Week 1 Lecture: Growth

ECON 125: The Science of Population

Demography

This couse is about *Demography*, the scientific study of population

Why learn about demographic concepts, theories, and measures?

1. Window onto historic changes in human circumstance

	1700	2023
Population	680 million	8.1 billion
Life expectancy at birth	27	73
Total fertility rate	6	2

2. Roadmap for understanding current and future crises

   - Migration, pandemic, population decline...

3. Data analytic toolbox for studying health, reproduction, migration, social and economic change, business projects

Basics

Professor: Tom Vogl

TAs: Regina Calles-Martinez, Grace Alster

Lectures: literature on Tuesdays, methods on Thursdays

Assignments: 10 readings (by Tuesday), 5 problem sets (in R)

Exams: midterm and final (in person & closed book with page of notes)

Grading: participation $\frac{1}{10}$; problem sets $\frac{4}{10}$; midterm, final $\left(\frac{2}{10}, \frac{3}{10}\right)$ or $\left(\frac{0}{10}, \frac{5}{10}\right)$

Participation: attendance checks, questions, discussions, office hours

Labs: Wednesday 5:30-7:30 pm on problem set weeks

Course Goals and Philosophy

Substantive goals:

- Understanding common demographic measures
- Learning how populations change

Practical goal:

- Getting comfortable working with data in R / tidyverse

Philosophy: students learn...

- *concepts* better when they confront them in data
- *coding* better when they use it to study interesting concepts

Problem Sets

The problem sets ask you to apply the tools we developed in class

You can work on code in a group but must write answers yourself

Problem Set 1 is easier, Problem Sets 2-5 more challenging

Grading is in whole numbers from 0 to 10

- Motived by ✓-, ✓, ✓+
- If you put in an earnest effort, you will get an 8, 9, or 10
- If you hand in nothing, you will get a 0
- Hard questions will be graded more discerningly than easy
- Make sure you check the solutions, even if you got a good score

Computing Tools

We will use R, RStudio, tidyverse, and R Markdown

- R is a statistical programming language
- RStudio provides a convenient user interface for R
- Tidyverse is a collection of R packages we will use for data transformation and visualization
- R Markdown is an R package we will use to create documents with text, code, and output

The syllabus suggests many resources for help with R (including AI!)

Problem Set 1 will guide you through setting up R and RStudio

Are You a Good Fit for This Course?

Are you interested in health, population, or the business/policy/society implications of changing demographics?

Have you taken an introductory statistics course?

If yes, you'll fit right in

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If you took an intro statistics course that is not listed as a prerequisite, just submit an EASy request

If you don't have much coding experience, don't worry

- Course assumes no previous coding knowledge
- You may have to work a bit harder than your coding-savvy classmates at the start, but I promise to make it accessible

ECON 125 - The Science of Population - Vogl [SP25]

Jump to Today

Syllabus PDF

Time and place: Tu/Th 9:30 am – 10:50 am @ SOLIS 104

Course GitHub repository: https://github.com/tomvogl/econ125

Professor: Tom Vogl

E-mail: tvogl@ucsd.edu

Office hours: Th 1:30 pm – 2:30 pm @ SDSC E-194 (except week 1)

Teaching assistant: Regina Calles Martinez

E-mail: rcallesmartnez@ucsd.edu

Problem set labs: Wed 5:30 pm – 7:30 pm @ SSB 107 (problem set weeks only)

View Course Stream
View Course Calendar
View Course Notifications

To Do

Nothing for now

March 2025

23	24	25	26	27	28	1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31	1	2	3	4	5

Course assignments are not weighted.

main 1 Branch 0 Tags Go to file Code

tomvogl . 5c80be6 · yesterday 5 Commits

cheatsheets	.	last month
data	.	last month
lectures	.	yesterday
methods	.	yesterday
problem sets	.	yesterday
.gitattributes	Initial commit	2 months ago
econ 125 syllabus S25.pdf	.	yesterday

About

Repository for UCSD ECON 125

Activity

0 stars

1 watching

1 fork

Report repository

Releases

No releases published

Packages

Getting to the Substance

Today, we focus on the size and growth rate of populations historically, as well as the processes drove that growth.

