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BACKGROUND PAPER

Population, Labour Force and Unemployment: Implications for the Creation of (Decent) Jobs, 1990-2030

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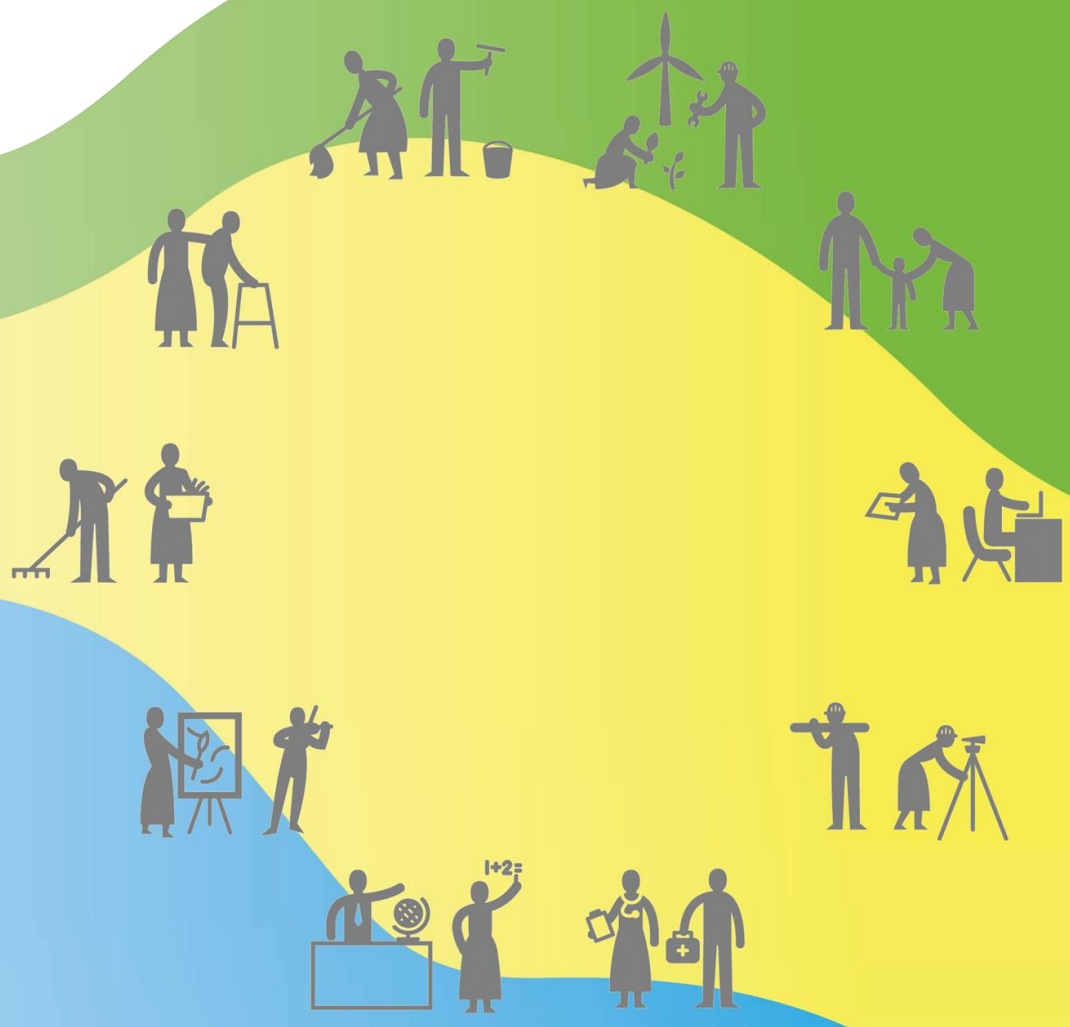

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ABSTRACT

We estimate that 734 million jobs will be required globally between 2010 and 2030 to accommodate recent and ongoing demographic shifts, account for plausible changes in labour force participation rates, and achieve target unemployment rates of at or below 4 percent for adults and at or below 8 percent for youth. The challenge of job creation, which is quite sizeable in historical perspective, is further compounded by the fact that the majority of new jobs will be required in countries in which 'decent' jobs are less prevalent.[1]

[1] This paper was prepared as a background paper for *Human Development Report 2015*. The authors are grateful to the United Nations Development Programme, Human Development Report Office for support and to Selim Jahan for helpful comments. The authors also thank Daniel Cadarette for his editorial assistance.

Introduction

Between 2010 and 2030, global labour markets will face the daunting task of generating roughly three-quarters of a billion new jobs. As calculated in this paper, this is the estimated number of jobs required to absorb the projected 21 percent increase in the world's working-age population, to accommodate a trend of increasing labour force participation (predominantly among the female population as fertility declines), and to allow for a target reduction in youth unemployment rates to no more than 8 percent and adult unemployment rates to no more than 4 percent. Although the scale of this job creation challenge will subsequently abate due to declining rates of both fertility and population growth, job creation requirements in the coming two decades predominantly reflect the past two decades of population growth (Bloom and Freeman 1986), which was substantial by historical standards.

The challenge of job creation is further magnified by the fact that roughly 91 percent of the new jobs will be required in low- and lower-middle-income countries, where traditions of decent work are not well entrenched. Indeed, with respect to the need to create decent jobs, the magnitude of the challenge facing the world is without historical precedent.

This paper explores the number and quality of jobs that need to be created to accommodate recent and ongoing demographic shifts, and to account for plausible changes in labour force participation and unemployment rates. We examine these patterns globally; by geographic region, country income group and human development category; and over time. We distinguish the effects of demographic change on job creation that reflect accounting from those that reflect behaviour.

The following section of the paper sets out the standard accounting identities we use to relate population, labour force, unemployment and employment; provides a brief overview of the data upon which we rely; and describes our estimates. The next section distinguishes between jobs and decent jobs, and further explores the nature and magnitude of the job creation challenges facing the world. The paper then discusses some key behavioural links between demographics and employment, most notably, the effects of fertility and education on labour force participation. A final section presents some conclusions.

Framework, data and estimates

ACCOUNTING IDENTITIES

Many of the calculations reported later in this section rely on the standard accounting identities and definitions in equations (1a–d):

$$N_{a,i,k,t} = LF_{a,i,k,t} + NLF_{a,i,k,t} \quad \textbf{(1a)}$$

$$LF_{a,i,k,t} = E_{a,i,k,t} + U_{a,i,k,t} \quad \textbf{(1b)}$$

$$LFPR_{a,i,k,t} = \frac{LF_{a,i,k,t}}{N_{a,i,k,t}} \quad \textbf{(1c)}$$

$$UR_{a,i,k,t} = \frac{U_{a,i,k,t}}{LF_{a,i,k,t}} \quad \textbf{(1d)}$$

where *N* is population; *LF* is labour force; *NLF* refers to people not in the labour force; *E* is employed people; *U* is unemployed people;[2] *LFPR* is the labour force participation rate; *UR* is the unemployment rate; and *a* denotes age group, *i* denotes country, *k* denotes sex and *t* denotes year. Following standard convention, we treat 15-64 as the working age, which we further divide into a youth working age (15-24) and an adult working age (25-64).

