The Four Dividends:
The Age-structural Timing of Transitions in Child Survival, Educational Attainment, Income, and Political Stability

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ABSTRACT

Policymakers in high-fertility countries have shown increasing interest in the potential economic benefits of future changes in population age structure, typically described as the demographic dividend. However, framing the dividend in purely economic terms obscures broader effects of fertility decline and age-structural change. This paper hypothesizes that the age-structural transition is associated with at least four types of development-related transitions that can be characterized as demographic dividends, including but not limited to the economic sector. To test for a statistical association between the age-structural transition and each of these transitions, we generated age structural models for discrete categories in each type of dividend. These logistic functions were fit to aggregated dichotomous data across a domain described by median age. Countries' likelihood of achieving specific categorical levels of development across the four dividends exceeds 50 percent at various median ages—and yet each transition is "timed" differently in demographic terms.

Introduction

Whereas the vast majority of contemporary research on fertility decline has focused on motivations, access, benefits and risks associated with contraceptive use at the individual and community levels, a growing segment of studies has sought to understand the macro-level consequences of declines in fertility rates and shifts in age structure on populations, institutions, and states. These efforts are descended from prescient conceptual models of the age-structural transition's effects on wealth, education and employment published by Coale and Hoover (1958). Introducing a political dimension, Möller (1968/69) hypothesized that the youthfulness of Europe's states during the early and mid-19th century helped explain the rise of nationalist militarism and revolution.

When a new cohort of economic and political demographers turned their attentions to these relationships in the late 1980s and 1990s, they sought greater clarity in determining the types, timing, magnitude, and consequences of these macro-level effects. Their pursuits were aided by access to substantially more, better-organized data than their predecessors could access. Importantly, recent fertility decline in East and Southeast Asia, and in a handful of states elsewhere, provided researchers with a basis for data-rich case studies and comparisons with high-fertility countries.

Over the past two decades, economic demographers have demonstrated that age-structure can offer benefits to state capacity—known collectively as the *demographic dividend*—during the demographic window of opportunity, a period of concurrent low levels of childhood and old-age dependency. Meanwhile, political demographers have demonstrated that the most youthful phases of the age-structural transition are associated with high statistical risks of intra-state conflict and other forms of political instability. For political demographers, the demographic window represents a period of rapidly declining risks of civil conflict, the demise of military regimes and autocratic monarchies, and the rise of stable liberal democracies.

Despite a welcome wave of renewed interest in the reproductive health and educational policies that facilitate fertility declines, we believe that the most common narrative framing of the demographic dividend in purely economic terms has downplayed the age-structural transition's broader and often more complex contributions to strengthening state capacity. Our goal has been to revise this narrow economic view by hypothesizing social, political, and additional economic components of the demographic dividend, statistically quantifying their age-structural relationships, and then testing the validity of those hypothesized relationships. We argue for extending the demographic dividend's narrative beyond its acknowledged impacts on per-capita income to encompass three additional development benefits—in child survival, educational attainment, and political stability—for which there is evidence of linkages to the age-structural transition.

Our results lend several fresh insights into the age-structural timing of these four key components of development. Notably, we find that attainment of the World Bank's upper-middle income category has been strongly associated with the demographic window, and we provide additional evidence suggesting that upper levels of child survival, high levels of educational attainment, and elevated levels of political stability are also associated with this advantageous period. In general, our conclusions provide evidence of a broad, yet highly complex role for fertility decline and age-structural maturation in building state capacity.

The Age-Structural Transition

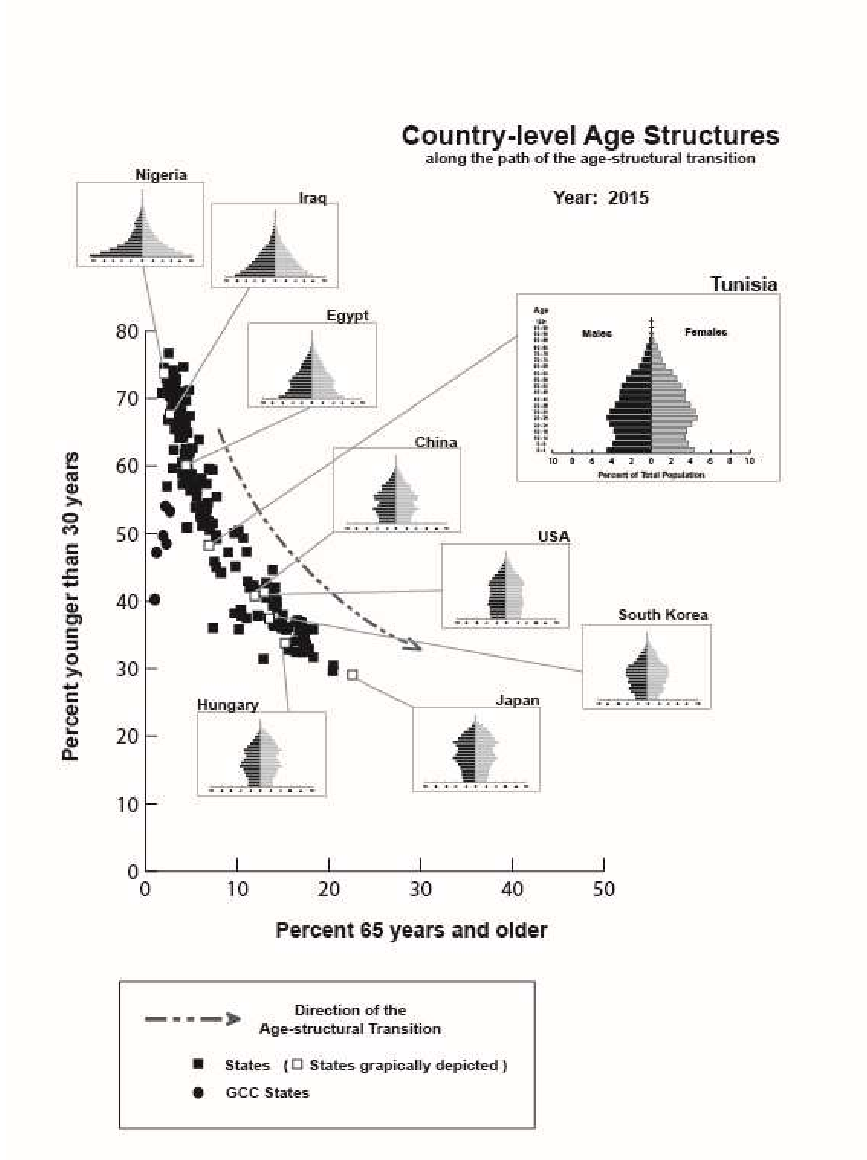
Driven forward largely by fertility decline that occurs after reductions in child mortality, the age-structural transition entails gradual, largely predictable shifts in the relative size of age cohorts (Figure 1). To describe a population's position in the age-structural transition, we employ a four-phase classification system (National Intelligence Council 2012, 2017), which is based on median age. The four age-structural phases are:

- *Youthful*. Age structures with a median age of 25.5 years or lower.
- *Intermediate*. Age structures with a median age from 25.6 to 35.5 years.
- *Mature*. Age structures with a median age from 35.6 to 45.5 years.
- *Post-mature*. Age structures with a median age of 45.6 years or higher.

The classification system has been applied to all UN Population Division's (UNPD's) country-level estimates (2015), except for the six states in the Gulf Cooperation Council (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and United Arab Emirates), all of which include large numbers of temporary labor migrants relative to permanent citizen-residents. For these states, we use the median age of the citizen-resident population (US Census Bureau, unpublished; data can be downloaded from *politicaldemography.org*), which places each of them the youthful category.

The path of the age-structural transition places demands on state institutions that can be described by an inverted U-shaped curve (∩). Youthful age structures among countries in the earliest, high-fertility portion of the transition typically present obstacles to attaining high levels of institutional capacity and state legitimacy. In the intermediate and mature phases of the transition, working-age adults come to proportionately dominate the population, while growth of the childhood and adolescent populations decline. The growth of demands placed upon institutions—such as healthcare, the provision of education, and the job market—typically slows during these phases, while levels of human capital and financial resources that support these institutions tend to increase as the taxable worker-bulge grows. Finally, in the post-mature phase of the transition, population aging produces relatively large proportions of seniors, many of whom develop needs for healthcare and shelter that exceed their income.

Figure 1. The Path of the Age-structural Transition, 2015



Data source: UNPD, 2015

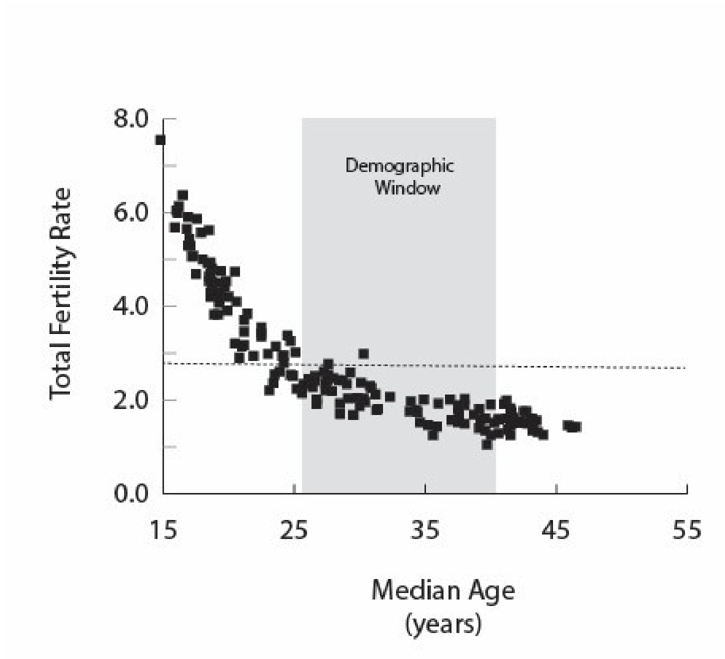
The Demographic Window

General estimates of the beginning and end of the demographic window—the period during which populations experience a series of developmentally favorable age structures—were first hypothesized by the UN Population Division in 2004. In the UNPD's original formulation, the demographic window was assumed to open when proportions of children zero to 14 years of age dipped below 30 percent of the total population, and seniors 65 years and older remained below 15 percent of the population. The rise of seniors to more than 15 percent was assumed to signal the close of the demographic window. The UNPD's estimate suggests that states experience the advantageous age structures that evolve during the demographic window for a period that usually ranges between four and six decades.

We converted the UNPD's upper and lower bounds to median age using a sample of 40 states, each entering the demographic window between 1950 and 2015. To minimize anomalies introduced by unusually large proportional influxes or outflows of migrants, we chose states with populations larger than 5 million (UNPD 2015) that were also not defined as oil- or mineral-reliant economies (>15 percent of GDP in oil and mineral revenues, according to the World Bank 2015). In this sample, we also avoided including two country populations that are a composite of demographically disparate ethnoreligious or regional age structures (Israel, India). Our resulting estimate of the demographic window—from a median age of 26 (25.7 ± 0.4) years through 41 (41.7 ± 0.5) years—covers the entire intermediate phase of the age-structural transition and about half of its mature phase.

What does it take to enter the demographic window? By graphing 2015 data for this set of countries, the relationship between total fertility rate (TFR) and a country's presence in the window become obvious. We find that entry into the window requires that the country-level total fertility rate drop below 2.8 children per woman (Figure 2).

Figure 2. Total Fertility Rate (TFR) Versus Median Age, 2015



Data source: UNPD, 2015. TFR for 2015 is the average of 2010-15 estimates and 2015-20 medium fertility variant projections. The dotted line is at a TFR of 2.8 children per woman. The country in the demographic window that is above TFR 2.8 is Israel, where several rapidly growing minorities experience high levels of fertility.

Analysis in Age-structural Time

Originally a measure used by population biologists and demographers to crudely characterize and compare population distributions, median age has recently been employed by political demographers as a continuous independent variable, indicating a state's position in the age-structural transition (Dyson 2013, Cincotta 2015a, 2015b, 2017). For that task, however, economic demographers and political demographers have more often used cohort ratios.