The *Demographic Balancing Equation* helps unpack population change:

$$P_1 = P_0 + \underbrace{(B - D)}_{\text{natural increase}} + \underbrace{(I - E)}_{\text{net migration}}$$

where

- P_0 and P_1 are the sizes of the population at times 0 and 1
- B and D are the $\#$ of births and deaths between 0 and 1
- I and E are the $\#$ of immigrants and emigrants between 0 and 1

Assigned Reading

Today's lecture draws on this week's assigned reading

Every week has an assigned reading, and you are expected to read it article **before** the first class of the week

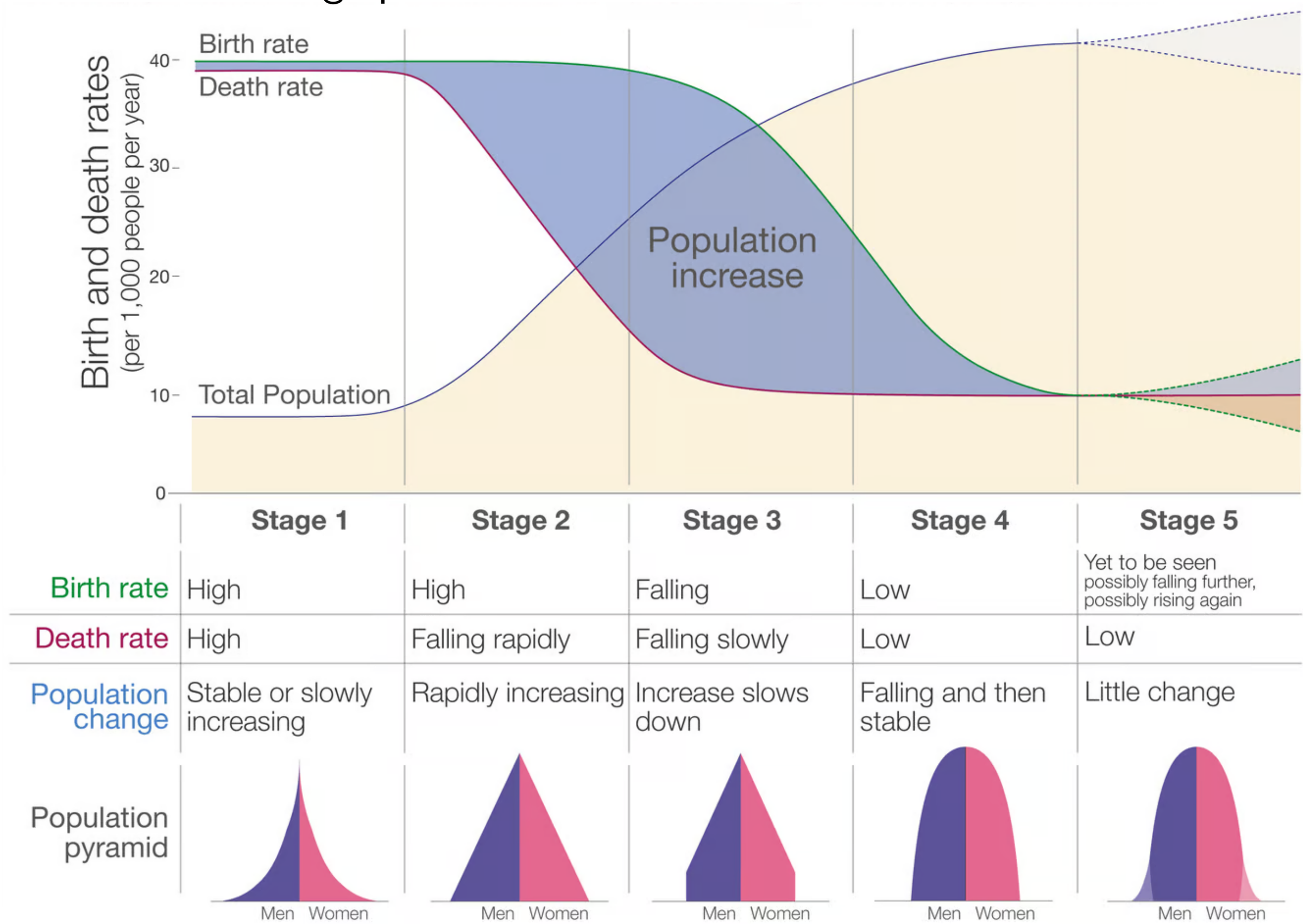
No problem if you did not read before today, but you should still read it, as it is fair game for the midterm and final

Journal of Economic Perspectives—Volume 17, Number 4—Fall 2003—Pages 167–190

The Demographic Transition: Three Centuries of Fundamental Change

Ronald Lee

What is the Demographic Transition?