Equations (1–d) imply that aggregate employment at time *t* can be expressed as

$$E_t = \sum_a \sum_i \sum_k [(N_{a,i,k.t} \times LFPR_{a,i,k.t}) \times (1 - UR_{a,i,k.t})] \quad \textbf{(2)}$$

We use equation (2) to calculate employment. We use the first difference of equation (2) to calculate changes in employment, which we do over two broad periods: 1990-2010 and 2010-2030. Equation (2) suggests that changes in employment over time are due to changes in any of three sets of variables: population, labour force participation rates or unemployment rates. Equation (2) thereby offers a framework for decomposing past and future projections of employment into portions associated with changes in population, labour force participation and unemployment. For example, holding unemployment rates and labour force participation rates constant at their time *t* values, we observe the change in employment at time *t*+1 attributable to changes in population. Doing so allows us to identify the primary demographic drivers behind historical employment changes and provides insight into the nature of future employment needs.

This decomposition further helps to distinguish between accounting and behavioural effects. A direct accounting link exists between changes in population and employment, as a portion of the additional population will directly enter employment assuming constant age- and gender-specific labour force participation rates and unemployment rates. By contrast, changes in age- and gender-

[2] As per the ILO definition, unemployed people include all those who are without work, currently available for work and have actively sought work over the past four weeks.

specific labour force participation rates reflect behavioural effects such as those due to changes in fertility or education (Besamusca et al. 2015, Bloom et al. 2009, Prettner et al. 2013). From 1990-2010, changes in the unemployment rate reflect historical shifts; from 2010-2030 these changes reflect an assumed target of reducing unemployment rates.[3]

DATA SUMMARY

Our analysis relies primarily on three data sets: the United Nations' *World Population Prospects: The 2015 Revision* (United Nations 2015b), the International Labour Organization's ILOSTAT database (ILO 2013b) and the ILO's *Global Employment Trends 2014: Supporting Data Sets* (ILO 2014). We rely on *World Population Prospects* for population estimates and projections, using the medium fertility scenario projections for 2015-2030; the ILOSTAT database for labour force participation rate estimates and projections; and *Global Employment Trends* for historical unemployment rates through 2010.

At the outset, four items are worth noting. First, this paper's estimates refer to the number of jobs needed, assuming no multiple job holding. Second, they do not distinguish between full- and part-time jobs. Third, the estimates refer only to employment of the 15-64 year-old population. These estimates could be biased downward as the 65-plus age group may very well experience increased labour force participation rates as mortality rates decrease (Bloom et al. 2014, Bloom et al. 2015, Lee and Mason 2010b). This would require not only increasing the number of jobs, but also redesigning the employment structure to accommodate older workers who may not be capable of working as intensively, yet are unable to retire due to needing higher savings for future years. Conversely, these estimates could be biased upward due to expansion of schooling and increased educational attainment (KC et al. 2010, Lutz and KC 2013). The ILO projections may not fully capture these effects because the model does not explicitly account for educational attainment.

Fourth, the data sets utilized in this analysis are not perfectly aligned with respect to the countries included. Among the countries in the *World Population Prospects* database (United Nations 2015b), 10[4] have no available data on labour force participation rates in the ILOSTAT database (ILO 2013b). The majority of these countries are small island nations, with the notable exceptions being South Sudan and the State of Palestine. We exclude these countries from our

[3] We use targets of at or less than 4 percent for adult unemployment and at or less than 8 percent for youth unemployment. For countries that are already below the 4 percent (55 countries) or 8 percent (28 countries) thresholds in 2010, we simply carry forward these values.

[4] See Table 1 notes for the list of countries for which labour force participation rates are unavailable.

analysis as the lack of labour force participation rates prevents us from being able to calculate employment. Because the countries excluded from analysis accounted for only 0.6 percent of global population in 2010, impact on the accuracy of our estimates should be minimal.

Table 1: Summary statistics of labour force participation rates and unemployment rates by age, sex and region (percentages)

	Labour force participation rates			Unemployment rates		
	1990	2010	2030	1990	2010	2030 (targeted)
Global						
Age group						
15-64	71.2	68.4	69.4	6.4	6.1	4.0
15-24	59.6	47.7	47.3	11.9	12.9	7.6
25-64	76.4	76.1	76.1	4.5	4.6	3.2
Sex						
Male	84.7	81.4	82.5	6.2	5.9	3.8
Female	57.3	55.2	55.8	6.7	6.6	4.0
Region						
Arab States	51.2	51.9	53.7	12.3	10.2	5.2
East Asia and the Pacific	81.5	75.6	76.3	5.0	4.3	3.6
Europe and Central Asia	67.1	62.1	64.1	9.3	10.6	4.8
Latin America and the Caribbean	64.0	70.3	73.0	8.1	7.3	4.3
South Asia	62.6	58.7	60.4	4.5	4.4	3.4
Sub-Saharan Africa	71.2	71.7	73.6	8.4	7.8	4.5

Notes: Values represent net effects from beginning to end of the period and do not reflect movement in the intervening years. Global estimates represent approximately 99.4 percent of global population due to labour force participation rates being unavailable for 10 countries: Antigua and Barbuda, Aruba, Curacao, Federated States of Micronesia, Grenada, Kiribati, Mayotte, Seychelles, South Sudan and State of Palestine. Regions are defined as in the *Human Development Report 2014* (UNDP 2014). Those included here represented approximately 82 percent of global population in 2010. From 1990-2010, however, they represented 93 percent of global population growth. From 2010-2030, they will represent 104 percent of population growth, indicating declining working-age populations in countries not belonging to any of these regions. A total of 54 countries do not belong to any of these regions, with the 10 largest (ranked by working-age population in 2010) being the United States, Russian Federation, Japan, Germany, France, United Kingdom, Italy, Republic of Korea, Spain and Poland.

Table 2: Estimated changes in population, labour force and employment during 1990-2010 and 2010-2030, by age, sex and region (millions)

	Change in population		Change in labour force		Change in employment 1990-2010	Change in employment 2010-2030	
	1990-2010	2010-2030	1990-2010	2010-2030		Constant 2010 unemployment rate	Unemployment rate targets of at or less than 4 percent for adults and at or less than 8 percent for youth
Global							
Age group							
15-64	1,300	940	799	695	757	659	734
15-24	219	63	-13	24	-17	19	53
25-64	1,100	877	812	668	773	640	681
Sex							
Male	652	490	476	430	452	411	451
Female	644	450	324	265	304	247	285
Region							
Arab States	96	104	51	60	47	53	62
East Asia and the Pacific	380	60	226	56	221	55	62
Europe and Central Asia	27	14	10	12	8	11	17
Latin America and the Caribbean	125	89	104	76	98	72	81
South Asia	397	367	206	240	198	233	238
Sub-Saharan Africa	187	346	135	263	126	245	261

Notes: Values represent net effects from the beginning to the end of the period and do not reflect movement in the intervening years. Population numbers were obtained from *World Population Prospects: The 2015 Revision* (United Nations 2015b) and thus refer to 1 July for each year indicated. Numbers are based on the medium fertility variant. It is worth noting that population growth is fairly sensitive to the variant used. Global estimates represent approximately 99.4 percent of global population due to labour force participation rates being unavailable for 10 countries: Antigua and Barbuda, Aruba, Curacao, Federated States of Micronesia, Grenada, Kiribati, Mayotte, Seychelles, South Sudan and State of Palestine.

Regions are defined as in the *Human Development Report 2014* (UNDP 2014). The regions included here represented approximately 82 percent of global population in 2010. From 1990-2010, however, they represented 93 percent of global population growth. From 2010-2030, they will represent 104 percent of population growth, indicating declining working-age populations in countries not belonging to any of these regions. A total of 54 countries do not belong to any of these regions, with the 10 largest (ranked by working-age population in 2010) being the United States,

Russian Federation, Japan, Germany, France, United Kingdom, Italy, Republic of Korea, Spain and Poland.

