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Cashing in the demographic dividend[1]

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PRELIMINARY DRAFT

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Abstract

This paper analyzes the effect of demographic change across countries in different stages of demographic transition, by taking into consideration two key channels of market integration, trade and migration across the world. While approximately half of the global population is currently living in countries that are quickly aging with a shrinking share of working age population, the other half still live in countries foreseeing an opportunity of realizing the first demographic dividend, with an increase share of working age population. This asymmetric stage in demographic transition across countries will alter both the relative sizes and the comparative advantages of countries in the global marketplace.

1. Introduction

This paper analyzes the effect of demographic change on growth, savings and poverty reduction, across countries in different stages of demographic transition taking into account their interactions through trade and migration in a general equilibrium setup. While approximately half of the global population is currently living in countries that are quickly aging with a shrinking share of working age population, the other half still live in countries foreseeing an opportunity of realizing the first demographic dividend, with an increased share of working age population. This asymmetry of demographic change across countries will alter both their relative sizes and the comparative advantages in the global marketplace. This process has important implications on the distribution of the global workforce in different stages of development, where growth challenges from a shrinking working age population in high- and upper-middle income countries, can be translated in opportunities for low- and lower-middle income countries through further market integration.

We take as given the demographic forces of countries around the world and ask, in turn, how trade and migration can boost potential demographic dividends. Specifically, we ask three key questions regarding demographic change, trade and migration:

a) What are the expected effects of demographic change on per capita GDP growth and poverty reduction for countries in different stages of demographic transition by 2030?
b) What is the potential contribution of improvements in trade facilitation to GDP growth and poverty reduction by 2030?
c) What is the potential contribution of migration to GDP growth by 2030?

To address these questions, we analyze scenarios related to demographic change, trade facilitation and migration for the global economy. We group countries following a demographic typology presented in World Bank (2015), where countries were classified according to their potential to benefit from demographic dividend. Thus, countries are defined as pre-, early-, late, and post-dividend. The scenarios are build using a Computable General Equilibrium (CGE) global dynamic model in combination with a microsimulation tool based on harmonized household surveys data, covering a large number of countries and more than 90 percent of global population. We follow a methodology presented in Ahmed et. al. (2016) and Devarajan et. al. (2015), which combines results from the LINKAGE (CGE) model with the Global Income Distribution Dynamics (GIDD) model to generate poverty scenarios.

This paper aims to contribute to a policy discussion related to how countries can benefit from a diverse stage of demographic transition to boost growth and reduce global poverty. There is a large literature analyzing the effects of demographic change on growth (Bloom and Williamson, 1998; Higgins and Williamson, 1997; Bloom and Canning, 2005; Kelly and Schmidt, 2005, Eastwood and Lipton, 2011) and poverty (Birdsall, 2001, Paes de Barros et. al., 2015; Cruz and Ahmed, 2016) using partial equilibrium analysis. However, there is no much evidence on the effect of demographic change and its interaction with trade, trade facilitation and migration, taking into consideration general equilibrium effects, on the global economy, and in particular on global poverty.

Our results suggest that demographic change can boost per capita income growth in pre- and early-dividend countries, but it may dampen growth prospects in aging countries and for the global economy. In pre- and early-dividend countries, where the share of working-age population will increase, demographic change could account for 0.5 to 0.8 percentage points of annual GDP per capita growth, over 2015–30 given the right enabling conditions. At the same time, even though per capita growth is expected to be high in late-dividend countries, including China, demographic change in the absence of countervailing policies could reduce annual growth by 0.2 to 0.4 percentage points in late- and post-dividend countries, where working-age population shares are expected to decline.

Also, by reducing the costs of trade for pre- and early dividend countries, substantial potential increases in trade flows and expansion of labor-intensive manufacturing can be achieved. Lower trade costs result in additional income gains in pre- and early-dividend countries, amounting, respectively, to 3.6 percent and 2.5 percent of GDP in 2030. The benefits from trade facilitation could lift an additional 13 million people out of poverty. Regarding migration, we estimate that global GDP in 2030 would be over 1.3 percentage points lower by 2030 without migration flows. This scenario also suggests that additional 10.4 million people would be living in poverty in pre-, early- and late-dividend countries,

Our results are broadly in line with those of other studies that take into consideration general equilibrium effects. Manyika et al. (2015) consider the impact of demographic change on growth for a longer time horizon and estimate that the declining working-age population share could reduce the global average income per capita by 20 percent over 2015–65. Simulation analysis by Batini, Callen, and McKibbin (2006) finds that the demographic transition can help raise developing countries' GDP up to 2 percent higher by 2025 than if demographic transition does not occur. This compares with our estimates of 1.1 percent increase in developing-country GDP from demographic transition over 2015–30. McKibbin (2006) conducts a similar analysis for several economies and finds that demographic change can lead to lower GDP for many high-income countries. For example, Japan's GDP in 2050 is projected to be 28 percent smaller than it was in 1985. Our estimate for Japan is a decline of 6 percent over 2015–30 due to demographic change. Tyers and Shi (2007) find that demographic transition could increase GDP in Sub-Saharan Africa by 15 percent over 1995–2030.

Furthermore, our scenarios suggest that global poverty could drop from 11.4 percent in 2015 to 4.4 percent in 2030 if potential benefits from demographic change are realized. This reduction is equivalent to a drop in the number of poor from 729.2 million in 2015 to 325.9 million by 2030. The demographic dividend has the potential to help to lift an additional 38.7 million people in pre-dividend countries and 24.4 million people in early-dividend countries out of poverty by 2030.

This paper is organized as following. Section 2 discusses the channels through which demographic change impacts economic growth, savings and poverty. Section 3 explains how we model demographic dividend and which scenarios are included in the analysis. Section 4 presents the results, and section 5 concludes.

2. The economic effects of demographic change

The literature on the relationship between population change and economic growth is varied and includes work that argues for every possible outcome – that declining population could enhance growth, restrict it or have no effect at all![2] However, as emphasized by Bloom and Canning (2004) and Kelly and Schmidt (2005) a key element of demographic change that affects growth is related to changes in age structure, particularly an increase in the share of the working age population, which has direct implications for labor supply and savings. Bloom and Williamson (1998) and Bloom et al. (2000) argue that the rapid growth, which East Asia experienced over 1965-1990 was substantially due to the working age population growing faster than populations as a whole – i.e. due to a so-called demographic dividend. According to the earlier, an increase of 1 percentage point in the growth of the working age population is associated to an increase between 1.4 and 2 percentage points on growth rate. They suggest that demographic forces appear to have contributed 0.6 percentage points p.a. to the East Asian miracle via labor inputs per capita and 1 percentage point via capital accumulation per capita.

