Republic, Egypt, Germany, Greece, Hong Kong, Hungary, Iran, Ireland, Italy, Luxembourg, Netherlands, Pakistan, Portugal, Russia, South Africa, Spain, Turkey and Venezuela. The results are then aggregated to 11 major regions, and are reported in Table 5.

Table 5: Projected GDP growth by region (%)

	2013	2014	2014-2019	2020-2025
UNITED STATES	1.6	2.3	2.4	1.7
EUROPE*	0.1	1.1	1.4	1.3
of which: Euro Area	*-0.3*	*0.8*	*1.2*	*1.2*
JAPAN	0.8	0.8	1.0	0.6
OTHER MATURE**	2.5	2.3	2.4	1.7
MATURE ECONOMIES	**1.0**	**1.7**	**1.9**	**1.4**
CHINA	7.5	7.0	5.9	3.5
INDIA	4.2	4.4	4.8	3.6
OTHER DEVELOPING ASIA	4.3	4.6	4.8	4.2
LATIN AMERICA	2.4	2.7	2.9	2.9
of which: Brazil	*2.0*	*2.3*	*2.9*	*2.8*
of which: Mexico	*2.5*	*2.9*	*2.9*	*3.1*
MIDDLE EAST & NORTH AFRICA	1.8	2.0	2.9	2.9
SUB-SAHARAN AFRICA	4.4	4.2	3.9	3.9
RUSSIA, CENTRAL ASIA, AND SOUTHEAST EUROPE***	2.9	2.5	1.8	1.3
EMERGING MARKET AND DEVELOPING ECONOMIES	**4.7**	**4.6**	**4.3**	**3.2**
WORLD	**2.8**	**3.1**	**3.1**	**2.4**

Note: projections are based on trend growth estimates, which – for the period 2014-19 – are adjusted for adjustments from remaining output gaps
* Europe includes 27 members of the European Union (excluding Croatia) as well as Switzerland and Norway.
** Other mature economies are Australia, Canada, Iceland, Israel, Hong Kong, South Korea, New Zealand, Singapore, and Taiwan Province of China.
*** Southeast Europe includes Albania, Bosnia and Herzegovina, Croatia, Macedonia, Serbia and Montenegro, and Turkey.
Source: The Conference Board Global Economic Outlook 2014, November 2013
(https://www.conference-board.org/data/globaloutlook.cfm)

Table 6: Composition of world GDP (percentages)

	2000	2012	2025
Mature Economies	64.7	51.7	47.7
Emerging Markets	35.3	48.3	52.3

As is evident from Table 5, in 2014, the GEO predicts a global economic growth rate of 3.1 percent, which is marginally higher than the 2.8 percent growth in 2013. This improvement is mainly driven by mature markets, which grow at 1.7 percent, 0.7 percent higher than the 1 percent growth they had in 2013. Emerging markets, on the other hand, show no improvement in their growth rate. In the medium-term (2014-2019), our projections show mature economies to grow slightly above their 2014 growth rate, while the growth rate of emerging market tend to decline marginally, though they still grow above 4 percent on average. This decline in the pace at which the emerging markets grow has an implication on the speed at which they influence the composition of world income. While the emerging markets increased their share in world GDP from 35 percent in 2000 to 48 percent in 2012 – an increase of 13 percent in 12 years, during the next 13 years, it is projected to increase to 52 percent – an increase of 4 percent (see table 6).

4. Comparison of GDP Projections with Other Studies

The results from The Conference Board's growth projections can be compared with those of a number of other studies, which also provide projections for world GDP growth. We compare our results with Jorgenson and Vu (2013), Lee and Hong (2010), Fogel (2007), Goldman Sachs (Wilson et.al. 2011), PWC (2013) and IMF's World Economic Outlook Database (October 2013).