KEY RESULTS

Between 2010 and 2030, approximately 734 million jobs need to be created to accommodate population growth, shifts in the age and sex composition of the population, changing age- and sex-specific labour force participation rates, and achievement of target levels of unemployment of at or less than 4 percent for adults and at or less than 8 percent for youth. This is almost the same number of jobs that were created between 1990 and 2010. In the 1990-2010 time frame, population growth stands out as the primary driver of employment growth, with its effect dampened somewhat by decreasing labour force participation rates and little to no impact from changes in unemployment rates. In the 2010-2030 time frame, population growth remains the primary driver of employment growth, but is magnified by general increases in labour force participation rates, a general shift in the age structure whereby population becomes more concentrated in higher participation age groups, and targeted decreases in unemployment rates.

CHANGES IN WORKING-AGE POPULATION

Tables 1 and 2 summarize global changes in population; labour force participation rates, the labour force, unemployment rates, and employment by age, sex and region. Focusing first on population, we see that the global working-age population increased by roughly 1.3 billion between 1990 and 2010. Projections show an additional increase of 940 million expected between 2010 and 2030. These numbers reflect growth of approximately 40 percent from 1990-2010 and 21 percent from 2010-2030. Looking at the growth rate in conjunction with the absolute value of changes in population highlights that while population growth is projected to slow considerably, the absolute number of people entering the working-age group will not fall off as sharply. While the rate of growth may be cut in half in the later period, there will still be a considerable addition to the working-age population of roughly 72 percent, the observed addition from 1990-2010.

Separating the total working-age population into youth and adult groups provides an interesting look at how the composition of population growth is expected to change. From 1990-2010, increases in the youth working-age population accounted for approximately 17 percent of total population growth. From 2010-2030, however, the proportion of the youth working-age population will drop to only 7 percent of total population growth. In fact, the projected increase in the youth working-age population from 2010-2030 is only roughly 29 percent of the increase experienced from 1990-2010. The projected increase in the adult working-age population from 2010-2030 is roughly 80 percent of the increase from 1990-2010.

This apparent divergence of population growth between the youth and adult working-ages can have significant implications for employment growth (Bloom et al. 2003). From 1990-2010, a higher proportion of additions to the working-age population were in the younger age groups, who tend to have lower labour force participation rates. Thus, while the increase in overall working-age population was higher from 1990-2010, the increase in 2010-2030 is more concentrated in high-participation age groups. Beyond labour force participation, unemployment rates also differ significantly between the two age groups, with youth unemployment rates tending to be considerably higher than adult unemployment rates.

Regionally disaggregating global population changes provides insight into the geographical concentration of population growth and highlights differences in the population trajectory among regions. Among the six regions in our analysis, all but one are projected to experience lower population growth rates from 2010-2030 than from 1990-2010. The one exception is sub-Saharan Africa, where the 76 percent growth experienced from 1990-2010 is expected to increase 3 percent to an anticipated growth rate of 79 percent from 2010-2030. In terms of absolute numbers, the Arab States join sub-Saharan Africa in projecting a larger population increase from 2010-2030 than that experienced from 1990-2010. The Arab States are projected to add approximately 8 percent more people than in 1990-2010, while sub-Saharan Africa is expected to add approximately 85 percent more people.

The largest decrease in population growth among the six regions examined is projected to occur in East Asia and the Pacific. The growth rate from 2010-2030 is projected to be only 4 percent as opposed to the 37 percent growth experienced from 1990-2010. In terms of the absolute number of additional people, only 16 percent of the growth experienced from 1990-2010 is expected to occur from 2010-2030. By contrast, the next largest decrease is projected to occur in Europe and Central Asia where we still expect approximately 52 percent of the growth experienced from 1990-2010.

The drastic gap between East Asia and the Pacific and sub-Saharan Africa in terms of anticipated changes in population growth highlights the difference between where each region lies along its growth trajectory. East Asia and the Pacific has already experienced the bulk of its population boom and is likely past its largest employment hurdle. Sub-Saharan Africa, however, continues to grow at an increasing rate and appears to be in the middle of its largest population boom. Thus, sub-Saharan Africa appears to have yet to face its most difficult job creation challenges.

Overall, the global working-age population is projected to grow approximately 21 percent from 2010-2030, roughly half the growth rate experienced from 1990-2010. In terms of absolute numbers, additions to the working-age population are projected to account for almost three-quarters of those observed from 1990-2010 because of a larger population base in 2010 than in 1990. Additionally, the

growth rate is projected to decline more sharply for youth than adults, exacerbating the challenge of job creation as a higher proportion of growth will be concentrated in higher participation age groups.

CHANGES IN LABOUR FORCE PARTICIPATION RATES

From 1990-2010, global labour force participation rates decreased approximately 2.7 percentage points, with the bulk of this shift being attributable to a decline among youth. By 2030, the overall rate is projected to rebound to a degree, while the youth rate continues to decrease (though at a substantially reduced pace).

From 2010-2030, the ILO projects the global labour force participation rate to be reasonably flat, with a correspondingly small implication for global job creation. At the global level, three forces influence the labour force participation rate: country- and age-specific participation rates, country age structures and the distribution of working-age population size across countries. As we show later, the stability of overall participation rates does not reflect underlying stability in these three sets of influences. During 2010-2030, countries with lower labour force participation rates are expected to gain in population share. The negative effect that this would normally have on the global labour force participation rate is offset by a global tendency for age-specific labour force participation rates to increase and for increased population shares in the ages with higher labour force participation.

Age-specific labour force participation rates can be influenced by a number of factors including, but not limited to, changes in the total fertility rate or changes in education. These two factors are behavioural, unlike accounting effects such as the shifting age structure. We utilize a decomposition analysis structured similarly to the decomposition described in the earlier section on accounting identities to tease out the separate impacts of behavioural and accounting effects on the aggregate labour force participation rate projections. Further, in a later section, we will elaborate on the behavioural effects by attempting to isolate the separate effects of fertility and education on labour force participation rates.

A closer look at the decrease in global labour force participation from 1990-2010 shows some sex and age-group differences. Comparing male and female rates, men experienced a steeper decline of 3.4 percentage points than women, who experienced a decrease of 2 percentage points. The biggest dichotomy occurred between the youth and adult working-age populations. The youth labour force participation rate decreased 11.8 percentage points, while the adult labour force participation rate only fell 0.3 percentage points.

Decomposing changes in the global working-age labour force participation rate into its separate components suggests that decreasing age-specific rates were the primary drivers behind decreases in the labour force participation rate. In fact, if not for a positive effect from a shifting age structure, the overall labour force participation rate would have fallen even further. This implies that a population

shift occurred from the lower participation youth group to the higher participation adult group, partially offsetting the effect of decreasing age-specific rates. The country share of working-age population also had a negative effect on overall labour force participation rates, indicating that population growth from 1990-2010 was somewhat more focused in countries where participation rates were already lower.

While the global labour force participation rate is projected to rebound marginally by 2030, it only reflects an increase of 0.9 percentage points. This increase will be slightly higher for male rates, which are projected to increase by 1.1 percentage points compared with female rates, which are projected to increase by 0.6 percentage points. The youth/adult split is projected to be considerably closer than in the prior period. Youth rates are still expected to decline, but only by 0.5 percentage points. Adult participation rates are projected to remain nearly constant, only increasing by 0.02 percentage points.