Bloom and Canning (2004) suggest that a 1 percentage point growth in the share of working age population leads to an increase by 1.4 percentage point growth of income per capita. Kelley and Schimidt (2005) developed a framework to explain the contribution of demographic change towards output-per-worker growth and translate the results into per capita terms. Their results suggest that over the period 1960-1995 demographic change, particularly due to changes in youth dependency ratio, have accounted for approximately 20% of per capita output growth impacts, with larger shares in Asia and Europe. Overall, the positive effect of a larger share of working age population on growth is widely supported in the literature (Bloom and Williamson, 1998; Higgins and Williamson, 1997; Eastwood and Lipton, 2011; Kelly and Schmidt, 1995, 2005, 2007), including its important role in Asia's growth between 1965 and 1990 (Bloom et. al., 2000) and improvements on the accuracy of growth projections by taking age structure into account (Bloom et. al., 2007).

Eastwood and Lipton (2011) summarize some of the key channels by which demographic change may affect output per capita. These channels include the dilution of natural capital (i.e. that as the number of workers grows the stock of natural capital tends to fall over time), the dilution of reproducible capital (i.e. investment does not keep pace with labor force growth), rising returns to the population via productivity improvements and scale economies due to higher population density, and age structure effects. This last channel has been the focus of much of the literature on the demographic dividend.

However, Bloom et al. (2003) suggest that a demographic dividend is not automatic and requires an enabling policy framework that addresses public health, family planning, labor market flexibility, and openness to trade, savings, and human capital accumulation. The question arises as to what scope there actually is for Sub-Saharan Africa and other 'young' countries to obtain a demographic dividend.

An increase in the share of the working-age population can boost economic growth through a range of channels. First, a rising working-age population has the potential to increase the

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[2] See Bloom et al (2003) for discussion of some of these alternate effects of population on growth. Brückner & Schwandt (2013) argue that economic growth can conversely also have an impact on population growth.

number of people employed as a share of the population. Second, it has the potential to increase aggregate national savings and hence the investment rate, since income-earners would become a greater share of the population. Third, it can lead to improvements on human capital accumulation, since households might have more resources to invest in fewer children, and it might be easier for mothers with lighter childrearing responsibilities to enter the labor market, providing additional resources to invest on nutrition and education of their children. However, certain enabling conditions are necessary for an increase in the share of the working-age population to boost economic growth, most notably that new labor market entrants are able to find productive employment and that the economy is able to investment in human and physical capital.

As part of the second demographic dividend, national private savings rates have been found to depend on the age composition of the population: individuals are typically net savers when they are working-age and continue to save in old age, on average, but tend to be predominantly consumers when they are children. Regarding the effect of demographic changes on savings, there have been many studies finding that lower child dependency leads to higher saving rates (Mason, A., 1987; Johnson and Lee, 1986), Kelley and Schmidt, 2005, Higgins and Williamson 1997, Kinugasa and Mason, 2005). Loayza et. al. (2000) find that both young and old dependency ratios have a significantly negative impact on the private saving rate. However, the effect of the aged dependency ratio on savings is more complex. Since people expect to live longer, they may save more during the economically active portion of their lives (Kinugasa, T. and A. Mason, 2007; Attanasio and Szekely, 2000, and Mason et. al., 2011).

In addition to the effects on growth and savings, there is also evidence that changes in age structure impact poverty and inequality, with few studies on the specific relation between demographic change and prosperity of population in the bottom income deciles (Merrick, 2001; Lipton, 1983; Paes de Barros et. al. 2015). Cruz and Ahmed (2016) provides a summary of this literature and estimate that an increase of 1 percentage point in the share of working age population may lead to a decrease of about 0.7 percentage points of the poverty rate.

In addition to the literature using partial equilibrium analysis, there are several previous studies of demographic change using computable general equilibrium (CGE) models, but this paper offers several extensions to that literature. Compared to the major study undertaken by Tyers and Shi (2007), this analysis updates the data from a base of 1997, looks at the impact of demographic change on international trade, and estimates the impact of trade facilitation and changes in migration. It also adds poverty and shared prosperity to the list of the implications of demographic change that it explores. Compared to Ahmed et. al. (2015) this analysis expands the geographical coverage beyond Africa and modifies the analytical set-up. Specifically, it endogenises GDP growth rates and the improvements in education in the baseline (based on IIASA estimates), improves the translation of improvements in education into changes in occupations based on estimates from household surveys, and offers a fuller analysis of international trade, and migration.

3. Defining the demographic dividend

The demographic dividend arises from the demographic transition – in which countries evolve from high birth and death rates, through declining death rates followed by declining birth rates

to a new steady-state in population size and structure. The phase during which the birth rate remains unchanged as death rates fall is characterized by high youth dependency rates followed by increasing overall participation rates. Based on these phases, we adopt here a typology first developed in World Bank (2015) which classifies countries into a continuum of four groups based on their demographic transition and hence potential for a demographic dividend. . The four-stage typology differentiates between countries past the demographic transition (post-dividend), late in the transition (late dividend), early in the transition (early dividend), and not yet in the transition (pre-dividend). During the early stages of the demographic transition, countries have the opportunity to realize a "first demographic dividend" as declining fertility translates into fewer children and eventually leads to a temporary boost in the labor supply relative to the population of dependents. More workers may thereby lead to higher per capita output and savings. To the extent that savings are productively converted into domestic investment, more capital (human and physical) may be accumulated. As a result, each worker will have more capital to work with in the future and production will rise further on account of that—giving rise to the "second demographic dividend."

The stages of the transition and hence of the dividend are sketched in figure 1 while the actual allocation of countries to phases is given in Map 1. Pre-dividend countries lag in key human development indicators and have fertility rates greater than four births per woman. Their high dependency ratios are expected to decline as the fertility transition proceeds. Early-dividend countries have progressed further in the fertility transition, with fertility rates below four births per woman and the working-age share in the population likely to rise considerably in the future. Realizing the first demographic dividend should be priority for these countries, as well as laying the groundwork for the second dividend. Late-dividend countries have shrinking working-age shares, but their overall age structures are still favorable for the first demographic dividend. However, they may experience rapid aging in coming decades so realizing the second dividend is key. Finally, post-dividend countries are where fertility has transitioned below replacement levels three decades ago, and have shrinking working-age population shares and high shares of elderly. They are too late in the transition to gain additional benefits from the first demographic dividend, but could still be realizing the second dividend.