	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5
Birth rate	High	High	Falling	Low	Yet to be seen possibly falling further, possibly rising again
Death rate	High	Falling rapidly	Falling slowly	Low	Low
Population change	Stable or slowly increasing	Rapidly increasing	Increase slows down	Falling and then stable	Little change
Population pyramid					

Lee's Account of the Demographic Transition

Pre-Transition:

- Short lives, many births, slow growth, more young than old

Transition:

- Mortality then fertility $\searrow$, population growth $\nearrow\searrow$

Post-Transition:

- Long lives, few births, slow growth, more old than young

Big changes!

- World population up 6x since 1800 when Lee was writing; now 8x

Table 1

Global Population Trends Over the Transition: Estimates, Guesstimates and Forecasts, 1700–2100

Life Expectancy (Years at Birth)	*Total Fertility Rate (Births per Woman)*	*Pop Size (Billions)*	*Pop Growth Rate (%/Year)*	*Pop < 15 (% of Total Pop)*	*Pop > 65 (% of Total Pop)*
1700	27	6.0	.68	0.50	36	4
1800	27	6.0	.98	0.51	36	4
1900	30	5.2	1.65	0.56	35	4
1950	47	5.0	2.52	1.80	34	5
2000	65	2.7	6.07	1.22	30	7
2050	74	2.0	8.92	0.33	20	16
2100	81	2.0	9.46	0.04	18	21