As mentioned before, our projection model is based on Jorgenson's growth accounting framework. However, Jorgenson and Vu (2013)'s projections for all input components are based on the performance of the near past, while in our methodology this only holds for the inputs capital services and TFP growth. Our methodology is closely akin to Lee and Hong (2010), in terms of both the growth accounting framework as well as the regression approach to estimate and project input factors. However, their work only covers Asian countries while ours includes 33 mature economies and 22 emerging ones. Fogel (2007) did not explicitly explain the model used for the forecast, but indicated that his forecasts were influenced by the forecasts of C.I.A. and *The Economist*. Goldman Sachs uses a simple canonical model of economic growth where output growth is a function of growth in labor force, capital accumulation and a process of convergence in technology with the frontier (United States) that drives productivity growth performance, with the speed of convergence being determined by so-called Growth Environment Scores (GES): a higher GES is associated with more rapid catch-up on the income levels of the

rich countries. Similar to our growth accounting model, PWC estimates and projects forward for each country potential GDP based on a Cobb-Douglas production function augmented to include human capital. Among four input factors, growth in working age labor force is based on UN population projections; increases in human capital are proxied by average education levels across the adult population. However, PWC differs from our regression approach, as growth in capital stock is derived from assumptions on capital investment, and growth in total factor productivity is assumed to be related to the extent to which a country lags behind the technological leader (US) and so has the potential for "catch-up".

Table 7 presents the comparison. Though the projection time periods are different between the studies, some comparisons are still useful. The slowdown pattern of GDP growth from medium to long term in our projection can also be found in the Goldman Sachs projections. Both our results and their results show a marginal increase in the UK, while for all other countries and for the global economy the projected growth rates are lower in the long-term. However, except for Germany and the United States, our long term projections between 2020 and 2025 are lower than Goldman Sachs's projection between 2020 and 2029. However, our projections for the United States are fairly close to Goldman Sachs's projection, and for Germany they are even the same. Between our projections for the whole period (2014-2025) and PWC's for 2011-2030, our projections are lower for most countries except for Germany, where our projections are more optimistic. For the medium term, our projections are mostly lower than IMF's projection with the exception of Germany and Brazil. Our projections for Germany and Brazil are higher than that of IMF, while they are quite close for Italy and Japan. Though the IMF lowered its projections for China compared to their past projections, they are still optimistic, predicting an average GDP growth of 6.8 percent between 2014 and 2018. In general, our projections are less optimistic compared to most others, except Lee and Hong. Our projections (if taking an average of 2014-2019 and 2020-2025), are quite close to the projections made by Lee and Hong for India and China for a longer time period, 2011-2030. When comparing our 2014-2019 projections with those of Jorgenson and Vu's projections for 2010-2020, our projections of Germany, Italy and Brazil are much sanguine. For other countries in the table, our projections are pessimistic. Notably, our projections show lower mid-term growth rates for Japan, China, India and Russia, resulting in a larger difference in the projections for emerging markets, and a consequent lower growth rate for the world economy. Our projection of world GDP growth is

0.4 percentage point lower than Jorgenson and Vu's. The long-term projections by Fogel are quite a bit higher than our projections for U.S., China, India and the world, while it is closer to ours for Japan. Fogel's projections are the most optimistic among all the studies. He forecasts a 5 percent average GDP growth for the world economy between 2000 and 2040 which seems overly optimistic given historical performance.

Table 7: Comparison of Projections of GDP growth among difference sources

	TCB Global Economic Outlook		Jorgen son and Vu	Lee and Hong	Fogel	Goldman Sachs		PWC	IMF
	2014-2019	2020-2025	2010-2020	2011-30	2000-2040	2010-2019	2020-2029	2011-2030	2014-2018
France	1.4	0.9	1.0			2.3	2.4	2.1	1.6
Germany	1.6	1.4	1.5			2.0	1.4	1.3	1.3
Italy	0.6	0.8	0.7			2.0	2.0	1.5	1.1
Japan	1.0	0.6	1.9		1.1	1.8	1.8	1.5	1.1
U.K.	1.9	1.1	1.4			2.6	2.7	2.3	2.0
U.S.	2.4	1.7	2.1		3.8	2.2	2.1	2.3	3.1
Brazil	2.9	2.8	2.9			5.4	4.7	3.8	3.1
China	5.9	3.5	7.0	5.5	8.4	7.5	5.4	5.4	6.8
India	4.8	3.6	6.4	4.5	7.1	6.9	6.0	6.0	6.1
Russia	1.8	1.2	3.8			5.3	4.0	3.0	3.3
Mature*	**1.9**	**1.4**	**1.8****						**2.4**
Emerging	**4.3**	**3.2**	**5.8*****						**5.4**
World	**3.1**	**2.4**	**3.6**		**5**	**4.3**	**3.9**		**4.0**