Map 1 World through the lens of the demographic typology
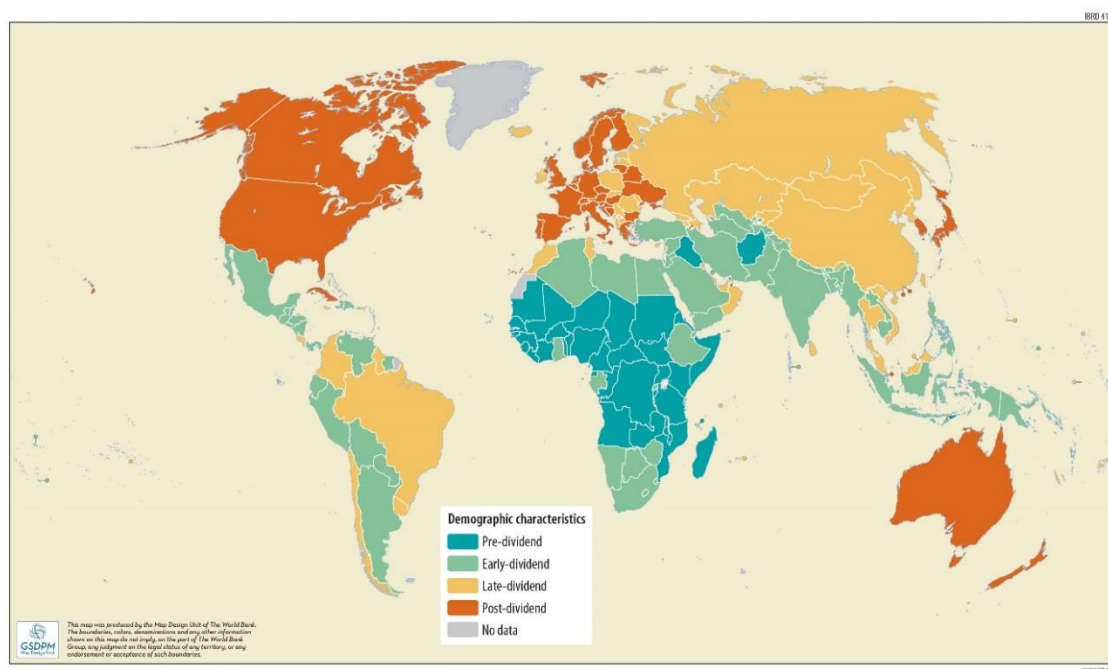
Source: World Bank (2015).

More than half of the global population lives in pre- and early-dividend countries and more than a third lives in late-dividend countries – see Table 1. Interestingly, most of the early-dividend population lives in lower-middle-income countries, in part because Bangladesh and India are lower-middle-income countries. Similarly, most of the late-dividend population lives in upper-middle-income countries, which include China. Pre-dividend countries, which account for less than 11 percent of the global population, are mostly low-income countries and are mostly in Sub-Saharan Africa. Post-dividend countries, accounting for another 11 percent of the global population, are predominantly high-income countries, mostly in North America and Europe.

Pre-dividend countries will account for most of the global population growth through 2050. The fertility rates of pre-dividend countries, above four by definition, will remain above replacement for several decades, leading to rapid population growth and slower age structure changes. The rate is falling only slowly in this group of countries and their younger age cohorts will continue to swell in the coming decades. As a result, the population of this group of countries will grow by 49 percent (or 413 million people) by 2030 and by 132 percent (or 1.1 billion people) by 2050. Children as a share of the population will remain above 40 percent until 2030, and above 34 percent until 2050.

Globally, the diverse pace of changes in the share of working age population across the countries has been leading to a redistribution of the global labor force, with implication to comparative advantage. Table 1 shows that in 1950 about 33.5 percent of global working-age population was living in high-income countries (HIC), most of them currently post-dividend countries. Their share of the global working age population has been reduced to about 16.7%

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in 2015 and will continue shrinking in the coming decades. On the other hand, Sub-Saharan Africa and South Asia, most pre- and early-dividend countries, represent about 25 percent of global working-age population by 1950 and increase their share to 35 percent in 2015. The fact that these two regions increase their share of children in the world to 50% in 2015 reinforces how they will continue growing in the global labor supply. Table 2 presents the descriptive statistics related to population, GDP, fertility rate, GDP per capita and savings rate by demographic typology.

Table 1: Descriptive Statistics by Stage of Dividend

Region	Total	Pop 00-14	Pop 15-64	Pop 20-40	Pop - 65up
1950					
EAP	28.7	29.7	28.5	28.4	24.1
ECA	5.2	4.6	5.4	5.2	6.5
HIC	31.5	25.9	33.5	31.9	46.0
LAC	5.3	6.5	4.8	5.1	3.5
MNA	3.0	3.4	2.9	3.0	2.3
SAR	18.9	21.0	18.3	19.3	12.9
SSA	7.3	9.0	6.7	7.0	4.6
Total	100.0	100.0	100.0	100.0	100.0
2015					
EAP	27.9	21.7	30.3	28.6	28.3
ECA	3.6	3.1	3.8	3.7	4.4
HIC	18.8	12.5	19.0	16.7	37.3
LAC	7.3	7.2	7.4	7.6	6.3
MNA	4.9	5.8	4.8	5.4	2.9
SAR	23.8	27.2	23.5	25.1	15.6
SSA	13.7	22.5	11.2	12.8	5.1
Total	100.0	100.0	100.0	100.0	100.0

Source: UN (2015)

Table 2: Descriptive Statistics by Stage of Dividend

Variable	Year	units	Stage of dividend				World
			Pre	Early	Late	Post	
Population	2015	million	872	2,967	2,265	1,184	7,287
	2030	million	1,282	3,492	2,374	1,234	8,382
Total GDP (2011 prices)	2015	thousand	1,152	11,458	17,366	48,161	78,137
	2030	thousand	2,579	22,646	33,249	63,593	122,066
Fertility rate	2015	child p/women	4.9	2.7	1.9	1.6	2.5
GDP pc (2011 prices)	2015	thousand	1,321	3,862	7,668	40,683	10,722
Savings rate	2015	share of GDP	16.7	24.8	36.0	20.3	24.4

Source: Authors elaboration based on WDI, UN(2015), and GTAP database (2015).

4. Modelling the Demographic Dividend

4.1. CGE Model

To analyze the implications of the demographic dividend and the policies that might interact with it, we apply the global dynamic computable general equilibrium (CGE) LINKAGE model (van der Mensbrugghe, 2011) along with the Global Income Distribution Dynamics (GIDD) (Bussolo et al. 2010) micro simulation tool to study the impact of demographic change on economic growth and poverty reduction up to 2030. This methodology combines a consistent set of price and volume changes from the CGE model with household surveys at the global level.