Before the Demographic Transition

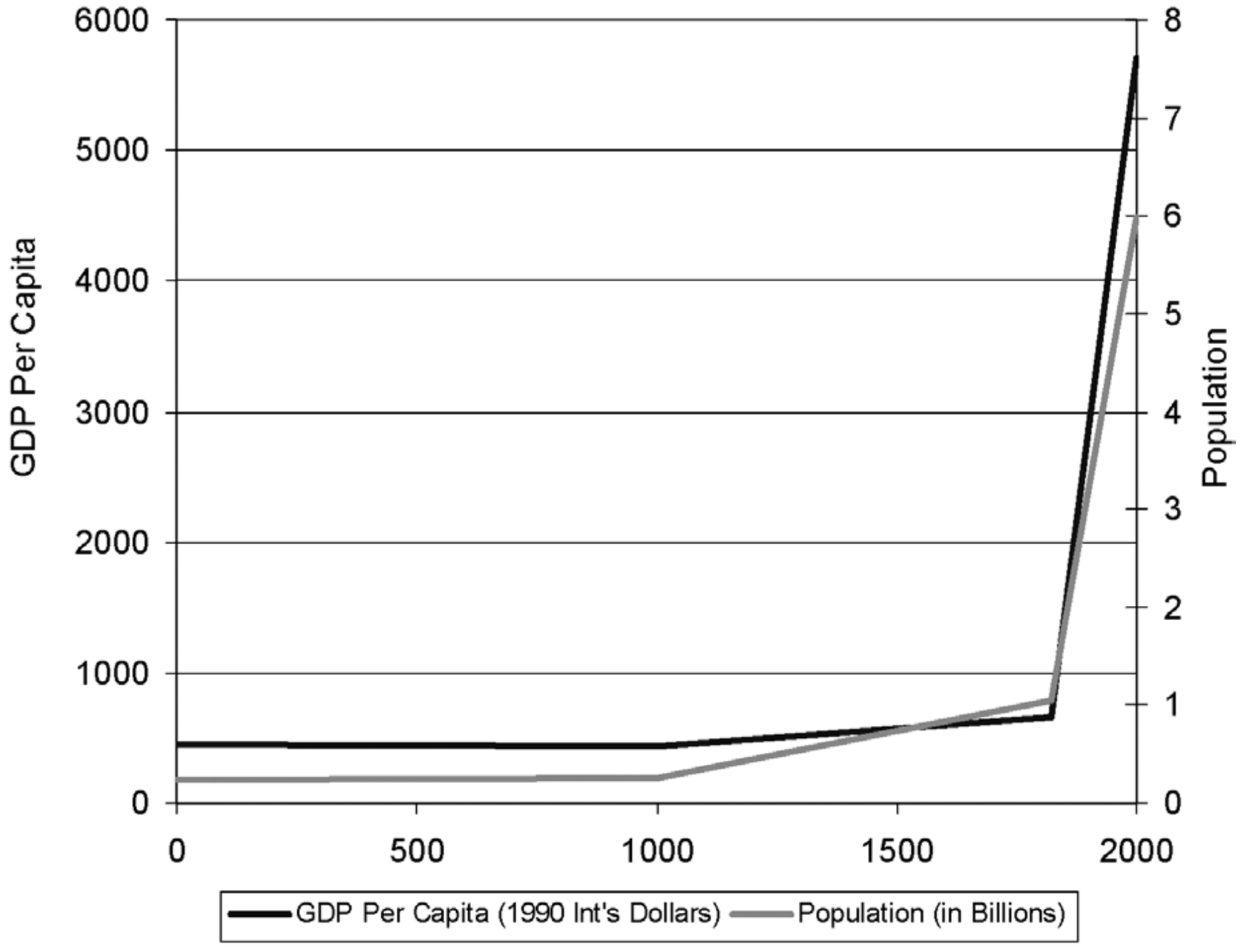
Malthusian theory

- Thomas Malthus, *An Essay on the Principle of Population*, 1798
- Size of population limited by economic capacity (e.g., land)
- Higher population growth $\rightarrow$ lower wages (or output/person) $\rightarrow$
  - Higher mortality ("positive check") **or**