* Mature economies in GEO are the United States, Europe (which includes the 27 members of the European Union, excluding Croatia) as well as Switzerland and Norway and other mature economies (Australia, Canada, Iceland, Israel, Hong Kong, South Korea, New Zealand, Singapore, and Taiwan Province of China.
** Growth rate for the G7 countries (Canada, France, Germany, Italy, Japan, U.K., U.S.)
*** Growth rate for seven major developing and transition economies (Brazil, China, India, Indonesia, Mexico, Russia, South Korea)

5. Closing Remarks

Projecting future growth is not an easy task. The only way we can forecast the future is by looking at past performances, and therefore the results will crucially depend upon the assumptions we make regarding the relationships between GDP growth and various factors that are expected to influence growth. Moreover, it will also be influenced by the way we measure the future trend in these variables. The growth accounting framework provides a good starting

point for projecting output growth in the medium and long term. It uses information from projected factor inputs – capital and labor – and productivity to project output growth. Therefore, the final projection results are strongly dependent on the approach to estimate factor inputs, particularly capital and total factor productivity growth rates. A common approach used in the literature to project future growth is using regression techniques. Does the regression approach provide robust results, which do not seem dramatically out of line with other, mostly simpler methods? We believe that our methodology combining simple growth accounting and regression analysis using economic variables makes it possible to be more explicit about understanding the sources of growth and the drivers of change over time.

Our projections of GDP growth may be seen as relatively low compared with other studies. However, over a time span as long as the one we have used, there will likely be deviations in both directions. Despite the transparency and comparability of our approach, the disadvantage is that there is no simple framework that can take into account all the country specific factors and potential shocks in the future. That said, our goal is not to provide an explicit forecast in the sense of the exact growth numbers, but rather to provide a reasonable way of benchmarking trend growth across a large group of economies.

There are two major directions of future work we plan to undertake. First, the trend growth of labor, capital and productivity are relatively stable factors, although they require adjustments for cyclical factors for the most recent years and the immediate future. In the current version of the outlook, we link the short-term growth with medium-term growth using linear interpolation. Additional research is needed to analyze the path and timing of the convergence of the short-term growth to trend growth. Second, the growth accounting approach provides projections for the growth of capital services, TFP and GDP. This information may be used to examine the level of the potential GDP so that we can measure the output gap.

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Appendix

In order to evaluate the accuracy of our projections, we carry out out-of -sample tests on capital services growth, TFP growth and GDP growth to measure the deviation of the forecast value from the actual value. Specifically, we use the first four or five periods' data in simultaneous equation system to predict capital services and TFP growth in periods 5 or 6. Together with the labor contribution, we then calculated the projected GDP growth. In the appendix table below, we list the actual and projected values for capital service growth, TFP growth and GDP growth, and the corresponding difference between the projected and actual values. Three points worth noting when reading the numbers in the appendix table:

1. Because we specify lagged variables as explanatory variables in the simultaneous equation system, the projected capital services growth and TFP growth is affected by the performance of the previous period. That is why in period 6 (2006 – 2012), which contains the 2008-2009 crisis and the European debt crisis, the projected growth is higher than the actual growth for most mature economies. This also explains why in our medium-term projection (2014-2019), the base scenario growth continues the downward trend. The model specification determines the path dependence nature of the projection and is not able to forecast any unforeseeable shocks, either negative (such as a global financial crisis, or the breakup of the euro zone) or positive (such as a strong acceleration in technological progress and innovation that will lift the world growth out of the sluggish trajectory).

2. The deviation between the projected GDP growth and actual GDP growth for period 5 and 6 comes not only from the differences in the projected and actual capital services growth and TFP growth. It is also partially due to the fact that in our projected GDP growth, we approximate the actual employment growth by the growth in working age population. The discrepancy will be especially evident in countries with volatile labor participation rate and employment rate.

3. Our medium and long-term projections for China and India may seem low compared with the actual GDP growth in the past decades in these two countries. However, when

comparing with the projections in period 5 and 6, these projections indicate a gradual slowdown in China and India instead of a sudden drop from 2014 onwards. It is a result of combined slowdown in all of the input factors. Specifically, China will run out of the demographic dividend during 2014-2019 as its working age population growth will decline; capital services growth gradually slow down as the return to capital declines after many years of intensive investment and the economy is shifting towards a more consumption driven growth model; last but not the least, productivity growth weakens as the country matures and the easy productivity gains from learning the leaders exhaust and future productivity growth has to originate from technological progress and innovation.