Briefly, the current version of LINKAGE relies on GTAP version 9 database[3]. The data includes social accounting matrices and bilateral trade flows for 140 countries/regions and 57 sectors in 2011. For computational and analytical purposes, the version employed in this study includes 24 countries and regions: Brazil, China, India, Japan, Nigeria, Russia, Sri Lanka, and USA; and EU, EFTA, HIC early-dividend, HIC late- dividend, HIC post-dividend, LAC early-dividend, LAC late-dividend, ECA early-dividend, ECA late-dividend, ECA post-dividend, EAP early-dividend, MENA early-dividend, EAP late-dividend, MENA late-dividend, SSA pre-dividend, SAR early-dividend and SSA early-dividend. It also includes six sectors: agriculture, natural resources, low-skill and high-skill manufacturing, and low-skill and high-skill services.

The core specification of the model replicates largely a standard global dynamic CGE model. Production is specified as a series of nested constant elasticity of substitution (CES) functions of the various inputs – unskilled and skilled labor, capital, land, natural resources (sector-specific), energy and other material inputs. LINKAGE uses a vintage structure of production that allows for putty-semi putty capital. In the labor market in the baseline we assume fixed unemployment at a benchmark level and a fixed participation rate, and allow for internal migration even though there is no endogenous international migration. The model allows for market segmentation by allowing rural to urban migration of unskilled labor to be a function of relative wages. Aggregate land supply follows a logistic curve with an absolute maximum available supply calibrated to IIASA (International Institute for Applied Systems Analysis) data.

Demand by each domestic agent is specified at the so-called Armington level, i.e., demand for a bundle of domestically produced and imported goods. Armington demand is aggregated across all consumers and producers and allocated at the national level between domestic production and imports by region of origin.

The standard scenario incorporates three closure rules. First, government expenditures are held constant as a share of GDP, fiscal balance is exogenous while direct taxes adjust to cover any changes in the revenues to keep the fiscal balance at the exogenous level. The second closure

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[3] The GTAP database is developed and maintained by the Global Trade Analysis Program based at Purdue University (www.gtap.org). We use pre-release candidate 2 of version 9 data base.

rule determines the investment-savings balance. Households save a portion of their income, with the average propensity to save influenced negatively by elderly and youth dependency rates, as well as GDP per capita growth rates. The savings function specification follows Loayza, Schmidt-Hebbel, and Serven (2000) with different coefficients for developed and developing countries. In the case of China and Russia, because we have long term projections based on country specific simulations, we impose projections of investment or savings rates up to 2030 from World Bank regional reports. Since government and foreign savings are exogenous, investment is effectively savings driven. The last closure determines the external balance. We fix the foreign savings and therefore the trade balance, hence changes in trade flows result in shifts in the real exchange rate.

4.2. Simulations

We first generate the long-term baseline, then run a number of counterfactual scenarios. By comparing these scenarios in different combinations, we can start to isolate the impacts of the differences in demographic transitions and various policy changes.

The Baseline scenario (B)

The GTAP data base is benchmarked to 2011. We run the model to 2017, replicating the key macroeconomic aggregates from the World Bank's Global Economic Prospects (GEP 2015)[4]. Population growth is based on the medium fertility variant of the UN's 2012 population projections. Labor force growth follows the growth of the working age population – defined here as the demographic cohort between 15 and 64 years of age. The evolution of the supply of skilled and unskilled workers is consistent with the IIASA constant educational trends (CET) scenario, where the growth rates of the supply of skilled workers exceed those of the unskilled. Capital accumulation is equated to the previous period's (depreciated) capital stock plus investment. Productivity growth in the baseline is "calibrated" to achieve the growth rates for the baseline scenario (as in the GEP, 2015) up to 2017, we then fix productivity growth for 2018-2030 at its 2017 value. These productivity growth rates remain fixed in all the counterfactual scenarios.

Demographic change impacts the economy via two channels: labor force and savings. In the baseline scenario, all new labor market entrants find productive employment. It is a neoclassical growth model, so increases in the labor force translate into higher output. Savings respond to changes in demographic structure of the population, with declines in the youth and elderly dependency rates increasing savings (and hence investment).

The baseline assumes no change in policies from the benchmark year of 2011, hence trade policy, domestic tax policies etc. do not change up to 2030.

The 'No Demographics' scenario (ND)

In the no enabling conditions scenario, we assume that the benefits (losses) linked to demographic change do not materialize. This is a hypothetical and illustrative scenario used to evaluate the importance of potential impacts of demographic change via increased labor force

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[4] For China, we replicate the growth projections of World Bank (2014d).

and savings (hence investment). In this scenario, total population changes at the same rate as in the baseline, but the share of working age population in total population remains fixed at the 2015 level over 2016-2030. Relative to the baseline, this scenario benefits late- and post-dividend countries, where working age population increases at a faster rate than in the baseline, while the opposite is true for pre- and early-dividend countries. Similarly, in the case of savings, because the lower youth and elderly dependency rates in pre- and early-dividend countries no longer come about, savings rates no longer rise, at least for this reason, while the opposite is true for late- and post-dividend countries. In short, we reverse the benefits of demographic change in pre- and early-dividend countries, while we eliminate losses from the demographic change in late- and post-dividend countries in order to isolate the impacts of demographic change on growth and poverty reduction, already embodied in the baseline scenario.

The 'Trade Facilitation' scenario (TF)

All the assumptions here are as in the baseline, but trade and transportation margins in early and pre-dividend countries are reduced by 15% of their 2015 value over the period of 2016-2030. Exports and imports of goods coming from and to these countries become less expensive and so their shares of world trade tend to rise.

In both developed and developing countries, there is substantial scope for the simplification and harmonization of trade processes (trade facilitation), which in turn will reduce trading costs. In developed countries, the simplification of procedures count account for 5.4 percent of the potential savings, followed by advance rulings (3.7 percent), automation (2.7 percent), and fees and charges (1.7 percent). In developing countries, the contribution of each indicator is different with total trade cost reductions amounting to 14.5 percent for low-income countries, 15.5 percent for lower-middle-income countries, and 13.2 percent for upper-middle-income countries although the contributions of the different components varies by group (Moïsé, Orliac, and Minor 2011; Moïsé and Sorescu 2013).

This scenario uses all the baseline assumptions, but additionally assumes that trade facilitation measures lead to reduction of trade costs in early- and pre-dividend countries, amounting to 15% of their 2015 value over the period of 2016-2030. Exports and imports of goods coming from and to these regions become less expensive, and to some extent replace exports from late- and post-dividend countries.

The 'Sudden Stop' in migration (SS)

The importance of migration for growth and poverty reduction over the next 15 years can be judged against a scenario where all migration suddenly stops in 2016. This scenario is identical to the baseline except that it adopts the "Zero migration" UN medium fertility scenario. This significantly changes the age dependency ratios and total population in several countries across the globe.