  - Lower marriage and fertility ("preventive check")

Malthus believed "moral restraint" (postponement of marriage and sex) was the only way to prevent misery (famine, war, and disease)

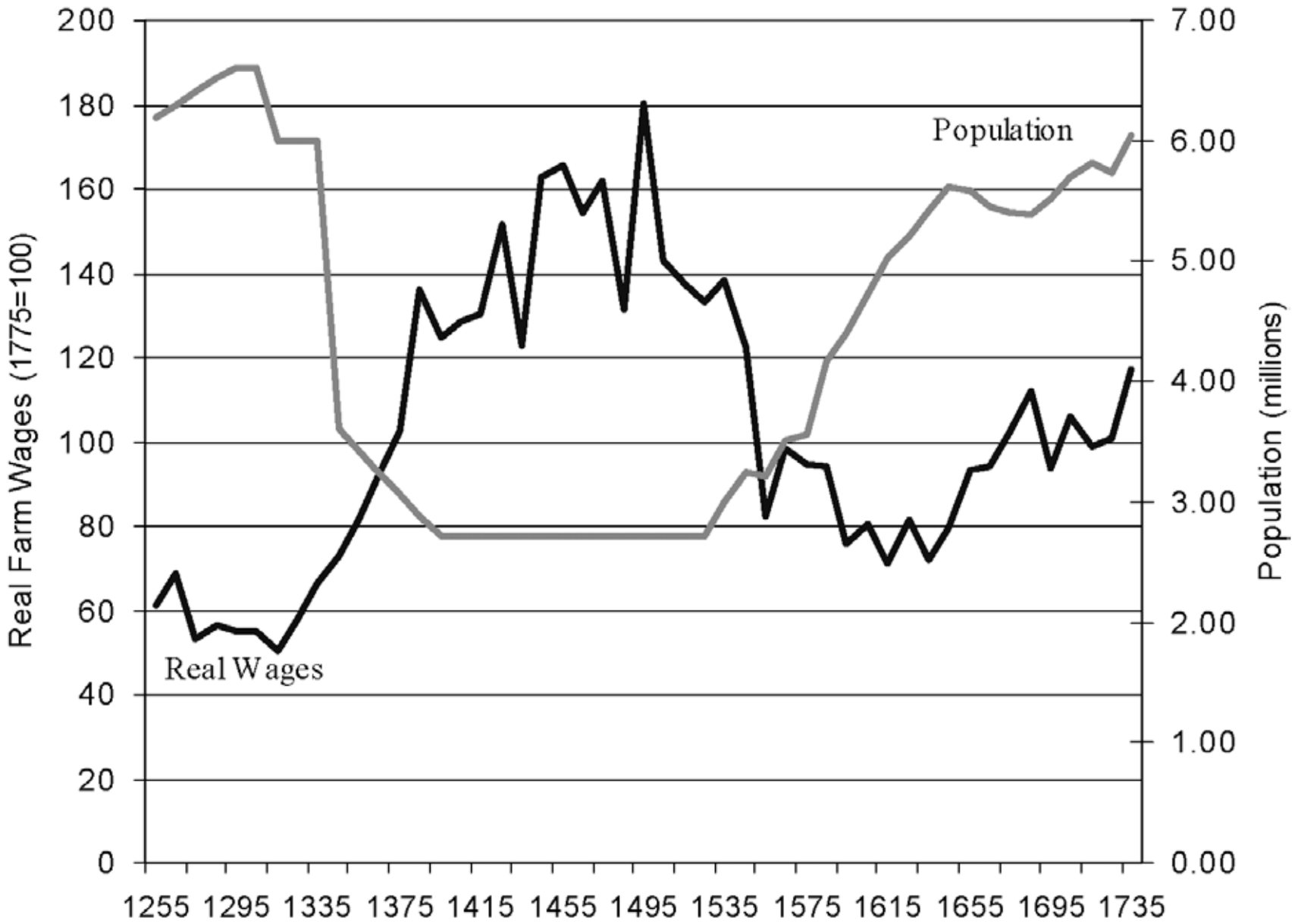
Theory correctly described the world before he wrote, but not after: pop'n grew slowly & living standards stagnated 200,000 BCE - 1800 CE