Decomposition of labour force participation rate changes between 2010 and 2030 shows that changes in age-specific participation rates are again projected to be the primary catalyst of changes in the overall participation rate. The force of the changes, however, is expected to occur in the opposite direction from that seen in the previous two decades. Shifts in the age structure are again projected to have a positive impact on labour force participation, as the adult group continues to make up a larger share of the working-age population. Changes in country shares of working-age population are projected to have a fairly large negative impact, indicating that population growth continues to be focused in countries with low participation rates.

Disaggregating by region, we find that from 1990-2010, three regions experienced decreasing labour force participation rates (East Asia and the Pacific, Europe and Central Asia, and South Asia) and three experienced increasing labour force participation rates (Arab States, Latin America and the Caribbean, and sub-Saharan Africa). Decomposing the changes in each region's labour force participation rates reveals some interesting regional differences. The Arab States is the only region where the largest effect came from shifting age structures. In fact, the positive effect of the shift in age structures was enough to fully offset the negative effect of decreasing age-specific rates. The Arab States and sub-Saharan Africa are the only two regions where the country shares of working-age population had a positive impact, indicating that for those two regions, population growth was focused in countries with higher participation rates. In fact, for sub-Saharan Africa, this was actually the dominant effect. Interestingly, Latin America and the Caribbean is the only region that experienced increasing age-specific labour force participation rates during this period.

From 2010-2030, changes in age-specific labour force participation rates are projected to have a positive impact on overall labour force participation rates in every region examined. In fact, for all but South Asia and sub-Saharan Africa, increasing age-specific participation rates are projected to be

the primary driver behind increasing overall participation rates. For South Asia and sub-Saharan Africa, the primary driver is projected to be shifts in the age structure, although the projected effects are much more evenly distributed in sub-Saharan Africa than in any other region. In the Arab States, East Asia and the Pacific, and Europe and Central Asia, changes in age-specific rates are projected to cause all positive effects, with shifts in the age structure and country shares of working-age population tempering these positive effects. Increasing age-specific rates are primarily expected to drive increased labour force participation in Latin America and the Caribbean. Shifts in the age structure are expected to have an additional positive effect, while a slight negative effect is expected due to changes in country shares of working-age population.

CHANGES IN UNEMPLOYMENT RATES

To this point, we have covered all components of employment other than unemployment rates. Rather than attempting to project unemployment rates out to 2030, we instead treat unemployment in two ways. The first projection of employment needs from 2010-2030 assumes constant unemployment rates at 2010 levels. The second projection assumes the target unemployment rates described in footnote 3, resulting in rates of at or less than 4 percent for adults and at or less than 8 percent for youth. In 2010, the global unemployment rate was approximately 6.1 percent. Split out for the two age groups, it was roughly 12.9 percent for youth and 4.6 percent for adults. We do not assume different targets on the basis of sex, therefore we assume targets of 4 percent for male and female adults and 8 percent for male and female youths.

TOTAL CHANGES IN EMPLOYMENT

Using equation (2) to combine the component changes described in the previous sections, we find that globally from 1990-2010, employment increased by 757 million, reflecting employment growth of approximately 35 percent. Projecting forward to 2030 and assuming a constant 2010 unemployment rate, we expect further additions of 659 million, or growth of roughly 23 percent. Taking into account the unemployment rate targets described above, we project an additional increase of 75 million, driving the growth rate from 23 percent to 25 percent. Focusing on the projections that assume our target unemployment rates, we find that while the growth rate of employment has decreased by 10 percentage points, the actual number of jobs needed by 2030 is approximately 97 percent of the number created between 1990 and 2010. While the challenge ahead clearly remains substantial, we can draw on experiences from 1990-2010 in creating the necessary jobs.

As far as employment trends by sex are concerned, no significant differences exist between time periods, but important differences occur between sexes within each period. Due to significant differences in labour force participation rates, nearly equal changes in male and female populations do not translate into equal changes in the labour force or employment. While female population

growth from 1990-2010 accounted for approximately 50 percent of all population growth, women only accounted for 41 percent of the changes in the labour force and 40 percent of changes in employment. This is due to women having significantly lower labour force participation rates compared with men; in 2010, the participation rates were 55.3 percent for women and 81.4 percent for men in the working-age population. The projected trends for 2010-2030 are nearly identical, deviating only by a few percentage points. Due to only very slight projected changes in male and female labour force participation rates, this dichotomy between male and female labour force participation and employment is not projected to converge by 2030.

As we saw above, significant differences in labour force participation rate changes occurred between youth and adult groups from 1990-2010. Youth participation rates decreased by more than 10 percentage points over this period, which led to decreasing youth employment in spite of an increasing youth population. From 2010-2030, however, the youth labour force participation rate is projected to remain nearly constant. With this and with youth population still growing in this time frame (albeit at a lower rate than in the prior period), we expect an increasing youth labour force necessitating higher rates of 'entry-level' job creation than in the prior period.

Compounding this need to create jobs for youth is our unemployment rate target. If we were only concerned with absorbing the growing youth population and maintaining a constant unemployment rate, we would need to create approximately 16 million new jobs. To reduce the unemployment rate to the target level, however, we require an additional 33 million jobs, bringing the total to roughly 49 million jobs. Strikingly, this 33 million represents nearly 45 percent of employment needs driven by our target unemployment rates. Considering that, in 2010, the youth labour force was approximately one-fifth the size of the adult labour force, youth jobs driving close to 45 percent of all unemployment-related growth is remarkable.

Utilizing the decomposition analysis in the section on accounting identities, we find that, due to increasing labour force participation rates and decreasing unemployment rates, job creation from 2010-2030 is not quite as intrinsically tied to population growth as in the prior period. While population maintains its role as the primary driver behind these changes, changes in labour force participation and unemployment rates will play a larger role, accounting for 6.1 percent and 10.1 percent of job creation respectively. This deviates markedly from 1990-2010, when decreasing labour force participation rates actually tempered the task of job creation and decreasing unemployment rates only accounted for approximately 1 percent of changes.

Examining this decomposition analysis separately for youth and adult workers highlights an interesting example of Simpson's Paradox, a phenomenon in statistics in which a pattern that appears in different subgroups or time periods of data disappears when they are combined (Pearl 2014). Unemployment rates increased for both groups from 1990-2010, which had a negative effect

on employment. The overall unemployment rate for the 15-64 working-age population, however, decreased during the same time frame, which had a positive effect on employment. This inconsistency between the aggregated and disaggregated unemployment rates can be attributed to shifts in the underlying weights of the youth and adult populations. Approximately 31 percent of the working-age population belonged to the 15-24 age group in 1990. By 2010, this proportion had fallen to 27 percent. Thus, even though unemployment rates increased for both groups, a shift occurred from the higher unemployment rate youth group into the lower unemployment rate adult group, leading to a decrease in the overall unemployment rate.

Focusing on regional differences in projected job creation by 2030, we find that more than half of these jobs will need to be created in two regions: sub-Saharan Africa and South Asia. Sub-Saharan Africa in particular faces a substantial challenge, with job needs by 2030 being more than double the number created between 1990 and 2010. For South Asia, the number of jobs that will need to be created by 2030 is roughly 20 percent higher than the number of jobs created from 1990-2010. While these two regions present the most demanding job creation challenges, the Arab States and Europe and Central Asia also face a difficult task in the number of jobs that will need to be created compared with 1990-2010. As these two regions are the smallest of the six analysed, however, the increases do not represent as significant a proportion of global job creation needs from 2010-2030.