Appendix Table: Actual and projected growth of capital services, TFP and GDP, and the differences

	Capital services growth (%)			TFP growth (%)			GDP growth (%)		
			Period 5 (1999-2005)						
Country	Actual	Projected	Difference (Projected - Actual)	Actual	Projected	Difference (Projected - Actual)	Actual	Projected	Difference (Projected - Actual)
Mature Economies									
United States	3.8	3.6	-0.2	1.0	0.7	-0.3	3.0	3.0	0.0
Austria	2.9	3.4	0.5	0.6	0.9	0.3	2.2	2.5	0.3
Belgium	3.7	4.1	0.4	0.1	1.5	1.4	2.1	3.2	1.1
Cyprus	1.1	1.3	0.2	1.5	1.2	-0.3	3.6	3.7	0.0
Czech Republic	5.9	5.2	-0.7	1.3	1.7	0.4	3.7	4.4	0.7
Denmark	3.6	3.8	0.2	0.1	1.0	0.9	1.7	2.5	0.8
Finland	3.2	4.2	1.0	1.3	1.0	-0.3	3.1	2.8	-0.3
France	3.2	2.8	-0.4	0.4	0.8	0.4	2.1	2.4	0.3
Germany	1.8	3.6	1.8	0.8	1.1	0.3	1.1	2.1	1.0
Greece	5.6	1.8	-3.9	0.1	0.9	0.8	3.9	2.4	-1.5
Hungary	6.8	3.2	-3.6	0.5	1.5	0.9	4.0	3.4	-0.6
Ireland	7.7	7.7	0.0	0.8	1.5	0.7	6.4	6.7	0.2
Italy	2.9	3.9	1.0	-0.4	0.7	1.1	1.4	2.4	0.9
Luxembourg	6.0	3.5	-2.5	0.4	0.7	0.2	4.8	3.2	-1.7
Malta	1.1	2.2	1.1	0.5	1.4	1.0	1.3	3.1	1.7
Netherlands	2.8	3.6	0.8	0.5	1.4	0.9	2.1	3.2	1.1
Norway	3.8	2.5	-1.3	0.3	1.0	0.7	2.3	2.8	0.5
Poland	4.1	3.4	-0.7	1.3	1.5	0.1	3.4	3.6	0.2
Portugal	5.2	3.5	-1.6	-2.0	1.0	3.0	1.7	3.2	1.5
Spain	5.3	3.6	-1.7	-0.9	0.8	1.7	3.7	3.5	-0.2
Sweden	3.3	5.0	1.7	1.5	1.5	0.0	3.2	3.9	0.7
Switzerland	3.2	4.7	1.5	0.2	1.4	1.1	1.6	3.1	1.4
United Kingdom	5.0	4.6	-0.4	0.7	0.7	0.1	3.1	3.2	0.1
Japan	1.5	3.3	1.9	0.6	1.2	0.6	1.1	2.8	1.7
Australia	5.1	3.8	-1.3	0.1	1.0	0.9	3.4	3.7	0.3
Canada	4.3	3.7	-0.6	0.3	1.2	1.0	3.3	3.6	0.3
Hong Kong	3.5	3.8	0.2	2.2	2.6	0.5	4.4	4.7	0.3
Iceland	4.1	2.3	-1.8	2.0	1.4	-0.6	4.2	3.4	-0.8
Israel	4.4	5.9	1.5	0.3	1.4	1.1	3.2	5.4	2.2
New Zealand	4.1	4.5	0.5	0.2	1.5	1.3	3.7	4.5	0.8
Singapore	3.1	7.3	4.1	3.2	2.4	-0.8	5.4	7.3	1.9
South Korea	5.8	6.3	0.5	2.6	1.5	-1.1	5.8	4.4	-1.4
Taiwan	5.8	5.4	-0.5	1.5	1.2	-0.3	4.2	4.3	0.1

Period 5 (1999-2005)