Global Population and Income Per Capita, 0 - 2000



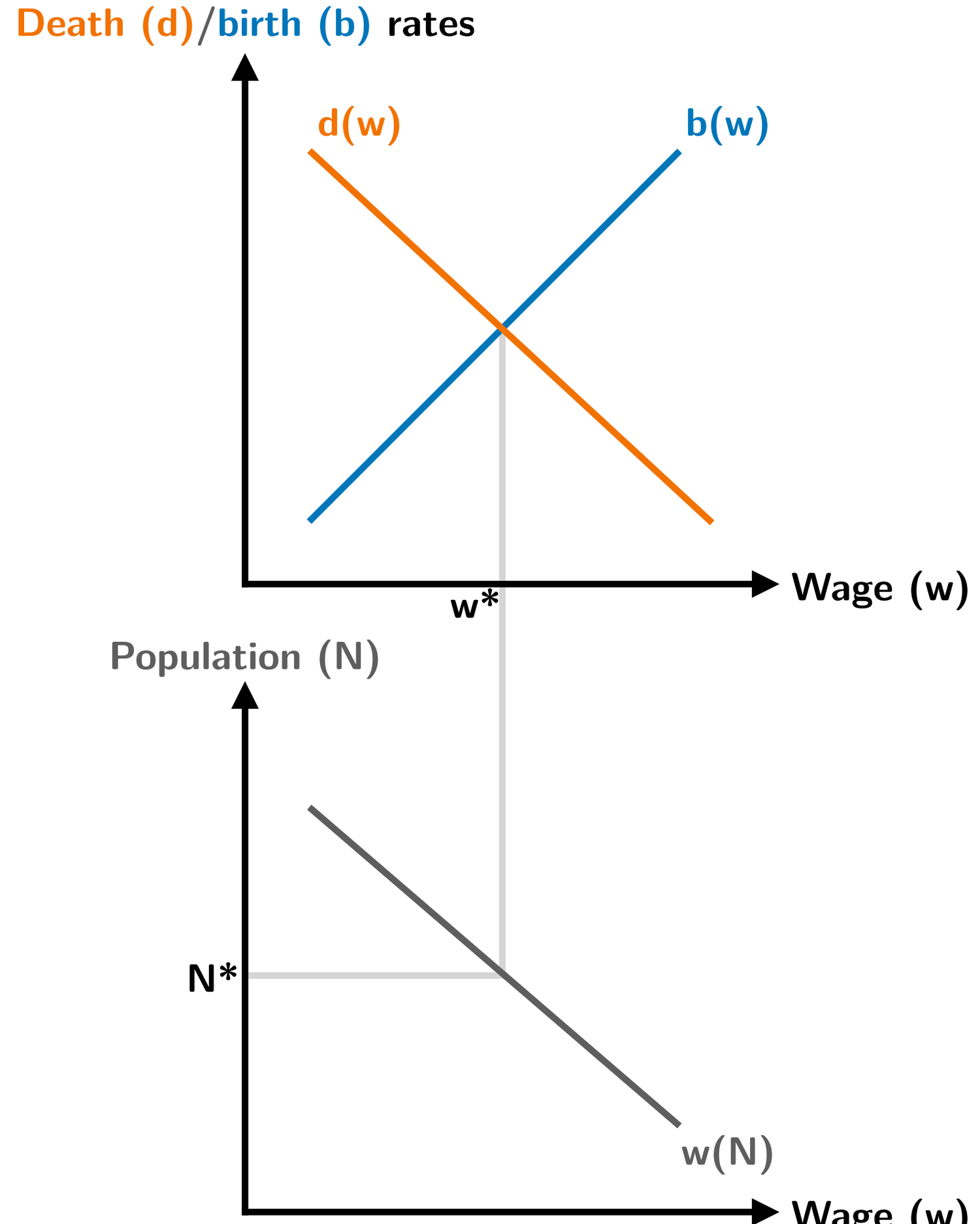
Source: Galor (2005) based on Maddison (2001)