4.3. Poverty and shared prosperity estimates

The translation of macro-economic changes from the LINKAGE model into changes in poverty and income distribution is done using the Global Income Distribution Dynamics (GIDD) model. The GIDD is the global macro-micro simulation tool, which combines a consistent set

of price and volume changes from a global CGE model with household surveys at the global level (see Bussolo et al. 2010). GIDD was developed by the World Bank's Development Prospects Group and was inspired by previous efforts involving simulation exercises (Bourguignon et al., 2002; Pereira de Silva, 2003; Bourguignon and Savard, 2008; Bourguignon et al., 2008; and Davies 2009). In this application, we employ a large sample of 90 household surveys, covering approximately 90% of global population and global GDP.

The counterfactuals for global (or country-level) income distribution are obtained by applying the following changes from the LINKAGE model to the initial distribution derived from household level data: (1) demographic changes (considering age structure and shifts in education), (2) changes in sectoral employment, (3) changes in relative wages across skills and sectors, and (4) the growth in consumption per capita. The richness of the micro data provides not only national-level poverty and inequality indicators, but also insights into the regional and demographic characteristics of the most affected households; these can be very useful for defining contingent and compensatory policies. Previous examples of the combined use of LINKAGE and GIDD include the effect of agriculture distortions in the global economy (Dessus, et al., 2008, Bussolo et al. 2010), the effect of climate change on poverty and inequality (Bussolo et al., 2008), the effect of demographic change on Africa (Ahmed et al., 2015), and the effects of external and internal shocks in Africa (Devarajan et al., 2015).

In addition to incorporating the key changes in the variables derived from the CGE scenarios, the GIDD methodology updates the household survey data for the end year of our simulation, 2030. This is done by re-weighting the population characterized by most recent available household survey in GIDD using non-parametric cross-entropy methods, but keeping it consistent with the UN population projections. For the skill-unskilled breakdown, the GIDD defines as skilled anyone with more than 9 years of education.

5. Estimating the size of demographic dividend

Provided that certain enabling conditions are met, an increase in the share of the working age population will boost output per head of population.[5] These conditions include the country's increased capacity to absorb additional labor in the case of the first demographic dividend, and to facilitate investment in physical capital in the case of the second demographic dividend. Given such conditions, with new labor market entrants finding productive employment and declines in total dependency rates (TDR) leading to higher accumulation of private savings translating into higher investment rates, the demographic dividend could contribute to faster income growth and poverty reduction. Our baseline scenario (B) assumes such an enabling environment and by comparing its results with those of the 'no demography' (ND) simulation we can estimate the effects of the demographic dividend. Table 3 reports the effects of the dividend on the total dependency ratio (TDR – block A), private savings (B), GDP pc (C), the poverty rate (D) and (E) the unskilled wage. The rows titled 2015 and 2030 refer to the outcomes of the baseline simulation (B), while those titled 'net impact' refer to the difference between the 2030 estimates from the 'no demographics' (ND) simulation and the baseline (B).

The results indicate that the net effect of demographic change on income is positive in pre- and early-dividend countries and negative in late- and post-dividend countries. Under the baseline

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[5] Kremer (1993), Lucas (1988), Barro (2003).

scenario, the increases in WAP as a share of total population translate into a higher share of income earners relative to consumers, while lower TDRs lead to higher savings and investment (block B). The demographic dividend contributes to faster development of pre- and early-dividend countries, increasing their incomes by 13.5 and 7.6 percentage points, respectively, by 2030. At the same time, in the absence of countervailing policies, the opposite trends of declining shares of WAP in total population and aging, slow development in late- and post-dividend countries, decreasing their income levels in 2030 by 3 and 8.8 percentage points, respectively (block C).

If realized to its full potential, the demographic dividend would contribute to lifting an additional 40 million poor out of extreme poverty. In the baseline scenario, the poverty rate (at $1.25 a day) at the global level declines from 14.5% in 2011 to 4.4% by 2030, out of which a net reduction of 0.5 percentage points would be accounted for by the demographic dividend. In other words, the demographic dividend has the potential to help lift an additional 26 million people in pre-dividend countries and 14 million people in early-dividend countries out of poverty by 2030, and to lower their poverty rates by the additional 2.8 and 0.4 percentage points, respectively (block D). However, without policies to mitigate adverse demographic changes, aging and declining support ratios would produce an additional 1.1 million poor in the late- and post-dividend countries. Harnessing the demographic dividend can yield visible income gains, yet outcomes will be determined by the degree to which countries adjust their policies related to labor market, human capital, and trade, migration and investment to take advantage of demographic trends at home and in other parts of the world. Finally, in block (E) we report the effects of the transition on the unskilled wage.

Table 3 Baseline outcomes (2015 and 2030) and effect of the demographic dividend (net impact)

				Stage of dividend			
		units	Pre	Early	Late	Post	World
(A) TDR	2015		87.8	53.6	40.2	51.8	52.1
	2030		76.0	48.5	47.5	63.6	54.0
	net impact		-11.8	-5.1	7.2	12.0	1.9
(B) Private Savings	2015		16.7	24.8	36.0	20.3	24.4
	2030		18.3	25.8	33.4	17.9	23.3
	net impact		1.9	0.3	-4.3	-3.5	-2.7
(C) Change in GDP pc	2015-2030	annual growth rate	2.8	3.5	4.1	1.6	2.1
	net impact		0.6	0.3	-0.1	-0.5	-0.2
(D) Poverty Rate	2015		46.0	13.9	2.5	1.4	11.4
	2030		26.9	1.7	0.5	1.2	4.4
	net impact		-19.1	-12.3	-2.0	-0.1	-7.0

Source: UN Medium Fertility Scenario and WB staff estimates based on Linkage and GIDD (see Annex 6A).
Note: Pre-, early-, late-, and post-dividend refer to stages of demographic transition of countries. For discussion of methodology and scenarios, see Annex 6A. 'Net impact' refers to the Net impact of demographic dividend in 2030 – the difference between simulations ND and B in 2030.

6. Policies to enhance the Demographic Dividend

Although, as we have shown, the demographic dividend is predicted to increase incomes and reduce poverty in pre- and early-dividend countries, it is still worth asking whether policy changes can enhance its benefits.