The remaining two regions are actually projected to have lower job creation needs than they did from 1990-2010. The difference is particularly stark in East Asia and the Pacific, where the 2010-2030 projections are roughly 28 percent of what they generated between 1990 and 2010. It is interesting to note that from 1990-2010, only one region (South Asia) had higher population growth than East Asia and the Pacific. From 2010-2030, population growth will drop dramatically for East Asia and the Pacific, while remaining more consistent in South Asia. Thus, two regions that followed a similar path over the first period are projected to diverge significantly over the second period. Based solely on changes in the working-age population, East Asia and the Pacific appears to have experienced the brunt of absorbing its population boom into employment (Bloom and Williamson 1997), whereas South Asia appears to be in the middle of this task and sub-Saharan Africa will be experiencing it between 2010 and 2030 (and potentially beyond if the 40-year employment growth span witnessed in South Asia is any indication).

Applying the same decomposition analysis from before highlights the different influence of demographic drivers across regions. From 1990-2010, three regions had decreasing labour force participation rates: East Asia and the Pacific, Europe and Central Asia, and South Asia. This implies that the number of jobs created in these three countries was actually tempered during this period, as a lower proportion of their growing population was entering the labour force. Labour force participation rates had the highest positive impact in Latin America and the Caribbean, accounting

for approximately 19 percent of job creation. Job creation in every other region was almost solely reflective of increasing population, with only a small impact from changes in unemployment rates.

From 2010-2030, the two regions where the majority of jobs need to be created are also those with the highest population effect. Ninety percent of employment needs in sub-Saharan Africa and 88 percent of employment needs in South Asia are attributable to increasing population. Labour force participation rates are expected to increase in all regions, while unemployment rates need to decrease in all regions to reach the targets. Thus, both of these factors have a positive effect on employment needs in each region and have a greater influence on job creation than in the prior period. This is especially apparent in Europe and Central Asia, where these two factors combined account for 53 percent of job creation. This is the only region where population changes are not expected to account for the bulk of employment growth.

Decent work

DEFINITION

As the foregoing analysis demonstrates, demographic change is ensuring a continuing job creation challenge. Projected job creation from 2010-2030 remains remarkably close to the number created from 1990-2010. Notwithstanding decreasing rates of population growth, we are faced with high levels of job creation due to increasing labour force participation rates, shifting age structures and a desire to reduce the unemployment rate. The challenge, however, is not just the number of jobs that need to be created, but the quality of those jobs; to that end, we examine the ideal of decent work (ILO 2001).

In 1999, ILO Director General Juan Somavia described decent work as "opportunities for women and men to obtain decent and productive work in conditions of freedom, equity, security and human dignity" (ILO 1999). The United Nations subsequently adopted a set of Millennium Development Goals (MDGs) that ran through 2015, including Target 1.B, to "achieve full and productive employment and decent work for all, including women and young people" (United Nations 2008). A series of Sustainable Development Goals was agreed in 2015, including Goal 8, to: "Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all" (United Nations 2015a).

A good starting point for elaborating the definition of decent work lies in the ILO Declaration on Fundamental Principles and Rights at Work (ILO 1998), adopted in 1998, and including the following:

- Freedom of association and the effective recognition of the right to collective bargaining,
- The elimination of all forms of forced or compulsory labour,
- The effective abolition of child labour, and
- The elimination of discrimination in respect of employment and occupation.

Jobs that do not abide by these standards cannot be considered decent work, but other aspects of decent work are not fully captured by these standards (Anker et al. 2002, Fields 2003). Some of these other aspects are encapsulated by the four indicators reported in the MDG databank (World Bank 2014): the employment-to-population ratio, the proportion of employed people living below $1 (purchasing power parity or PPP) per day (the poverty ratio), the proportion of own-account and contributing family workers in total employment (vulnerable employment), and the growth rate of gross domestic product (GDP) per person employed (i.e., labour productivity). In addition, we consider total public social expenditure as a percentage of GDP as a potential indicator of decent work.

The availability of these indicators varies significantly across countries, and attempting to create a decent work index is beyond the scope of this paper. We have correlated each of these indicators with stage of development (defined in two ways: human development group and country income group). Our assumption is that countries that find themselves on the lower ends of the human development or country income scales are less likely to have well entrenched traditions of decent work. The correlation coefficients are reported in Table 3, and all of these indicators are highly correlated with both human development group and country income group. As such, we are comfortable using these two groups as proxies for whether or not decent work prevails in the countries in question. From the indicators tracked in the MDG databank, it is apparent that an important aspect of decent work has to do with pay. Specifically, the poverty ratio deals with people who are employed but subsist on less than $1 (PPP) per day, and a high poverty ratio can be considered an indicator of indecent work (Fields 2003, ILO 2000). This can be seen in Table 3, where negative correlations between the poverty ratio and our proxies indicate that countries lower on the spectrum of human development or country income group are those where the poverty ratio tends to be high.

One more aspect of decent work has to do with unemployment, as being employed in decent work is impossible if one is not employed at all. While we deal specifically with unemployment in our analysis, we do not deal with the related aspect of underemployment. Underemployment consists of three subcategories: high-skilled workers in low-paying jobs, high-skilled workers in low-skill jobs, or part-time workers who would prefer to be full-time (Fields 2003, ILO 2000). Because these three

subcategories are not incorporated in unemployment, we have abstracted from them in our analysis. But, insofar as underemployed workers should not be considered as holding decent jobs, the projections estimated in this paper should be considered conservative as to the number of individuals for whom decent work will need to be generated.

Table 3: Correlation coefficients between decent work indicators and stage of development

Stage of development scale	GDP per employed person	Total public social expenditure	Poverty ratio	Vulnerable employment, total	Vulnerable employment, male	Vulnerable employment, female
Human development group	0.7915	0.7043	-0.7458	-0.8136	-0.7896	-0.8147
Country income group	0.8552	0.7345	-0.6401	-0.7939	-0.7753	-0.7854

Table 4: Summary Statistics of labour force participation rates and unemployment rates by stage of development (percentages)

	Labour force participation rates			Unemployment rates		
	1990	**2010**	**2030**	**1990**	**2010**	**2030 (targeted)**
Global						
Ages 15-64	71.2	68.4	69.4	6.4	6.1	4.0
Human development group						
Very high	69.7	71.4	73.5	7.0	8.3	4.4
High	76.9	72.1	73.1	6.6	5.5	3.9
Medium	64.9	61.8	63.3	5.5	5.5	3.5
Low	68.3	69.1	70.9	6.6	6.4	4.6
Country income group						
High-income	70.8	71.8	73.7	7.8	8.3	4.4
Upper-middle-income	76.3	71.5	72.3	6.3	5.8	3.9
Lower-middle-income	63.5	60.7	62.2	5.7	5.5	3.7
Low-income	77.9	77.4	80.0	5.2	5.3	4.2

Notes: Values represent net effects from the beginning to the end of the period and do not reflect movement in the intervening years. Global estimates represent approximately 99.4 percent of global population due to labour force participation rates being unavailable for 10 countries: Antigua and Barbuda, Aruba, Curacao, Federated States of Micronesia, Grenada, Kiribati, Mayotte, Seychelles, South Sudan and State of Palestine. Countries are classified into human development groups based on UNDP's Human Development Index 2013. Countries are classified into country income groups based on the World Bank's country income classifications set on 1 July 2014.