These ratios compare the relative proportions of two age cohorts to each other, or the relative size of a cohort to the total population. For example, political demographers have applied various types of "youth bulge" indicators that measure the relative size of the young adult population relative to the adult population or working age population (e.g., the proportion of the population ages 15 to 24 years relative to the population 15 and older (*see* Urdal 2006). Until very recently, economic demographers chiefly characterized age structure using the childhood (ages 0 to 14 years) or old-age population (aged 65 and older) relative to the assumed working-age population (15 to 64 years).

Whereas cohort-specific details are lost when the age-structural configuration is reduced to median age, this scalar indicator allows researchers to communicate variation in economic and political variables on a two-dimensional graph over the length of the age-structural transition (currently, extending from a median age of 15 years to 47 years). Moreover, unlike ratios that are focused on a specific portion of the age-structural transition—e.g., youth bulge indicators focused on young adults, or old-age dependency focused on the proportion of seniors—median age provides a universally applicable indicator across the age-structural transition.

Admittedly, as a predictor of state capacity, median age has several shortcomings. It is insensitive to several types of economically and politically significant demographic conditions. These include: the presence of large proportions of temporary labor migrants that lend maturity to the age structure but have little impact on politics (e.g., in the Gulf Cooperation Council states); out-migration of young adults and in-migration of retirees in small island states (e.g., some Caribbean countries); ethnoreligious or regional sub-populations that exhibit dramatic age-structural differences (e.g., Israel, Myanmar, and Turkey), and population size. These represent special problems for age-structural modeling and are sure to be the subjects of future research.

Methods

In this research, our objectives are to: statistically characterize transitions in child survival, educational attainment, per-capita income, and political stability—which we describe as the four dividends—as functions of the age-structural transition; to compare the statistical patterns of these transitions to patterns previously observed in age-structural models; and to situate these four transitions within the demographic window.

Age-structural Models

Our analysis employs a demographically-focused construct of logistic regression modeling called an age-structural model (Cincotta, 2015b, 2017), which is designed to produce its analytical output on the age-structural time domain. Each age-structural model begins as a hypothesis that a measurable state capacity outcome is generally associated with the movement of states through the age-structural transition (increasing median age, or other variable that tracks the maturation of age structures).

In our analyses, the age-structural time domain is measured by median age. Because age structural models operate solely within this domain, the median age of states in the sample appears as the only continuous independent variable in all regression analyses. All other independent variables—i.e., controls and experimental treatment variables—are added in dichotomous form (coded 1 or 0).

As in all logistic regression analyses, the dependent variable—in this case the state capacity outcome—must be coded in dichotomous form. Continuous dependent variables can be transformed into discrete categories, (e.g., the World Bank's GNI per capita income categories: low, lower-middle, upper-middle, and high), which then can each be analyzed in a dichotomous form: 1 (in the category) or 0 (not in the category).

Variables and Data

Child Survival Transition (5 categorical, dichotomous dependent variables). Our analysis of the child survival transition uses data quantifying under-five mortality (U5M) drawn from the most recent UNPD estimates, covering 6,251 country observations over the period from 1972 to 2015. The categorical breakdown of these data was adapted from the World Health Organization's (WHO's) global maps of country U5M levels (2015). Because there are currently no states in WHO's highest mortality category (>200 deaths per 1,000 live births), we created a fifth category by breaking the WHO's lowest child mortality category into two categories. Our five categories for child survival are: low child survival (≥100.0 deaths per 1,000 live births), lower-middle child survival (50.0 to 99.9), middle child survival (25.0 to 49.9), upper-middle child survival (10.0 to 24.9), and high child survival (<10.0).

Educational Attainment Transition (5 categorical, dichotomous dependent variables). To assess the relationship between age-structural dynamics and the educational attainment transition, we analyzed net late-secondary enrollment data (UNESCO 2015). Data are from 1,906 country observations from 1999 to 2014. This indicator, which represents the number of students actually enrolled in the latter years of secondary education as a proportion of the population that is expected to be under conditions of 100 percent enrollment, was broken down into five equally-scaled categories: low enrollment (<20.0 percent enrolled), lower-middle enrollment (20.0 to 39.9 percent), middle enrollment (40.0 to 59.9 percent), upper-middle enrollment (60.0 to 79.9), and high enrollment (≥80.0).

Per-capita Income Transition (4 categorical, dichotomous dependent variables). Existing demographic dividend literature has quantified the potential effects of age structure change on the growth rate of per capita income. We elected to analyze the associations between age structure and income level, another economic indicator often of much interest to policymakers. Our analysis of the per-capita income transition draws on the World Bank's (2015) calculation of gross national income (GNI) per capita based on $US, Atlas Method. These data represent the per-capita incomes of 5,495 country observations from 1980 to 2014, and were disaggregated into the World Bank's four income categories: low, lower-middle, upper-middle, and high income.

Political Stability Transition (4 categorical, dichotomous dependent variables). Our analysis of the political stability transition uses years of intra-state conflict per decade, a variable that has been extensively studied by political demographers for its connections to age structure. Data from 1,906 country observations over 1972 to 2014 from the Uppsala-PRIO Conflict Dataset (UCDP/PRIO 2014) represent the presence or absence of an intra-state conflict, measured by a minimum of 25 battle-related deaths per year. The four categories are: low stability (6 years of intra-state conflicts per decade); lower-middle stability (3 to 5 years of conflict); upper-middle stability (1 year of conflict); high stability (0 years of conflict).

Population Age Structure (1 continuous independent variable). Over the past decade of age-structural research, analysts have identified a small set of exceptional conditions that are associated with countries that are either more sensitive, or less sensitive to their position in the age-structural transition. As states pass through the age-structural transition, states with these qualities often, but not always, perform differently than the majority group of states. Before graphing the function, running experiments with other dichotomous variables, or identifying exceptional states, it is useful to control for the following three factors.