6.1. Trade Facilitation

A key mechanism of the adjustment to any economic shock or trend is international trade, and this includes the accommodation to the differences in the demographic transitions that countries are experiencing. The differences in the growth rates of the four groups of countries that we distinguish imply that their shares of world trade will change over time. The dominance of post-dividend countries in world trade has already been substantially eroded, with their share of world exports declining from 75 percent in early 2000s to 61% in 2015, and it is expected to shrink further in the baseline (B) to 52% by 2030. (The figures for their shares of imports are 65% and 58%, respectively.) Commensurately, comparing 2015 and 2030, pre-dividend countries are expected to increase their share of world exports from 1.5% in 2015 to 2% in 2030, of which 0.3 percentage points can be attributed to the demographic dividend[6]; the corresponding figures for the early- and late- amount to 15% and 22 % in 2015, respectively and 19% and 27% in 2030.

The differences between countries' demographic transitions also affect their comparative advantages in production, which in turn affects their trade profiles. Given the sluggish adjustment of the capital stock, countries with relatively slow working age population growth tend to become relatively more capital-abundant over time, while countries with relatively faster population growth become relatively more labor-abundant. For example, pre-dividend countries' exports are already mainly concentrated in agricultural and natural resource products, accounting for 7 percent and 68 percent of total exports respectively in 2015 – see Figure 2; by 2030 we expect these figures to be 13.5% and 52%, with specialization in (labor-intensive) agricultural goods and labor-intensive manufacturing increasing at the expense of natural resource products. In 2015 early-dividend countries export mainly manufactured and natural resource goods, accounting respectively for 46 and 36 percent of exports, and the respective shares of late dividend countries are 71 and 19 percent. By 2030 exports of manufactured goods and services are expected to represent a larger share for both groups. Finally, late-dividend countries' exports are currently heavily concentrated in manufactured products and services, but by 2030 all sectors are likely to expand at the expense of manufacturing.

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[6] The 2015 figure comes from the base dataset, the 2030 from the baseline run (B) and the attribution to the transition from the difference between the no-demography (ND) and the baseline (B) runs.

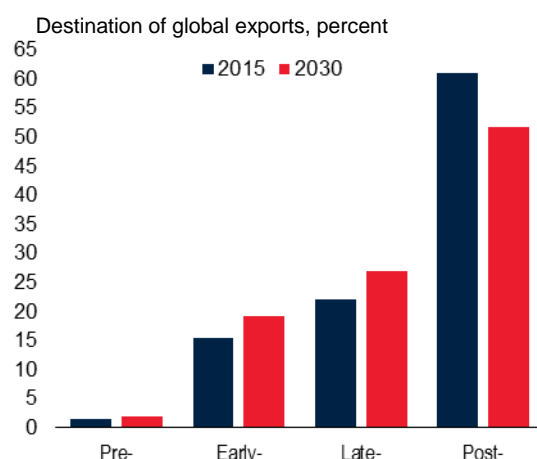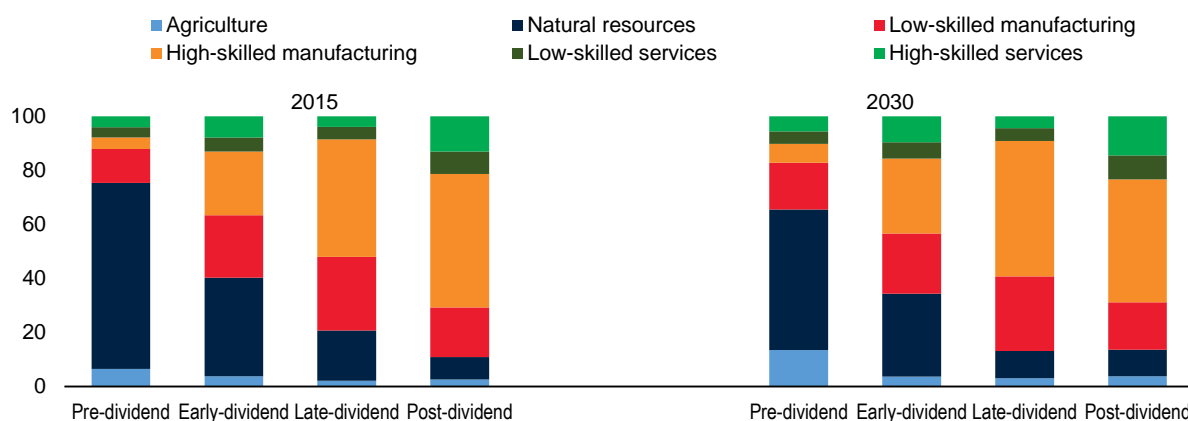**Figure 2: Pre-, early- and late- dividend countries will increase their importance as export markets**

Destination of global exports, percent

Figure 3 Shifts in export composition 2015-2030

Export shares by sectors, percent

Source: Simulation results

Note: Agri = agriculture, NatRes = natural resources, LowSkManuf = low skilled labor-intensive manufacturing, HighSkManuf = high-skilled labor-intensive manufacturing, LowSkServ = low-skilled labor-intensive services, HighSkServ = high-skilled labor-intensive services.

Given the relevance of the trade adjustments we now analyze the effects of explicit efforts to reduce the cost of conducting international trade. Both theory and empirics have shown that this is likely to have beneficial effects on trade, growth and poverty, but given the way in which demographic transitions are widening the factor endowment differences between countries, it seems likely to be particularly effective.

Trade facilitation entails streamlining customs, border, and transit procedures, improving logistics and transport services, and extending physical infrastructure. In developed countries, the policy areas that could have the greatest impact on trade performance are related to advanced rulings in determining classification and value of goods, fees and charges, processes, and procedures. Low- and middle-income countries would benefit most from simplifying documentation requirements, automating processes, and making trade-related information available.

Table 4 The Effects of Trade Facilitation, 2030

| Change in, 2030: | units | Stage of dividend | | | | World |
		Pre	Early	Late	Post	
GDP	%	3.6	2.5	0.6	-0.2	0.6
GDP pc	%	3.6	2.5	0.6	-0.2	0.6
Poverty Rate	ppts	25.5	1.5	0.5	1.2	4.1
Net effect - Poverty Rate						
Share in total exports of:		-1.4	-0.2	0	0	-0.3
low-skilled manufactures	ppts	8.3	4.8	1.7	-1.1	-
High-skilled manufactures	ppts	3.1	10.0	-4.9	-0.1	-
low-skilled services	ppts	-0.8	-1.9	0.0	0.3	-
High-skilled services	ppts	-1.1	-3.2	0.0	0.6	-

Source: UN 2013a, Medium Fertility Scenario, and WB staff estimates (see appendix D).
Note: Pre-, early-, late- and post-dividend refer to stages of demographic transition of countries.