Table 5: Estimated changes in population, labour force and employment during 1990-2010 and 2010-2030, by stage of development (millions)

	Change in population		Change in labour force		Change in employment 1990-2010	Change in employment 2010-2030	
	1990-2010	2010-2030	1990-2010	2010-2030		Constant 2010 unemployment rate	Unemployment rate targets of at or less than 4 percent for adults and at or less than 8 percent for youth
Global							
15-64	1,300	940	799	695	757	659	734
Human development group							
Very high	107	-3	88	14	75	13	35
High	430	49	248	52	244	51	70
Medium	498	457	281	309	267	296	315
Low	255	432	179	317	168	296	310
Country income group							
High-income	107	-19	84	2	74	2	26
Upper-middle-income	460	107	270	90	259	85	109
Lower-middle-income	544	555	302	369	288	351	371
Low-income	186	297	143	234	135	221	228

Notes: Values represent net effects from the beginning to the end of the period and do not reflect movement in the intervening years. Population numbers are obtained from *World Population Prospects: The 2015 Revision* (United Nations 2015b) and thus refer to 1 July for each year indicated. Numbers are based on the medium fertility variant. It is worth noting that population growth is fairly sensitive to the variant used. Global estimates represent approximately 99.4 percent of global population due to labour force participation rates being unavailable for 10 countries: Antigua and Barbuda, Aruba, Curacao, Federated States of Micronesia, Grenada, Kiribati, Mayotte, Seychelles, South Sudan and State of Palestine. Countries are classified into human development groups based on UNDP's Human Development Index 2013. Countries are classified into country income groups based on the World Bank's country income classifications set on 1 July 2014.

KEY RESULTS

Demographic changes have been, and will continue to be, the main drivers behind a growing global challenge of providing decent employment. This challenge is especially concentrated in low-income and low human development countries where population growth rates are above the world average, and traditions of decent work are not well entrenched.

Although low and medium human development (low- and lower-middle-income) countries comprised slightly less than half of world population in 2010, they are projected to account for more than 80 percent of job creation needs between 2010 and 2030. This concentration of job creation needs is in large part attributable to these countries accounting for a disproportionate share of population growth, with more than 90 percent of all population growth projected to occur in low and medium human development (low- and lower-middle-income) countries. General increases in labour force participation, a shift in the age structure from low-participation youth to high-participation adults, and targeted decreases in unemployment rates magnify these population size influences on our employment projections in these groups of countries.

CHANGES IN WORKING-AGE POPULATION

Tables 4 and 5 summarize global changes in population, labour force participation rates, the labour force, unemployment rates and employment by stage of development. Examining population growth trends by human development and country income groups immediately shows a fairly drastic split between countries on the low and high end of each scale, and a significant shift in the distribution of population growth between periods. Among human development groups from 1990-2010, growth was most concentrated in the lower two groups (medium and low). These two experienced growth greater than 50 percent, at 56 percent for medium and 77 percent for low. Further, in terms of absolute numbers, these two groups combined accounted for 58 percent of total population growth from 1990-2010. The high human development group, however, actually saw a significantly larger increase than the low in terms of absolute numbers, with additions of 430 million people compared with 255 million. Combined, the high and medium groups accounted for 71 percent of total population growth during this period.

From 2010-2030, we expect to see population growth even more concentrated in medium and low human development countries. During this period, these two groups combined are projected to account for 95 percent of all population growth. In terms of absolute numbers, medium countries will experience 92 percent of the additions already experienced, while low countries will add 169 percent of the population they added from 1990-2010. By contrast, working-age population in very high human development countries is actually expected to decrease slightly, by approximately 0.4 percent. High countries are only expected to grow by roughly 3 percent, a far cry from the 33 percent they grew from 1990-2010.

Looking at population growth by country income group paints a similar picture, with growth concentrated in the low- and lower-middle-income groups. From 1990-2010, these two groups were the only ones that experienced population growth greater than 50 percent, with 55 percent for lower-middle-income countries and 71 percent for low-income countries. In terms of absolute numbers, however, upper-middle and lower-middle-income countries experienced the largest additions, accounting for 77 percent of total population growth.

Once again, from 2010-2030 we project population growth to become more concentrated in the lowest country income groups. In terms of absolute numbers, population growth will exceed its 1990-2010 value in both lower-middle- and low-income countries. Lower-middle-income countries can expect to add approximately 102 percent of their 1990-2010 additions, while low-income countries can expect additions of roughly 160 percent of their 1990-2010 additions. Combined, these two groups are expected to account for 91 percent of total population growth from 2010-2030.

CHANGES IN LABOUR FORCE PARTICIPATION RATES

Between 1990 and 2010, participation rates increased in very high and low human development countries, while they decreased in high and medium human development countries. The magnitude of the change was greater in the groups that experienced declines, with participation rates falling by 4.8 percentage points in high countries and 3.1 percentage points in medium. Increases in participation rates were 1.7 percentage points in very high countries and 0.8 percentage points in low countries. Changes in age-specific participation rates were the predominant driver of participation rate changes in all groups. In low human development countries, shifts in the country shares of working-age populations actually partially offset the positive impact of increasing age-specific rates, indicating that population growth was more concentrated in countries with lower participation rates. This holds true for all groups, with the other three experiencing smaller effects. Changes in the age structure positively affected all groups, indicating higher proportions of adult working-age populations in all groups.

Projecting changes in labour force participation rates through 2030, we expect increasing rates in all human development groups. Our decomposition of participation rates shows an interesting difference between the two highest and lowest groups. Very high and high human development groups are expected to get the largest positive effect from increasing age-specific rates. Simultaneously, these two groups expect negative effects from both changes in the age structure and changes in country shares of working-age populations, significantly dampening the positive effect of their increasing age-specific rates. Medium and low human development countries, however, can expect the largest positive benefit to come from shifts in their age structures, seeming to indicate large youth cohorts moving into the adult working age over the coming two decades. Increasing age-specific rates additionally provide a positive impact, but are not as important as in the other groups. Only low human development countries can expect a positive effect from changes in the country share of working-age population.

Turning to country income groups, we find that only high-income countries experienced increasing labour force participation rates from 1990-2010. Here, increasing age-specific rates were the primary drivers behind increased labour force participation rates, with a smaller positive boost from a shifting age structure. Decreasing age-specific rates were the primary drivers behind

decreasing labour force participation rates in the remaining three groups. Each of these three groups, however, also experienced a positive, slightly offsetting effect from shifting age structures, suggesting higher proportions of workers in the adult working-age population.

We find a few different trends by country income group when projecting participation rates through 2030. All groups are expected to experience increasing labour force participation rates, with high, upper-middle and lower-middle-income countries expected to see increasing age-specific rates. This will be the primary driving factor for high- and upper-middle income countries, where the positive effect is partially offset by shifting age structures and changes in the country shares of working-age populations. Lower-middle-income countries, however, will receive their largest boost from shifts in age structures, with a slight offsetting negative effect from changes in the country share of working-age population. In contrast, increasing labour force participation rates in low-income countries are entirely driven by shifting age-structures, with both other components having a dampening effect.