Control Variables (dichotomous independent variables). Political demographers have identified a small set of exceptional conditions that are associated with countries that are either more sensitive, or less sensitive to their position in the age-structural transition. As states pass through the age-structural transition, states with these qualities often, but not always, perform differently than the majority group of states. The three factors that have been statistically significant in most age structure models include:

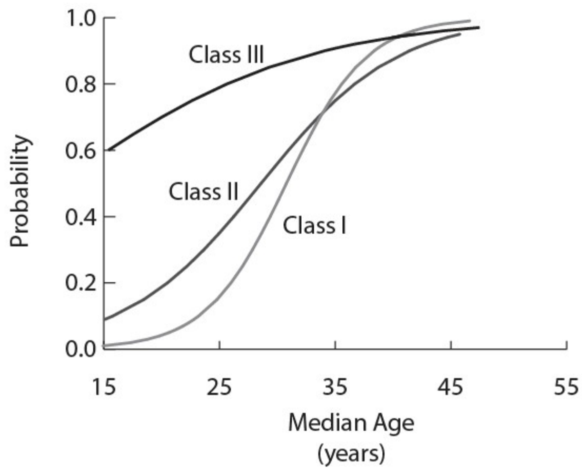
- *States with small populations* (1 dichotomous independent control variable). This factor identifies states with a mid-year population of fewer than 5.00 million, as estimated by the UNPD (2015).
- *States engaged in high intensity conflict* (1 dichotomous independent control variable). A state is deemed to be in high intensity conflict if, for that year, it experiences more than 1,000 battle-related deaths (UCDP/PRIO 2014, Gleditsch et al. 2002). This control is omitted when the dependent variable is a conflict-related variable.
- *Resource-reliant states* (1 dichotomous independent control variable). A state is deemed as significantly dependent on oil and mineral wealth if revenues from these resources comprised over 15 percent of gross domestic product (World Bank 2015).

Age-structural Functions

Each age structural model is graphed as a single function. This function describes a range (Y-axis) of probabilities of being within a category at all median ages (X-axis). To neatly capture nearly all recent past, current, and foreseeably future positions in the age-structural transition, the standard X-axis of this graph begins at 15 years and ends at 55 years, representing the likely minimum and maximum observable bounds of median age. Over the course of UNPD estimates from 1950 to 2015, the populations of a few states (including Niger in 2015) have experienced median ages below 15 years. On the high side of the domain, however, no country-level age structure has yet passed a median age of 48. Nonetheless, the UNPD projects that Japan will reach a median age higher than 50 years before 2030, and that several European and additional East Asian countries will follow it into the post-mature phase (a median age of 45.6 or higher) soon thereafter.

Not all age-structural functions that are fit to data by an age-structural model are qualitatively similar. Age-structural functions have been categorized into three qualitative classes (I, II, III), according to the conditions associated with the age-structural function that they describe (Figure 3). These conditions influence the form and fit of the age-structural function.

Figure 3. Three Classes of Age-structural Functions



Each class (I, II, III) is associated with a particular set of dynamics exhibited by states, in terms of a categorical dependent variable (Y), over the length of the age-structural domain (X axis).

Class I age-structural functions belong to a family of cumulative distribution functions (CDFs). These CDFs are generally associated with irreversible or virtually irreversible processes, and are generated by the numerical integration of the normal or near-normal frequency distribution that discrete levels of these processes characteristically produce (e.g., the World Bank income categories and U5M rates). When these data are submitted to logistic regression analysis, class I age-structural functions generally produce an ideal fit that takes the form of a complete logistic function (S-shaped curve). Under most class I conditions, logistic regression usually produces a function with higher pseudo-r^2 values and narrower confidence intervals than functions in either class II or class III.

Class I functions that rise quickly (over a relatively short span) on the age-structural domain are the most appropriate for forecasting. True class I functions have strong *attractors*—regions along the curve where switching from the prior category to the category of the function is likely to occur. The attractor can also be described as the median age inflection point at which the theoretical probability of being assessed in the dependent variable category (or a higher category) is equal to 50 percent.

Class II age-structural functions appear as complete, or nearly complete, logistic functions. They describe a state capacity or development process that largely moves in one direction across the age-structural domain but is not irreversible. Moreover, there is no *a priori* assumption that every state will complete the transition. The age-structural function describing the presence of liberal democracy—indicated by an assessment of FREE in Freedom House's annual survey of political rights and civil liberties—is a well-studied example of a class II function (Cincotta 2015a, 2015b). The strength of class II attractors is typically weaker than class I. Nonetheless, class II functions can rise sufficiently rapidly to support statistical forecasts based on the vicinity of an inflection point or attractor median age representing a 50 percent likelihood of achieving the dependent variable category status.

Class III age-structural functions appear as a portion of a logistic curve, and carry no *a priori* assumptions that all states will undergo the hypothesized transition, or that particular points on the curve are unusually sensitive to changes. Because class III functions are typically poor fits to data, their underlying relationships deserve close inspection. Class III functions have been shown to be entirely appropriate and exceedingly useful in understanding the problem of civil conflict and democratic stability. However, it is also possible that a logistic curve—which is necessarily monotonic—does not accurately characterize the dependent variable's variation in the age-structural domain. Other statistical models may be more appropriate.

Results

In the following section, we present age-structural models and functions for each series of categories among the four dividend transitions that we have analyzed in this study. All categories in each transition were fit using a logistic regression algorithm in Statgraphics Centurion XVII. Each category is described by its transition's regression table and by a single logistic curve, portraying its best-fit statistical distribution in the age-structural domain. Each series of categorical models, taken together, portrays the age-structural timing of the potential dividend as it proceeds over the length of the age-structural transition, and the strength of that dividend transition's directionality.

Child Survival Dividend Transition

All five categorical models representing the child survival transition (Table 1) were determined to be statistically significant ($p<0.01$). All child survival models representing the transition in U5M (Figure 4) are assessed as class I functions—i.e., advances in child survival have been nearly (but not quite) irreversible. The exceptions are mainly in Sub-Saharan Africa, mostly associated with AIDS-related mortality from mother-child transmission of HIV.