As noted above, we model trade facilitation by reducing trade and transportation margins in early and pre-dividend countries by 15% of their 2015 value over the period of 2016-2030. Exports and imports of goods coming from and to these countries become less expensive and so their shares of world trade tend to rise, allowing a significant expansion of labor-intensive manufacturing. Lower trade costs result in additional income gains in pre- and early-dividend countries, amounting, respectively, to 3.6 percent and 2.5 percent of GDP in 2030 (Table 3), while loss of competitiveness leads to a slight decline of income in post-dividend countries. The benefits could lift an additional 13 million people out of poverty. In addition, trade facilitation could increase unskilled wages in pre- and early- dividend countries by XX and CC%. Faster income growth is driven by substantially higher values of trade and some production upgrading. In pre-dividend countries, the share of low-skilled and high-skilled labor-intensive manufacturing products in total exports could increase, at the expense of agriculture and natural resources, by an additional 8 and 3 percentage points, respectively. Similar changes in the share of exports could take place in early-dividend countries: 5 and 10 percentage points, respectively.

6.2. The role of migration

Differing demographic transitions disturb the distribution of population around the world and so one should immediately think of migration – which re-distributes population – as part, or maybe the whole, of the adjustment process. In a very simple no-frictions neo-classical world, migration and international trade have the same effect – Mundell (1957). The fundamental premise of the neo-classical theory of international trade is that the incentive to trade arises from differences in countries' relative costs of producing different goods, which, in turn, arise from differences in the countries' endowments of various factors of production. These endowments are assumed to be immobile between countries but mobile between sectors within any country. In its purest form, the theory generates the remarkable prediction that free (and costless) trade in goods between countries whose endowments are 'not too different' is sufficient to ensure that their factor prices are equalized – the so-called Factor Price Equalisation (FPE) Theorem of Samuelson (1949). If this were true, trade in goods and the

movement of factors of production would be substitutes: as trade was freed, the incentives for labor and capital movement would decrease, ultimately to zero.

However, no-one (least of all Samuelson) took the prospect of complete FPE seriously – the casual evidence against it is just overwhelming even in the absence of barriers to mobility such as within the European Union. Moreover, once we move beyond the strictly neo-classical theory trade and migration become complements rather than substitutes, and wage differences can persist indefinitely (e.g. Markusen, 1983, and Dunlevy and Hutchinson, 2001). Among the reasons that FPE may not hold in reality are that trade is determined by other factors such as differences in technology or tax structures between countries; the existence of many goods and services, many of them non-tradable; not all countries produce all goods (so-called complete specialisation); and the existence of economies of scale and agglomeration which allow larger economies to pay higher wages.

All of this means that there will be gains to eliminating barriers on labor mobility, and in fact, they are huge - one or two orders of magnitude larger than the gains from dropping all remaining restrictions on international flows of goods and capital - Clemens (2011). And because the demographic dividend happens to have the effect of making already labor-abundant countries more labor abundant, migration becomes even more important.

A very early calculation of the benefits of labor mobility was Hamilton and Whalley's (1984) calculation that if labor were able to move between regions sufficiently to equalize wages around the world, world income would increase by around 150%! Much later Winters et al (2003) suggested that a modest increase in migration which would allow the quantity of labor in the labor importing countries to increase by 3% would increase world GDP by about $150 billion (at 1999 prices) or 0.6% of initial world income. The migration would amount, for example, to about 2.7 million extra unskilled workers and 2.4 million skilled workers in the USA and about 2.4 million unskilled workers and 0.49 million skilled workers fewer in China. Winters et al reckoned that the benefits were about fifty percent higher than those of removing all trade barriers on goods. A repeat of the same experiment but using a slightly fuller model - an early version of LINKAGE - and in 2005 prices suggested that a rise in migration sufficient to increase the labor force of high income countries by 3 percent phased in over 2010-2020 would yield a global gain of real income of $674bn or 1.19% (World Bank 2006). Both experiments found that the impact of migration on trade was relatively mild[7].

Demographic differences have clearly been playing a role in driving recent migration flows. Migration takes place largely from young developing countries to aging developed countries. Between 1960 and 2000, the stock of migrants from pre- and early-dividend countries residing in late- and post-dividend countries increased almost 800 percent, almost four times as fast as the global stock of migrants residing in these regions – Ozden et al (2011). However, international migration in Africa, Asia, and the CIS countries is predominantly within the region. For example, intra-regional flows account for two-thirds of all migration within Sub-Saharan Africa, and for two-thirds within Europe and Central Asia. [8]

The critical question is whether migration will actually play an equilibrating role over the period 2015-2030. As early and pre-dividend countries increase their incomes one might expect the incentives to emigrate from them to fall over time. However, in truth this is neither here nor there. First one needs to consider real wages rather than GDP pc and also the distribution

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[7] Subsequent exercise of this sort have refined, but not fundamentally changed, these conclusions – e.g . Walmsley, Winters and Ahmed (2011).

[8] Black et al. 2008.

of income and provision of services, all of which will influence intentions to migrate. Second, because international migration is costly, increases in incomes frequently stimulate emigration from poor countries rather than the opposite. Although one should not think of the so-called migration hump – the phenomenon that emigration rates appear to peak only at around $7,000 pc – as an economic 'law' or a deterministic relationship, it is sufficiently well established empirically that one must take the possibility of its existing seriously.[9]

Most importantly, however, one must realize that international migration is largely determined by the willingness of high and upper-middle income countries – basically, our late- and post-dividend groups – to accept immigrants. This is very far from assured, although the case for their doing so is strong.

Figure 4 Migrant stock by destination in 2000, in million
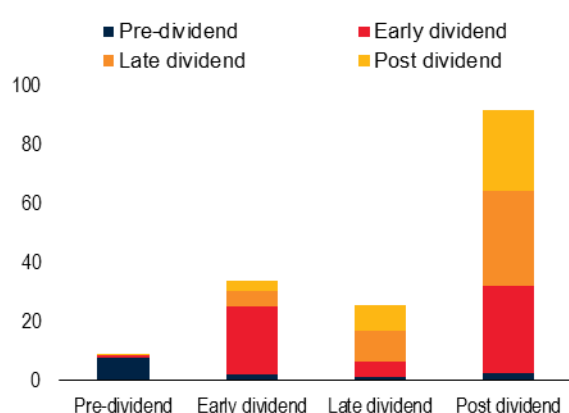
Source: World Bank staff estimates.
Note: Data are from Ozden et al. (2011).

First, international migration flows will be critical for slowing down the decline in working age populations across aging countries. Younger immigrants can help to rebalance the decline in the working-age population relative to the number of older people across late- and post-dividend countries, as has been the case in the OECD countries. Hence immigration flows can play a central role in improving the growth prospects and, ultimately, in ensuring the sustainability of public finances in destination countries.[10] Similarly, emigration can help to boost wages in pre and early-dividend (labor-exporting) countries, by helping to reduce the increase in labor-abundance implied by the demographic transition.