Country	Capital services growth (%)			TFP growth (%)			GDP growth (%)		
	Actual	Projected	Difference (Projected - Actual)	Actual	Projected	Difference (Projected - Actual)	Actual	Projected	Difference (Projected - Actual)
Emerging and Developing Economies									
China	10.6	9.0	-1.5	4.1	2.9	-1.2	10.1	8.4	-1.6
India	6.6	6.2	-0.4	1.9	1.0	-0.8	6.3	5.2	-1.1
Indonesia	4.3	7.3	3.0	1.3	1.2	-0.1	4.1	5.9	1.8
Malaysia	3.7	8.4	4.7	2.2	1.6	-0.6	5.4	7.5	2.1
Pakistan	4.0	5.4	1.4	1.6	0.6	-1.0	4.8	4.9	0.2
Thailand	2.1	7.4	5.3	2.6	1.7	-0.8	5.1	6.2	1.2
Argentina	1.2	3.3	2.1	-0.8	1.0	1.8	0.5	3.4	2.9
Brazil	2.9	3.7	0.8	-0.5	0.9	1.4	2.6	3.9	1.3
Chile	6.0	3.3	-2.8	-1.6	1.7	3.3	3.7	4.4	0.8
Colombia	2.8	3.3	0.5	-0.8	1.0	1.8	2.3	3.7	1.4
Mexico	4.0	3.2	-0.8	-0.5	1.0	1.6	2.8	3.9	1.1
Venezuela	0.9	3.4	2.5	0.1	0.7	0.5	1.4	3.6	2.2
Iran	2.7	2.2	-0.5	1.0	0.1	-0.9	5.2	3.0	-2.2
Saudi Arabia	3.3	4.4	1.2	-1.0	-0.3	0.7	3.5	3.8	0.3
United Arab Emirates	3.6	4.1	0.4	0.4	-0.1	-0.5	6.0	4.7	-1.2
Algeria	1.3	3.6	2.2	2.4	1.1	-1.3	4.6	4.5	-0.1
Egypt	3.0	6.0	2.9	0.7	1.2	0.4	4.2	5.8	1.6
Morocco	4.3	6.4	2.1	0.7	1.6	0.9	3.8	6.0	2.2
Nigeria	3.2	5.0	1.8	5.5	-0.5	-6.0	8.3	3.3	-4.9
South Africa	4.4	4.4	0.0	-0.4	-1.8	-1.4	3.6	1.6	-2.0
Russian Federation	-1.8	0.3	2.1	6.9	0.6	-6.3	6.5	1.0	-5.5
Turkey	5.8	3.8	-2.0	0.7	0.3	-0.3	3.6	3.6	-0.1

Period 6 (2006-2013)									
	Capital services growth (%)			TFP growth (%)			GDP growth (%)		
Country	Actual	Projected	Difference (Projected - Actual)	Actual	Projected	Difference (Projected - Actual)	Actual	Projected	Difference (Projected - Actual)
Mature Economies									
United States	2.3	4.5	2.2	0.3	0.7	0.4	2.2	3.7	1.5
Austria	1.8	3.6	1.8	0.4	0.8	0.4	1.4	2.1	0.7
Belgium	2.8	4.6	1.7	-0.7	2.1	2.8	0.9	3.9	2.9
Cyprus	2.2	0.9	-1.3	-1.1	0.7	1.8	0.1	2.7	2.6
Czech Republic	4.6	5.0	0.4	-0.5	2.6	3.0	1.7	4.3	2.6
Denmark	2.8	5.0	2.2	-0.6	1.1	1.7	0.2	2.7	2.5
Finland	3.6	4.1	0.5	-0.7	1.0	1.7	0.9	2.4	1.5
France	2.2	2.8	0.6	0.1	0.6	0.4	1.4	2.0	0.6
Germany	1.9	4.9	3.0	0.8	1.7	0.8	1.9	3.9	1.9
Greece	3.2	3.3	0.1	-2.6	0.7	3.2	-2.2	2.4	4.6
Hungary	4.5	4.7	0.2	-1.7	2.4	4.1	-0.1	4.4	4.5
Ireland	4.6	6.9	2.3	-0.6	1.3	1.9	0.7	5.1	4.4
Italy	1.1	3.8	2.7	-0.4	0.3	0.7	0.2	2.0	1.8
Luxembourg	4.9	2.8	-2.1	-2.3	0.6	2.9	1.5	2.7	1.2
Malta	0.2	2.1	1.9	0.8	1.2	0.3	1.9	2.3	0.4
Netherlands	1.6	3.6	2.0	-0.1	1.7	1.8	0.7	3.0	2.3
Norway	4.3	2.7	-1.6	-1.9	1.1	3.0	1.3	2.8	1.5
Poland	4.9	3.5	-1.4	0.6	1.3	0.7	3.8	3.3	-0.5
Portugal	2.8	3.2	0.5	-1.0	0.6	1.7	-0.6	2.4	3.0
Spain	3.3	3.2	0.0	-0.4	0.6	1.0	1.0	2.7	1.7
Sweden	3.6	5.2	1.6	-0.3	1.5	1.8	1.7	3.3	1.6
Switzerland	2.5	5.5	3.0	0.1	1.2	1.1	1.9	3.3	1.5
United Kingdom	2.9	4.6	1.7	0.0	0.3	0.3	1.7	3.1	1.4
Japan	0.8	3.4	2.5	0.8	0.8	0.0	1.2	2.7	1.5
Australia	6.7	4.9	-1.9	-1.1	0.9	2.0	2.8	3.7	0.9
Canada	4.0	4.4	0.3	-0.6	1.3	1.8	2.2	4.2	2.0
Hong Kong	3.0	2.3	-0.7	1.9	2.9	1.1	3.5	4.2	0.7
Iceland	0.0	1.4	1.4	0.9	1.1	0.2	0.9	2.5	1.6
Israel	4.2	5.8	1.6	0.1	1.6	1.6	4.1	5.3	1.2
New Zealand	3.6	4.8	1.2	-0.5	1.6	2.1	1.4	4.3	2.9
Singapore	5.0	5.1	0.1	-0.1	2.1	2.3	5.2	5.9	0.7
South Korea	5.1	5.5	0.4	1.5	1.6	0.1	3.4	3.8	0.4
Taiwan	2.8	4.9	2.1	1.8	1.3	-0.5	3.5	4.1	0.6