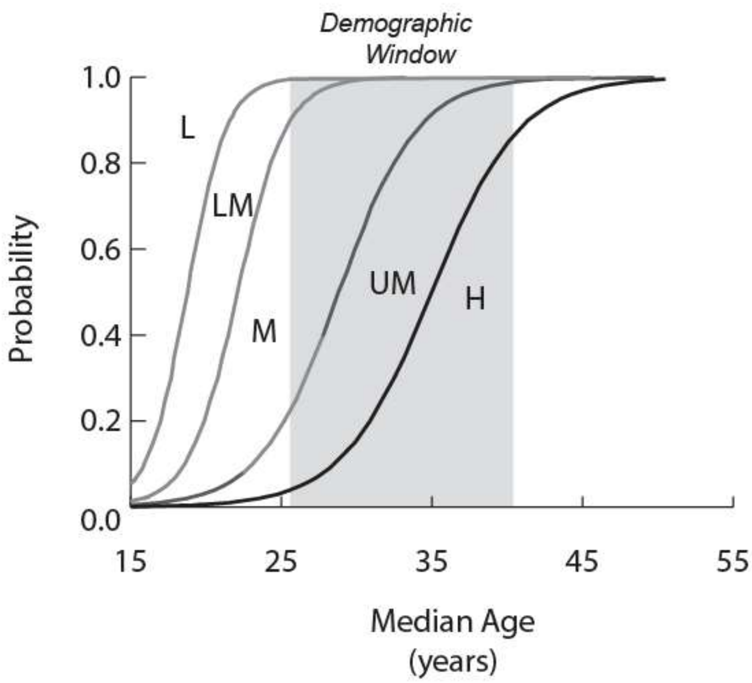
During the early portion of the age-structural transition, declines in child mortality generally precede major declines in fertility. Thus, it is no surprise that most countries reach the middle child survival category (<50 deaths per 1,000 live births) before reaching the demographic window, while they still have a young median age. However, to achieve the upper-middle category (<25 deaths per 1,000 live births) of child survival, a country's age structure must nearly always progress into the demographic window. The inflection point for child survival's upper-middle category is a median age of 28.4 years, representing the moment in demographic time at which 50 percent of states should reach this development milestone.

Table 1. Child Survival Transition Models

Dependent Variable	*Probability of being within the category*				
Data source	*UN Population Division, World Population Prospects: The 2015 Revision*				
Variable, Scope of data	*Under-5 mortality, all states, 1972-2015*				
Model ⇨	**Low**	**Lower-Middle (and higher)**	**Middle (and higher)**	**Upper-Middle (and higher)**	**High**
Category Ranges (deaths/1,000 births)	≥100.0	<100.0	<50.0	<25.0	<10.0
Variables ⇩	*Model Coefficients & Standard Errors*				
Median age (years)	-0.820** (0.028)	0.771** (0.026)	0.622** (0.019)	0.384** (0.010)	0.340** (0.011)
Dichotomous controls for:					
(a) Small population (<5.0 million)	-0.021 (0.086)	-0.040 (0.085)	-0.496** (0.096)	-0.955** (0.104)	-0.086 (0.120)
(b) Resource reliance (mineral & oil revenue >15.0% of GDP)	0.931** (0.105)	-0.938** (0.104)	-1.185** (0.112)	-1.286** (0.131)	-0.191 (0.287)
(c) High-intensity conflict (>1000 battle-related deaths/year)	-1.680** (0.194)	1.510** (0.189)	1.476** (0.201)	0.358 (0.198)	0.528* (0.220)
Constant	16.074 (0.606)	-14.988 (0.572)	-13.547 (1.454)	-9.190 (0.308)	-12.153 (0.463)
n	6251	6251	6251	6251	6251
Adjusted pseudo-r^2 (%)	49.8	48.7	61.2	59.2	54.5
MA | *p*(MA) = 0.50 (median age, years, ±0.95 confidence interval)	---	18.8 ±0.2	22.1 ±0.8	28.8 ±0.4	35.0 ±0.6

Statistical significance of coefficients: * $p<0.05$, ** $p<0.01$
MA | *p*(MA) = 0.50 : The median age (and 0.95 confidence interval) at which the dependent variable equals 0.50 .

Figure 4. Categories of Under-5 Mortality Representing the Child Survival Dividend Transition



L = >100 deaths per 1,000 live births
LM = 99-50
M = 50-25
UM = 25-10
H = <10

Educational Attainment Dividend Transition

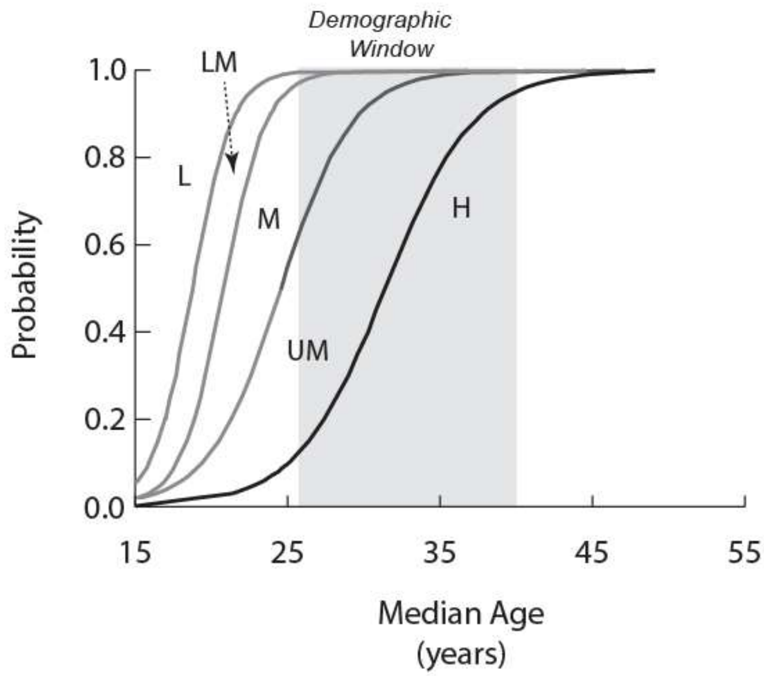
All five categorical models representing the educational attainment transition as measured by late-secondary enrollment rate (Table 2) were determined to be statistically significant ($p<0.01$). All late-secondary school enrollment models representing the transition (Figure 5) were assessed as class I functions. Therefore, advances in educational attainment have been largely irreversible. The exceptions were largely countries that experienced protracted high-intensity armed conflict (>1,000 battle-related deaths per year)—a factor controlled for in the regression analysis.