TOTAL CHANGES IN EMPLOYMENT

Among human development groups, the distribution of job creation needs splits rather drastically between 2010 and 2030. Mirroring the split in population growth, approximately 85 percent of these jobs are concentrated in countries classified as low or medium human development, based on the Human Development Index. Further, both of these groups are projected to face a more difficult task than previously. In comparison with the number of jobs created between 1990 and 2010, the number required from 2010-2030 is expected to be approximately 18 percent higher in medium human development countries and 85 percent higher in low human development countries. In contrast, very high and high human development countries face easier paths forward, particularly the high human development countries, where the anticipated need for jobs is roughly one-third of the number created between 1990 and 2010.

Decomposition analysis for human development groups provides valuable insight into the composition of job creation needs in each period. For each group, the primary driver of job creation from 1990-2010 was an increasing working-age population. This population effect was partially offset in high and medium human development countries, which experienced decreasing labour force participation rates. Unemployment rates played a more minor role in each group, although they had a larger negative role in very high human development countries.

From 2010-2030, we expect a negative effect of population on employment needs for very high human development countries, as population is projected to decrease by approximately three million in these countries. Population remains the largest positive contributor for all other groups, driving more than 85 percent of the need for job creation in medium and low human development countries.

Labour force participation rates are projected to have the largest positive effect in very high and high human development countries. Likewise, unemployment rates are projected to decrease to reach our target levels, and the largest positive effect from these will be experienced by very high and high human development countries.

Turning our attention to country income groups, a similar split in job creation needs is evident from 2010-2030, where 82 percent is concentrated in countries classified as either low or low-middle income. By comparison, high-income countries are projected to make up roughly 4 percent of employment needs. Once again, the two classifications facing the greatest challenge are those with the highest projected population growth. Additionally, low- and lower-middle-income countries both face a tougher task than they experienced between 1990 and 2010. Lower-middle-income countries are projected to need to generate approximately 29 percent more jobs than in 1990-2010, while low-income countries are faced with the prospect of generating approximately 69 percent more jobs. Both upper-middle- and high-income countries are projected to need to generate less than half of the number generated between 1990 and 2010. Interestingly, upper-middle-income countries experienced the second largest growth in employment from 1990-2010, but low-income countries are projected to overtake that growth between 2010 and 2030 as upper-middle-income country employment needs fall and low-income country employment needs rise.

Revisiting our decomposition analysis, now for country income groups, we find some interesting trends. From 1990-2010, upper-middle-, lower-middle-, and low-income groups all had decreasing labour force participation rates, which offset a portion of the significant population effect. High-income countries, however, experienced increasing labour force participation rates, but simultaneously increasing unemployment rates partially offset these effects. Outside of high-income countries, unemployment rates had a negligible effect from 1990-2010.

Examining trends from 2010-2030, an even greater divergence occurs between high income and other countries. We find that the working-age population is actually declining for the high income group, signifying that all employment needs result from changes in labour force participation and unemployment rates. In fact, our target of decreasing unemployment rates seems to be the primary driver, accounting for more than 80 percent of projected job creation. Population growth remains the predominant driver of the need for jobs in the other three groups, with upper-middle-income countries having a higher proportion of job creation needs due to labour force participation and unemployment rates than the other two. Population growth is still expected to account for 88 percent of needs in lower-middle-income countries and 96 percent in low-income countries.

Behavioural effects of fertility and education on labour force participation

DESCRIPTION OF DATA

To estimate the behavioural impact of changes in fertility and education on employment through labour force participation rates, we use the data set underlying "Fertility, Female Labor Force Participation, and the Demographic Dividend" by Bloom, Canning, Fink and Finlay (2009, henceforth BCFF). To tailor this data set specifically to the questions at hand, we also supplement projections out to 2030 of the total fertility rate from *World Population Prospects* (United Nations 2015b) and mean years of education from the International Institute for Applied Systems Analysis (IIASA 2010).

Some important differences exist between our full dataset (henceforth BM) and the BCFF data set. Notably, BCFF only extends through 2000, with coverage of 97 countries, accounting for approximately 80 percent of global population. Population coverage in BCFF varies considerably across regions. For example, Europe and Central Asia in these data only includes one country that accounts for approximately 30 percent of the population in that region, while South Asia includes six to seven countries depending on the year of analysis, and covers between 98-99.9 percent of the total population in the region.

Comparisons between the two data sets can also be drawn on the basis of total fertility rates, labour force participation rates and mean years of schooling. Global fertility was approximately 2.73 in 2000 (United Nations 2015b). The weighted average of the total fertility rate across the countries included in the BCFF data is 2.64. As for labour force participation rates, BCFF includes data on participation rates for a more limited subset of age groups, specifically 20-44 years in five-year age bands. For analysis of the effect of fertility and education on labour force participation, this does not pose a significant problem because the effects of both fertility and education are likely negligible for the 15-19 and 45-64 age groups. The global female labour force participation rate for the 20-44 year-old age group was approximately 64 percent in 2000 (United Nations 2015b). The weighted average of the female labour force participation rate for the 20-44 year-old age group across the countries included in the BCFF data in 2010 is 65 percent. Mean years of schooling for the full set of countries in the Barro-Lee database is approximately 7.19. For the subset of countries included in the BCFF data, mean years of schooling is roughly 7.04. As such, the countries included in these data seem to be a fair representation of global population as a whole, as they do not significantly deviate from expected values in key variables.

MODEL

The effects of changes in fertility on employment can be divided into an accounting and a behavioural effect (Bongaarts 1978). The accounting effect is simply that population growth slows due to declining total fertility rates. This decline in population growth leads to fewer entrants to the labour force, therefore easing the task of job creation. The behavioural effect has to do with a higher proportion of women entering the labour force, driving up their labour force participation rates and requiring more jobs to accommodate them (Prettner et al. 2013).

The following analysis relies on regressions used in BCFF where age-specific female labour force participation rates are a function of the total fertility rate, the percentage of the population living in urban areas, physical capital per working-age person, the infant mortality rate, the average years of schooling of men and women, and country and time fixed effects. Abortion legislation is used as an instrument for fertility. The model is run separately for five age-specific labour force participation rates (20-24, 25-29, 30-34, 35-39 and 40-44). The data and results from BCFF provide a causal link between the total fertility rate and female labour force participation. As such, we isolate the effect of fertility on labour force participation by using these regressions to project the female labour force participation rate while allowing only the total fertility rate to vary over time. Utilizing the accounting identities presented in equations (1a–d), we trace through the effect of changes in fertility on female labour force participation to estimate projections of job creation needs for women attributable to the concurrent effect of changing fertility.

We should note that our prior analysis of changes in female employment relied on projected labour force participation rates obtained from the ILO, which differ from what this model projects. The BCFF model isolates the effect of changes in fertility and projects higher female labour force participation rates. The ILO projections rely on a two-step procedure of mechanic projections and judgemental adjustments (ILO 2010, ILO 2013a). Two mechanic projections are calculated: a constant scenario that is used as a reference point and a logistic trend scenario that combines projections from four variations of their basic equation. Two of the variations used in the logistic trend scenario include two variables that are of particular interest in comparison with our analysis: the share of children (0-14) in the total population and the share of older persons (60-plus) in the total population. Additionally, contrary to the analyses undertaken in the ensuing sections, the ILO projections do not explicitly account for projected changes in educational attainment. To the extent that mean years of schooling are expected to increase over time, the ILO projections may fall short of what our model predicts.