Population and Real Wages in England, 1250 - 1750



Source: Galor (2005) based on Clark (2001, 2002)

Malthusian Equilibrium

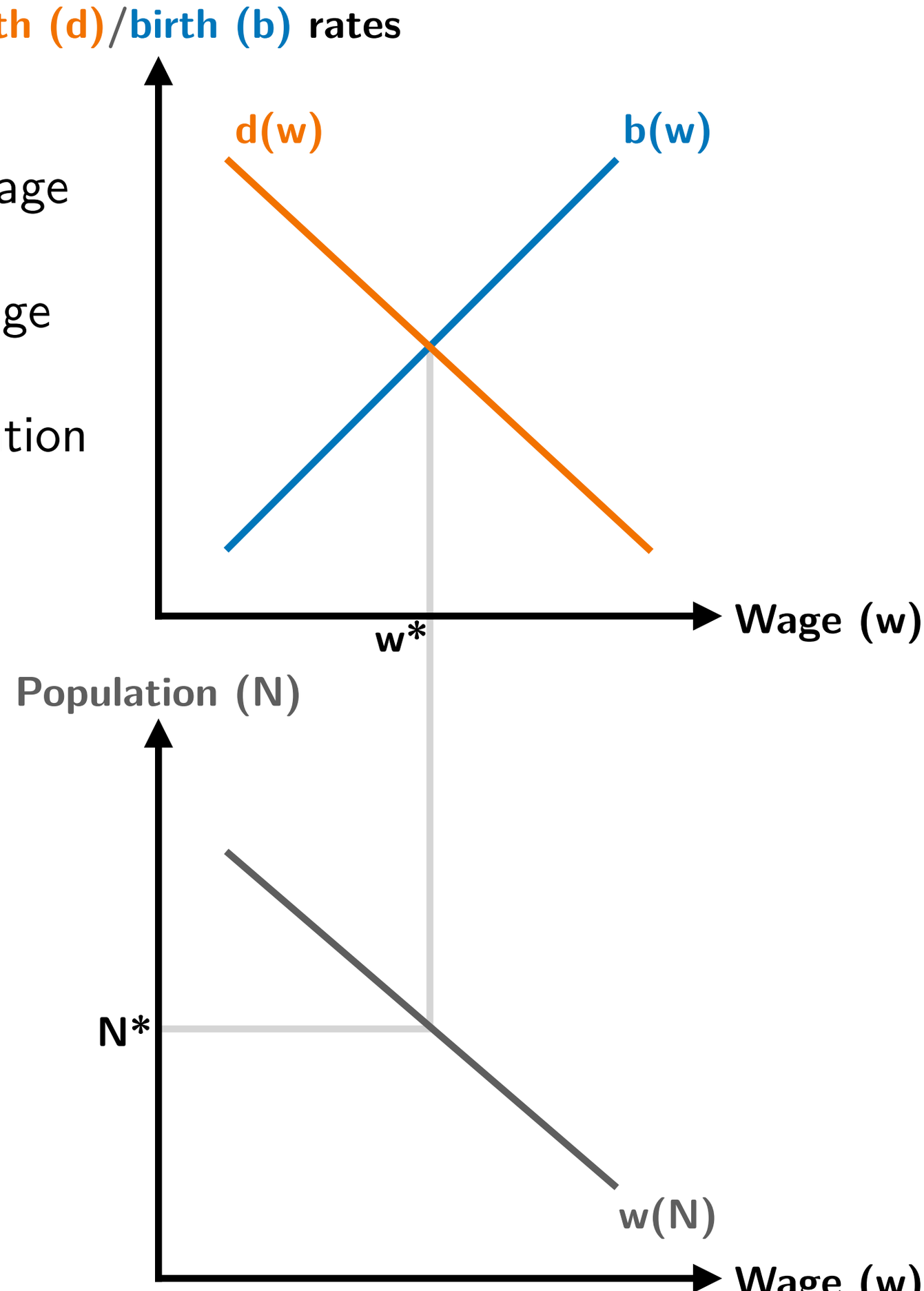


Malthusian Equilibrium

d(w): death rate as function of wage

b(w): birth rate as function of wage

w(N): wage as function of population



Malthusian Equilibrium

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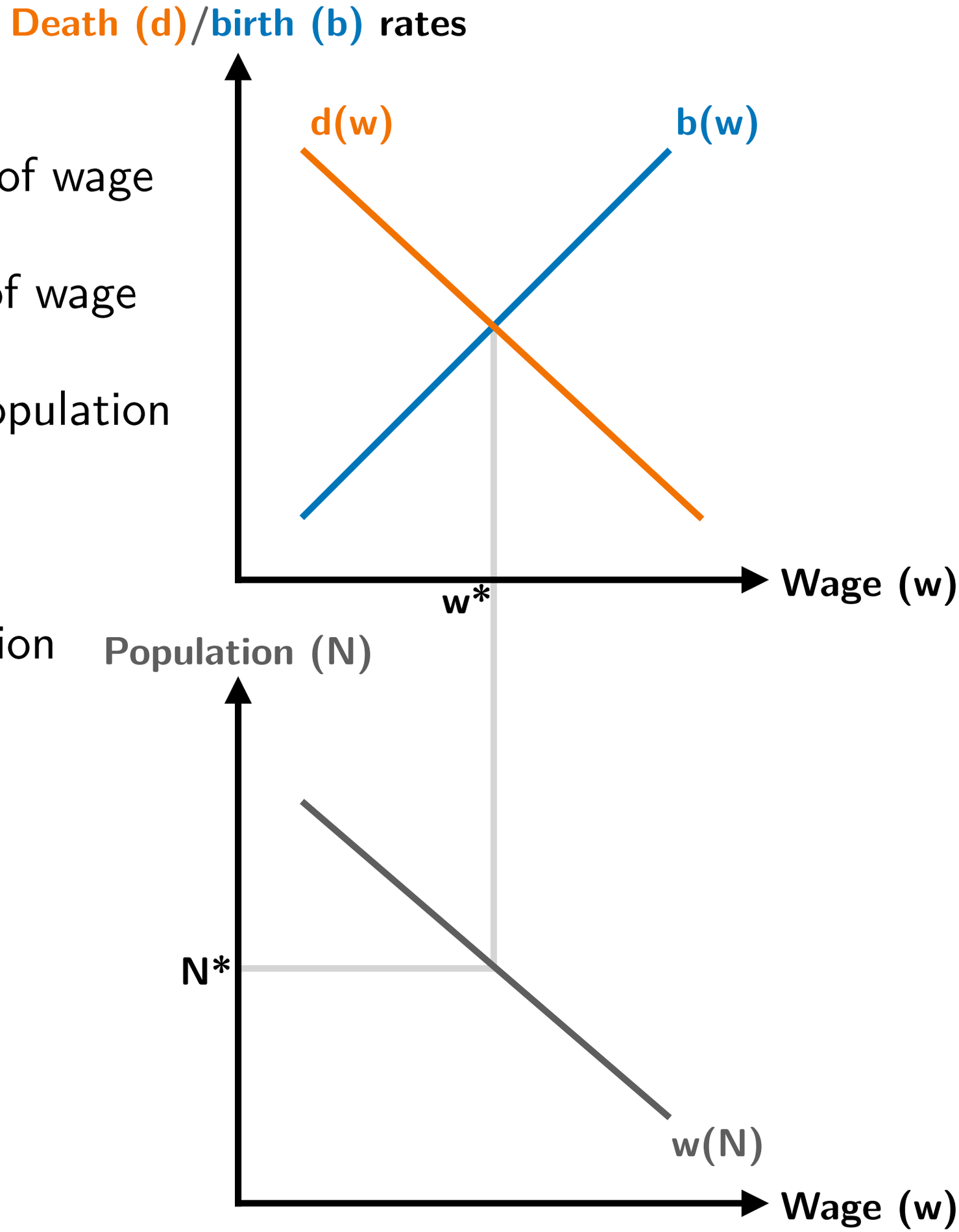
w(N): wage as function of population