Significant gains in educational attainment are frequently achieved by countries in the youthful portion of the age-structural transition. The inflection point for the upper-middle category (≥60 percent late-secondary enrollment), at 25.5 years median age, is situated at the cusp of the opening of the demographic window. However, entering the demographic window is virtually a prerequisite to achieve the high category (≥80 percent enrollment).

Table 2. Educational Attainment Transition Models

Dependent Variable	***Probability of being within the category***				
Data source	*UNESCO Institute for Statistics, UIS-Stat Database, 2016*				
Variable, Scope of data	*Late-secondary school enrollment, all states, 1999-2014*				
Model ⇨	**Low**	**Lower-Middle (and higher)**	**Middle (and higher)**	**Upper-Middle (and higher)**	**High**
Category Ranges (percent of eligible enrolled)	<20.0%	≥20.0%	≥40.0%	≥60.0%	≥80.0%
Variables ⇩	*Model Coefficients & Standard Errors*				
Median age (years)	-1.071** (0.088)	1.071** (0.088)	0.710** (0.042)	0.425** (0.022)	0.345** (0.016)
Dichotomous controls for:					
(a) Small populations (<5 million)	-0.299 (0.263)	0.299 (0.263)	-0.417* (0.206)	-0.605** (0.178)	-0.515** (0.178)
(b) Resource reliance (mineral & oil revenue >15.0% of GDP)	1.637** (0.310)	-1.637** (0.310)	-0.868** (0.239)	-1.300** (0.209)	-2.260** (0.242)
(c) High-intensity conflict (>1000 battle-related deaths/year)	-0.125 (0.673)	0.125 (0.673)	2.271** (0.340)	2.003** (0.335)	0.305 (0.325)
Constant	-18.085 (1.868)	18.085 (1.868)	-15.759 (1.041)	-10.533 (0.676)	-8.382 (0.514)
n	1906	1906	1906	1903	1906
Adjusted pseudo-r^2 (%)	59.8	59.8	62.3	58.3	57.5
MA | *p*(MA)=0.50 (median age, years, ±0.95 confidence interval)	---	18.0 ±0.3	20.8 ±0.4	24.6 ±0.6	31.4 ±0.3
Statistical significance of coefficients: * p<0.05, ** p<0.01 MA | *p*(MA) = 0.50 : The median age (and 0.95 confidence interval) at which the dependent variable equals 0.50 .					

Figure 5. Categories of Late-secondary Enrollment Representing the Educational Attainment Dividend Transition



L = <20 percent late-secondary enrollment
LM = 20-39 percent
M = 40-59 percent
UM = 60-79 percent
H = ≥80 percent

Income Dividend Transition

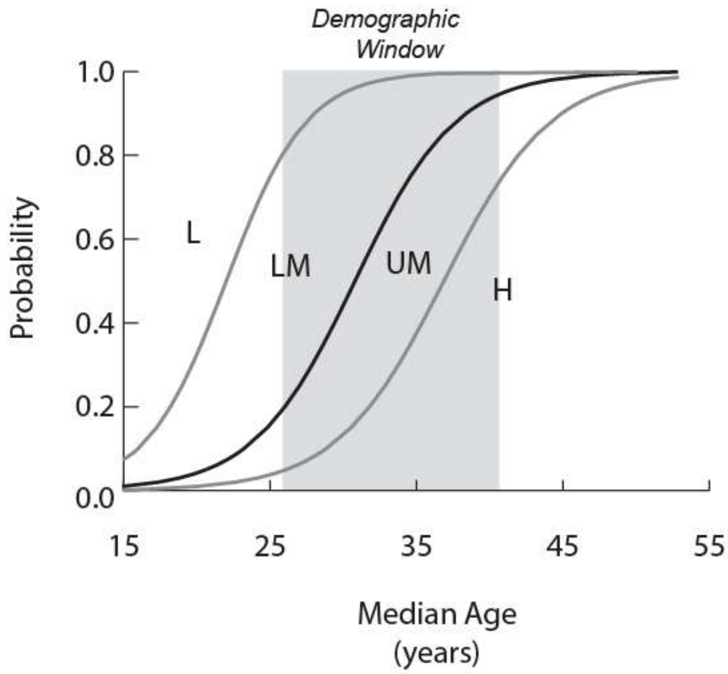
The four categories of the income transition are based on GNI per capita (World Bank 2015). All categorical models representing the income transition (Table 3) were determined to be statistically significant ($p<0.01$). Like the child survival and late-secondary school enrollment models, all income models representing the transition (Figure 6) were assessed as class I functions. Thus, for most countries, advances in per-capita income have generally been irreversible since 1972. The exceptions were largely countries that experienced protracted high-intensity armed conflict (>1,000 battle-related deaths per year) and those dependent on fluctuating oil prices, factors which are controlled for in the logistic regression analysis.

Achievement of the World Bank's upper-middle income category (ranging from $3,956 to $12,235 in 2016) is closely associated with the demographic window. The upper-middle income curve's inflection point—at which 50 percent of countries are expected to be within the upper-middle income category or higher—is located at a median age of 31.0 years. For the World Bank's high-income category, the 50-percent point is at 36.9 years.