Country	Capital services growth (%)			TFP growth (%)			GDP growth (%)		
	Actual	Projected	Difference (Projected - Actual)	Actual	Projected	Difference (Projected - Actual)	Actual	Projected	Difference (Projected - Actual)
Emerging and Developing Economies									
China	11.6	7.4	-4.2	2.6	2.7	0.1	9.6	7.5	-2.1
India	8.9	6.3	-2.5	1.7	1.3	-0.4	7.1	5.5	-1.6
Indonesia	7.2	6.3	-0.9	0.5	1.7	1.2	5.6	5.9	0.3
Malaysia	4.5	6.5	2.0	0.6	1.9	1.3	4.6	6.3	1.7
Pakistan	6.3	5.9	-0.4	-1.3	1.1	2.3	3.8	5.6	1.8
Thailand	3.9	6.3	2.4	0.5	1.7	1.2	3.5	5.6	2.2
Argentina	5.6	3.9	-1.7	0.3	1.1	0.8	4.1	3.8	-0.3
Brazil	6.0	4.3	-1.7	-0.6	1.2	1.8	3.2	4.0	0.7
Chile	7.7	2.5	-5.2	-1.4	1.7	3.1	4.3	3.8	-0.5
Colombia	7.1	4.0	-3.1	-0.5	1.1	1.7	4.5	4.3	-0.3
Mexico	4.4	3.4	-1.0	-0.2	0.9	1.1	3.6	4.1	0.5
Venezuela	5.5	3.6	-1.8	-0.4	0.6	1.0	3.6	3.8	0.2
Iran	4.7	2.8	-1.9	-0.3	0.5	0.7	2.7	3.1	0.4
Saudi Arabia	6.6	4.5	-2.1	0.9	-0.1	-0.9	5.6	3.7	-2.0
United Arab Emirates	6.4	3.2	-3.1	-5.9	0.2	6.1	3.1	3.7	0.6
Algeria	4.6	3.4	-1.2	-0.9	1.4	2.3	2.6	4.3	1.7
Egypt	6.4	6.4	-0.1	0.0	1.2	1.2	4.5	5.6	1.1
Morocco	8.0	6.5	-1.5	-0.2	1.7	1.8	4.5	5.9	1.4
Nigeria	12.2	7.5	-4.7	-1.0	1.8	2.9	6.6	7.0	0.4
South Africa	7.8	6.1	-1.7	-1.2	-0.1	1.2	3.1	3.4	0.3
Russian Federation	3.4	2.0	-1.4	1.5	1.6	0.1	3.5	2.6	-0.8
Turkey	8.0	3.0	-5.0	-1.0	0.3	1.3	4.9	3.0	-1.8