Based on this approach, our estimates of female labour force participation may be higher than the ILO estimates for several reasons. Because the ILO takes account of the share of older persons, the effect of fertility may be offset to an extent. Perhaps as populations age and mortality increases,

the burden on women of caring for family members shifts from children to older persons. It is conceivable that even with having to care for fewer children, having to care for parents who are living longer offsets the beneficial effect of fertility on female labour force participation. Another possibility is that the inclusion of models that do not account for these dependency rates in their combination may somewhat depress the effect of fertility on labour force participation. As the goal of our analysis is to isolate the separate impacts of fertility and education, we are not concerned that we have obtained different labour force participation projections from the ILO, as any factors that may offset the effect of fertility should not change the isolated effect.

Table 6: Isolating the impact of changes in fertility or education on employment during 2010-2030

	Change in fertility/ education	Change in labour force participation rate (percentage points)	Change in employment (assuming constant labour force participation rates at 2010 levels, in millions)	Change in employment (using BCFF projected labour force participation rates, in millions)	Change in employment (isolated effect due to change in fertility or education, in millions)
Effect of fertility on female labour force participation rate	-0.25	3.6	232	323	91
Effect of education on female labour force participation rate					
Male effect	0.94	-2.3	234	177	-58
Female effect	1.39	2.7	234	302	68
Net effect		0.4	234	245	11
Effect of education on male labour force participation rate					
Male effect	0.94	0.2	379	384	5
Female effect	1.39	-0.9	379	356	-24
Net effect		-0.7	379	361	-18

Notes: Projections of labour force participation rates are based on BCFF data and model. They are then applied to the BM population data to obtain an estimate of employment needs for the global population. Projections of changes in labour force participation rates are based on the 20-44 age group. We assume negligible effects of

fertility and education on the 15-19 and 45-64 groups, and apply these changes to the 15-64 age group as a whole. Net effects of education are simply the sum of male and female effects.

FERTILITY EFFECT

Table 6 traces through the impact of changes in total fertility rates and education on employment, through labour force participation rates, from 2010-2030. We isolate the effects of fertility and education by taking the difference between projections of employment that use constant labour force participation rates at 2010 levels and projections that use labour force participation rates as projected through the BCFF model. Due to the scope of the data described previously, projections from the BCFF model are applied to population values from the BM data set. This provides estimates of fertility and education effects extended to a global scale as opposed to the subset of countries included in the BCFF. Further, we assume negligible effects of fertility and education in the 15-19 and 45-64 age groups, allowing us to apply these projections to the 15-64 working-age population.

Turning our attention first to the impact of fertility, declining global total fertility rates suggest increasing female labour force participation rates. From 2010-2030, the global total fertility rate is projected to decrease by approximately 0.25, resulting in a projected increase in female labour force participation of 3.6 percentage points. Assuming constant labour force participation rates at 2010 levels, we find that approximately 232 million women globally would need jobs. Allowing age-specific labour force participation rates to change as a result of decreasing fertility as projected in the BCFF model, we find an additional 91 million women requiring jobs. This reflects roughly a 28 percent increase in the number of women seeking employment due solely to changes in fertility. By contrast, the ILO projections estimate an increase of only 0.6 percentage points in female labour force participation between 2010 and 2030. As touched upon above, because we are calculating the isolated change in labour force participation due to changes in fertility, several factors could explain the sizeable difference between the values discussed here and those reported in Table 2.

EDUCATION EFFECT

Before discussing our estimates of the effect of education on employment, one caveat deserves mention. Our education analysis uses different time frames for the male and female regressions. The female regression utilizes available labour force participation rates from 1960-2010, while the male regression only utilizes labour force participation rates from 1990-2010. The BCFF data set was designed with the goal of estimating the effect of fertility on female labour force participation rates and thus did not include male rates. As such, we supplemented the data with male rates from the BM data. Values prior to 1990, however, were not included in that data set and were not fully populated in the ILOSTAT database (ILO 2013b) used to extract labour force participation rates. With this in

mind, we have examined the male regressions to ensure that the coefficients on the two education measures behave in a reasonable manner and are confident that the values reported are reliable estimates reflective of the underlying further reaching trend.

Examining net effects of education on labour force participation rates tends to mask the underlying pattern of offsetting effects from changes in male and female education. Increasing male education has a negative impact on female labour force participation and a positive impact on male labour force participation. Meanwhile, increasing female education has a negative impact on male labour force participation and a positive impact on female labour force participation. These findings are consistent with the story that male earnings have an income effect on female labour supply, thus lowering female work incentives. Additionally, there is a substitution effect of female earnings on female labour supply, increasing female work incentives (Goldin 1995). The substitution effect dominates the income effect, and thus the net effect of changing education on female labour force participation is positive. The same trend holds true for male labour force participation, resulting in a negative net effect of education on male participation rates and employment.

From 2010-2030, mean years of schooling are projected to increase by 0.94 for men and 1.39 for women. The increase in male education corresponds to a projected decrease in the female labour force participation rate of 2.3 percentage points and a projected increase in the male labour force participation rate of 0.2 percentage points. The increase in female education corresponds to a projected increase in the female labour force participation rate of 2.7 percentage points and a projected decrease in the male labour force participation rate of 0.9 percentage points. Summing the individual effects of education, we find net effects of a 0.4 percentage point increase in female labour force participation and a 0.7 percentage point decrease in male labour force participation.

Interestingly, the female labour force participation rate seems to be more sensitive to changes in sex-specific education than the male rate. The net effects dilute this sensitivity, however, and leave us with a result in which male labour force participation appears to be more sensitive to changes in education. Tracing through these net effects, we find the isolated effect of education on employment for women to be an addition of 11 million jobs. For men, we find that changes in education reduce the number of jobs needed by approximately 18 million. Thus, changes in education increase the number of jobs needed for women by approximately 5 percent, while reducing the number of jobs needed for men by approximately 5 percent. This further outlines the importance of looking separately at sex-specific effects of education, as even the overall effect of education on labour force participation is offsetting.

Conclusion

A TRANSITORY ISSUE

While the world faces a formidable task of job creation through 2030, reason for optimism exists regarding the challenge post-2030. Job creation requirements between 2010 and 2030 predominantly reflect population growth in the prior two decades, which was the largest period of population growth in history. Because of these lags in the effect of fertility, currently decreasing fertility and population growth rates imply that this is a transitive issue rather than a permanent one.

From 1990-2010, the working-age population grew faster than the labour force did. Between 2010 and 2030, however, the reverse is projected. The differences in youth and adult population growth can partially explain this reversal in growth rates. From 2010-2030, the youth population is projected to grow by 5 percent, a considerably lower growth rate than the adult population growth rate of 27 percent. This is due primarily to decreasing fertility and population growth leading to low rates of replacement in the youth working-age population. The adult working-age population will continue to grow at a much higher rate due to large youth cohorts moving into the adult population in the near future.

REVERSE CAUSALITY

While we have focused primarily on the effect demographics have on decent work, there could be a reverse causality story here. Increases in decent work could likely have an impact on future demographics. As was touched upon previously, creating decent work involves both absorbing new members of the labour force into employment and restructuring existing work to ensure that it is decent. As a higher proportion of the population is employed in decent work, fertility is likely to decrease further. This is especially true if a high proportion of women become decently employed, as they will have less incentive to leave the workforce due to the quality of the jobs they hold. As fertility declines, it becomes easier for children to attain higher levels of education. With fewer children, a higher investment in human capital per child can occur (Lee and Mason 2010a). As the average level of education increases, the quality of workers increases, requiring a further enhancement of the type of jobs available. This reverse causality would have a considerable lag though, perhaps a generation long, as it depends on the investment of benefits earned through decent work into enhancing the human capital of the children of those employed in decent work.

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