Table 3. Income Transition Models

Dependent Variable	***Probability of being within the category***			
Data source	***World Bank, World Development Indicators 2015***			
Variable, Scope of data	*Gross National Income per capita (Atlas Method), all states, 1972-2014*			
Model ⇨	**Low Income**	**Lower-Middle Income (and higher)**	**Upper-Middle Income (and higher)**	**High Income**
Category Ranges (GNI per capita, US$)	<1,026	≥1,026	≥4,036	≥12,476
Variables ⇩	*Model Coefficients & Standard Errors*			
Median Age (years)	-0.375** (0.011)	0.379** (0.012)	0.300** (0.008)	0.274** (0.010)
Dichotomous controls for:				
(a) Small populations (<5 million)	0.290** (0.082)	-0.227** (0.083)	-0.771** (0.113)	-0.500** (0.113)
(b) Resource reliance (mineral & oil revenue >15.0% of GDP)	1.446** (0.100)	-1.482** (0.101)	-2.270** (0.123)	-1.969** (0.179)
(c) High-intensity conflict (>1000 battle-related deaths/year)	-1.068** (0.171)	1.078** (0.159)	-0.155 (0.171)	-0.119 (0.201)
Constant	7.436 (0.318)	-7.557 (0.320)	-6.088 (0.246)	-7.508 (0.311)
n	5495	5495	5495	5495
Adjusted pseudo-r^2 (%)	41.9	42.4	47.5	40.7
MA | *p*(MA) = 0.50 (median age, years, ±0.95 confidence interval)	---	21.6 ±0.3	30.9 ±0.5	36.9 ±0.5
Statistical significance of coefficients: * p<0.05, ** p<0.01 MA | p(MA) = 0.50 : The median age (and 0.95 confidence interval) at which the dependent variable equals 0.50 .				

Figure 6. Categories of GNI Per Capita Representing the Income Dividend Transition



(L = the low World Bank's income category
LM = lower-middle income category
UM = upper-middle income category
H = high income category

Political Stability Dividend Transition

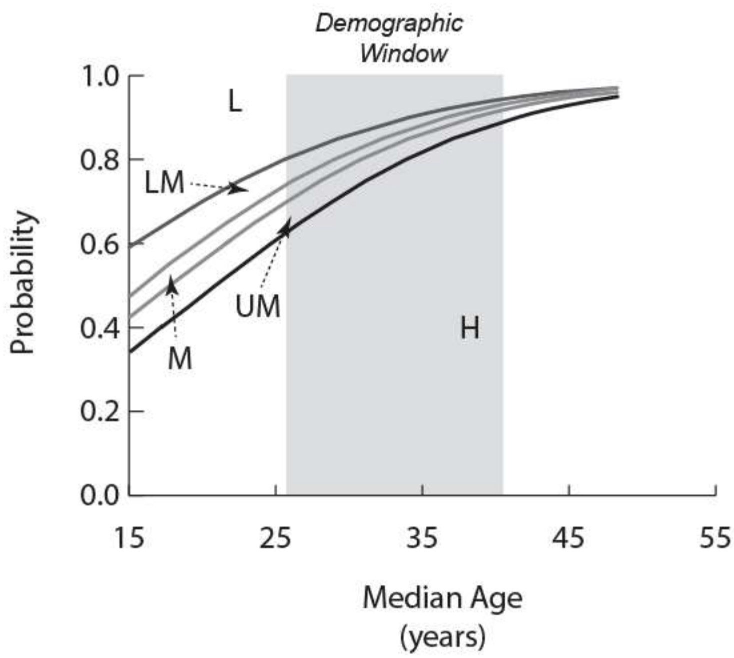
The political transition's five categories (Figure 7) are based on the proportion of intra-state conflicts reported in a decade, with the observation year in the middle of the decade. While all categories in the political transition were determined to be statistically significant ($p<0.01$) (Table 4), unlike the other transitions examined, these categorical models were found to be category III functions—a relatively poor fit to a logistic model. Thus, advances in political stability—measured by the frequency of intra-state conflict —have not been irreversible over the period of the data. Although intra-state conflict is considerably more prevalent at the early stages of the age-structural transition, there is no inflection point (attractor) where the frequency of entry into these categories peaks.

Table 4. Political Stability Transition Models

Dependent Variable ⇨	***Probability of being within the category***				
Data source ⇨	*UCDP/PRIO Dataset, 1972-2014*				
Variable, Scope of data ⇨	*Years in intra-state conflict, from +4 to -5 years from observation year, 1977-2010*				
Model ⇨	**Low**	**Lower-Middle (and higher)**	**Middle (and higher)**	**Upper-Middle (and higher)**	**High**
Category Ranges (years in intra-state conflict per period)	≥6	4-5	2-3	1	0
Variables ⇩	*Model Coefficients & Standard Errors*				
Median age (years)	- 0.096** (0.006)	0.096** (0.006)	0.106** (0.005)	0.106** (0.005)	0.107 ** (0.004)
Dichotomous controls for:					
(a) Small populations (<5 million)	-1.810** (0.113)	-1.810** (0.113)	-1.481** (0.087)	-1.337** (0.079)	-1.148** (0.070)
(b) Resource reliance (mineral & oil revenue >15.0% of GDP)	0.327** (0.114)	-0.327** (0.114)	-0.204 * (0.099)	-0.206 * (0.209)	-0.038 (0.242)
Constant	-1.055 (0.182)	1.055 (0.182)	-0.013 (0.152)	-0.342 (0.141)	-1.058 (0.128)
n	5356	5356	5356	5356	5356
Adjusted pseudo-r^2 (%)	12.2	12.2	12.3	12.0	11.9

Statistical significance of coefficients: * p<0.05, ** p<0.01 ;
Class III function, very weak attractor at p=0.50

Figure 7. Categories of Intrastate Conflict Representing the Political Stability Dividend Transition



L = ≥6 years of intrastate conflict per decade
LM = 4 or 5 years
M = 2 or 3 years
UM = 1 year
H = no intrastate conflict in a decade ±5 years from observation year

Discussion

What should analysts expect from these models of four demographic dividends, knowing when a country is projected to enter the demographic window? They should expect dramatic developmental change over the course of this period, particularly in three of these four component transitions: child survival, educational attainment, and income—transitions characterized by class I age-structural functions. These functions suggest rapid changes with advances in median age, and significant development once the state reaches the demographic window. More specifically, states moving through the demographic window can be expected to attain:

- the upper-middle category of child survival (U5M of less than 25 deaths per 1,000 live births);
- the high category of educational attainment (greater than 80 percent enrollment in late-secondary school); and
- the World Bank's upper-middle income category.