There has been much ink spilt over the skill levels of migrants, with both countries of origin and destination desiring skilled workers while being indifferent or worse towards the numbers of unskilled workers. This is not the place to rehearse arguments about the so-called brain drain – see, for example, Commander et al (2004) or Docquier and Rapaport (2012) – but we note that it far from proven that the emigration of skilled or potentially skilled workers from poor to rich countries is welfare reducing for the former. Similarly, as the work-force declines in

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[9] Clemens (2015) offers a useful summary of the evidence on the migration hump.
[10] The evidence is currently that migration has little effect on receiving countries' fiscal positions (REFS??), but as the population structure becomes ever more unbalanced in rapidly aging societies, it inevitably will come to do so.

post-dividend countries, it could be that labor-intensive services – personal, caring etc. – become sufficiently expensive that inflows of relatively unskilled workers are welcome.

Predicting the policy positions of countries and the precise responses of migration to various incentives is currently beyond us, so we illustrate the role of migration in smoothing the demographic transition by means of an alternative counterfactual simulation. [11] We assume that after 2015 there are no further migration flows! It is clearly unrealistic that there be no future gross flows of migrants to and from countries (even if some politicians appear to dream about such an outcome), but it is not inconceivable that net stocks remain largely unchanged. That is, that the number of people born in country A and living in country B remains the same even if the people themselves do not. We refer to this as the 'Sudden Stop' (SS) scenario. [12]

With no net inflow of new migrants, the working age population of post-dividend countries would be 5.7 percent lower in 2030, while the impact on the remaining groups of countries would be slightly positive due to cessation of net emigration – Table 4. The elderly- and youth-dependency rates would decline in pre-dividend countries because the working population had increased, while in post-dividend countries the share of youth falls and elderly would increase for the opposite reason.

As we noted above, the demographic dividend has two phases. Phase 1 reflects the ratio of working to total population, with a higher ratio permitting higher growth in GDP per head. Phase 2 arises because aggregate savings increase over phase 1 and if these are invested effectively the capital stock will increase. These two phases are evident in this simulation, albeit in reverse. With a sudden stop in migration, post-dividend countries would record a three percentage points decline of GDP by 2030 as the workforce share declined. Over the same period, GDP would also decline in the pre-dividend group (the poorest countries) but now because during 2015-2030 savings would have fallen by XX% cumulatively, which would have lowered the capital stock, and hence labor productivity and rewards. Early and late-dividend countries, on the other hand, would show increases in GDP as their working populations increased relative to the baseline scenario. Overall, we estimate that global GDP in 2030 would be over 1.3 percentage points lower than in the baseline simulation. One way of thinking about this is that a stop on migration worsens the efficiency with which labor is allocated over space, with fewer workers residing in areas where their productivity is highest.

GDP pc does not move pari passu with GDP, however, because population is changing: GDP pc declines in every group except for the post-dividend countries. In pre-dividend countries, the GDP decline results in an additional 10.4 million people living in poverty, while in early- and late-dividend countries,

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[11] The alternative approach is adopted by Winters et al (2003) who analysed an exogenous increase in migration, arguing that it was reasonable to treat an increase in the high income countries' work forces as such, because it would only happen if immigration quotas were relaxed and that if such a relaxation occurred there was bound to be sufficient excess demand for places that the quotas would be fully used.

[12] "Zero migration" UN medium fertility scenario.

Table 5 The Effects of a Sudden Stop in Migration, 2015-2030

Baseline outcomes in 2015 and 2030 and net impact of the sudden stop in migration

			Stage of dividend			
	units	Pre	Early	Late	Post	World
(A) Population	2015	872	2,967	2,265	1,184	7,287
	2030	1,282	3,492	2,374	1,234	8,382
	net impact	11	42	13	-61	5
(B) Working Population	2015	464	1,932	1,615	780	4,791
	2030	728	2,352	1,609	754	5,444
	net impact	7	29	9	-43	1
(C) TDR	2015	87.8	53.6	40.2	51.8	52.1
	2030	76.0	48.5	47.5	63.6	54.0
	net impact	-0.1	0.0	0.0	1.4	0.1
(D) GDP	2015	1,151,971	11,457,946	17,365,526	48,161,389	78,136,833
	2030	2,578,603	22,645,912	33,248,578	63,593,396	122,066,489
	net impact	-5,950	41,004	299,071	-1,916,491	-1,582,366
(E) GDP pc	2015	1,321.1	3,862.2	7667.9	40,683.0	10,722.5
	2030	2,011.9	6,484.4	1,4005.0	51,546.5	14,563.2
	net impact	-22	-65	51	1042	-197
(F) Savings Rate	2015	16.7	24.8	36.0	20.3	24.4
	2030	18.3	25.8	33.4	17.9	23.3
	net impact	-0.10	-0.22	0.04	-0.35	-0.11

Note: Pre-, early-, late-, and post-dividend refer to stages of demographic transition of countries.

Source: UN Medium Fertility Scenario and WB staff estimates. POP refers to total population and WAP refers to working age population

7. Conclusion

This paper analyzes the effect of demographic change across countries in different stages of demographic transition, by taking into consideration two key channels of market integration, trade and migration across the world. We analyze scenarios related to demographic change, trade facilitation and migration for the global economy using a CGE global dynamic model in combination with a microsimulation tool based on harmonized household surveys.

Our results suggest that demographic change can boost per capita income growth in pre- and early-dividend countries, accounting for 0.5 to 0.8 percentage points of annual GDP per capita growth, over 2015–30, but it may dampen growth prospects in aging countries and for the

global economy, by reducing annual growth by 0.2 to 0.4 percentage points. Moreover, our findings suggest that demographic dividend has the potential to help to lift an additional 38.7 million people in pre-dividend countries and 24.4 million people in early-dividend countries out of poverty by 2030.

Also, lower trade costs could lead to additional income gains in pre- and early-dividend countries, amounting, respectively, to 3.6 percent and 2.5 percent of GDP in 2030. The benefits from trade facilitation could lift an additional 13 million people out of poverty. Regarding migration, we estimate that global GDP in 2030 would be over 1.3 percentage points lower by 2030 without migration flows, which would likely lead to higher poverty rate in pre-, early- and late-dividend countries. Yet, our scenarios do not take into account the counterfactual of having larger migration flows, an important issue under discussion in the global economy. Even though the estimated loss of income associated with a sudden stop in migration is an indication of the gains migrants generate in the global economy, this remains an important area for which further research is much needed.

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