Transitions into these categories (Figure 8) tend to occur near the curve's inflection point (Table 5). Typical of transitions represented by class I functions, they are generally irreversible.

The likelihood of achieving the fourth dividend, political stability, represented by a class III age-structural function, should be expected to increase markedly but gradually. Like all class III functions, analysts should expect some backsliding along the path to political stability. Research by Yair and Miodownik (2016) suggests that, even after the youthful phase of the age-structural transition (in the intermediate and mature phases), ethnoreligious conflict remains a source of conflict risk in countries where there are large, poorly integrated minorities. Nonetheless, the likelihood of attaining a decade without intra-state conflict increases dramatically as median age rises: from a probability of 0.35 at a median age of 15.0 years, to 0.64 at a median age of 26.5 years, the opening of the demographic window. By the middle of the demographic window, at a median age of 34.2 years, the probability of a conflict-free decade has increased to 0.80.

A substantial amount of data supports the observation that, among high-fertility populations, significant increases in child survival nearly always precede initial declines in fertility. In fact, any increase in child survival (in the absence of fertility decline) drags median age backwards to younger levels. For this reason, in virtually all high-fertility populations, age structure has first grown more youthful before it has grown older. Nonetheless, higher median ages are associated with increasingly higher levels of child survival. This dynamic reinforces literature indicating that there is a great deal of positive feedback linking child spacing and fertility decline with child survival (Rutstein 2005)—enough to ultimately overcome child survival increases' drag on median age.

Much debate has centered around the mutually reinforcing relationship between fertility decline, investment in children, and educational attainment. Our analysis indicates that, in a majority of countries, significant strides in educational attainment can be made while country-level age structure is still youthful and growing rapidly—although, historically, this has often occurred at low levels of per-pupil investment (Schultz, 1987). Nonetheless, achieving nearly universal late-secondary enrollment, one of the Sustainable Development Goals, is unlikely (outside of the group of major oil/mineral exporters) until median age nears 31 years.

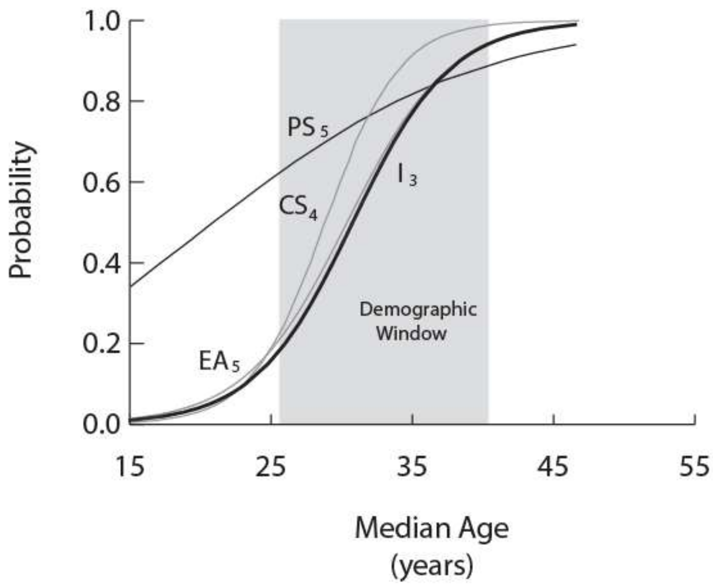
Similarly, having a youthful age structure does not appear to constrain countries from progressing from the World Bank's low-income to lower-middle income status. However, attainment of the upper-middle income category—a hallmark of the early stages of economic independence—is also unlikely until a country enters and progresses through the demographic window. At a median age of 31 years, 50 percent of countries can be expected to have entered the upper-middle income category.

Table 5. Key Categories in the Demographic Window

Component Transition	**Category**	**Category Range**	**Function Class**	**Median Age at Inflection Point** $p = 0.50$	**Window Opening** median age 25.6 yrs	**Mid-Window** median age 34.2 yrs	**Window Closing** median age 41.9 yrs
				years	*probability*	*probability*	*probability*
Child Survival	Upper-Middle	U5M rate <25 deaths per 1,000 live births	I	28.8 ±0.4	0.29	0.88	0.96
Educational Attainment	High	≥80.0% late-secondary enrollment	I	31.3 ±0.3	0.15	0.72	0.97
Per-capita Income	Upper-Middle	US$ 4,036-12,475 (GNI per capita)	I	30.9 ±0.5	0.21	0.73	0.96
Political Stability	High	0 years of intra-state conflict per decade	III *	21.0 * ±0.7	0.64	0.80	0.90

* Class III functions exhibit a gradual rise; its inflection point is not prominent.

Figure 8. Selected Categories of the Four Dividend Transitions Within the Demographic Window



CS_4 = Child Survival, Upper Middle
EA_5 = Educational Attainment, High
I_3 = Income, Upper Middle
PS_5 = Political Stability, High

The dynamics of the control variables provide some insights into states that deviate from these general trends. States with populations under 5 million are likely to attain the middle and upper-middle categories at younger median ages than more populous states. States relying on natural resource wealth (>15% of GDP) are likely to attain all categories, except the high child survival category, at younger median ages than non-resource reliant states. In general, states that are involved in a high-intensity conflict (>1,000 battle-related deaths per year) are likely to be delayed in their attainment of higher categories.

Conclusion

Our conceptual linking of four sets of development-related benefits that can accrue to states as their age structures mature, supported by the results of these statistical analyses demonstrating specific median ages that serve as inflection points to achieve those benefits, may be useful in the policy arena. Grouping health, education, economic, and political potential benefits of age structural change can attract and coalesce interest in and support for demographic program interventions from decision makers across the four sectors. Perhaps even more important, given frequent rhetoric trumpeting the demographic dividend as a foregone conclusion, are our findings that three specific development benefits that are desirable to most policymakers have historically only been attained once a country's median age matures well into the demographic window of opportunity, specifically to the range of 29 to 31 years.

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