When **d(w)** $=$ **b(w)**, population does not change



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d(w): death rate as function of wage

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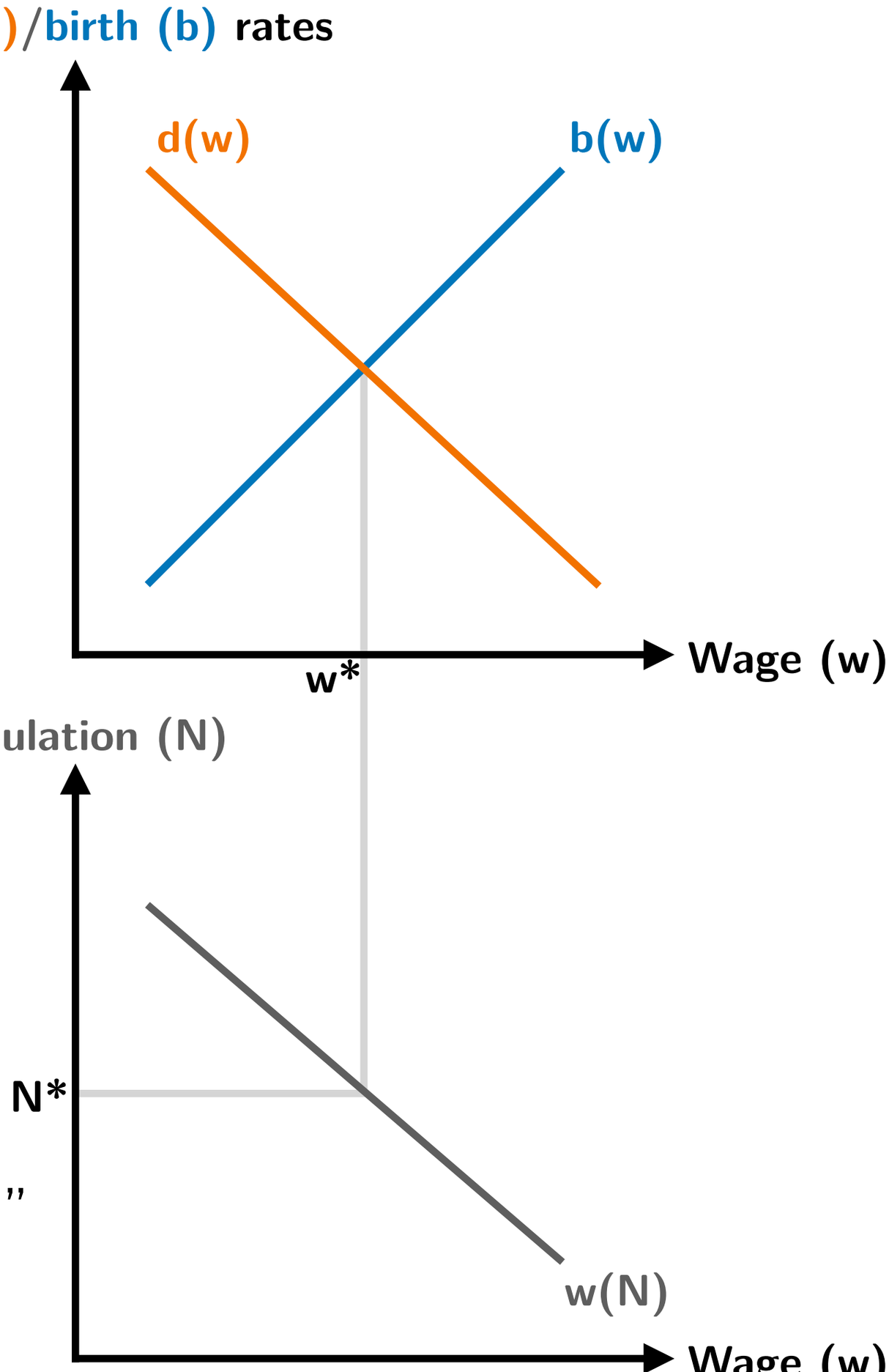
w(N): wage as function of population

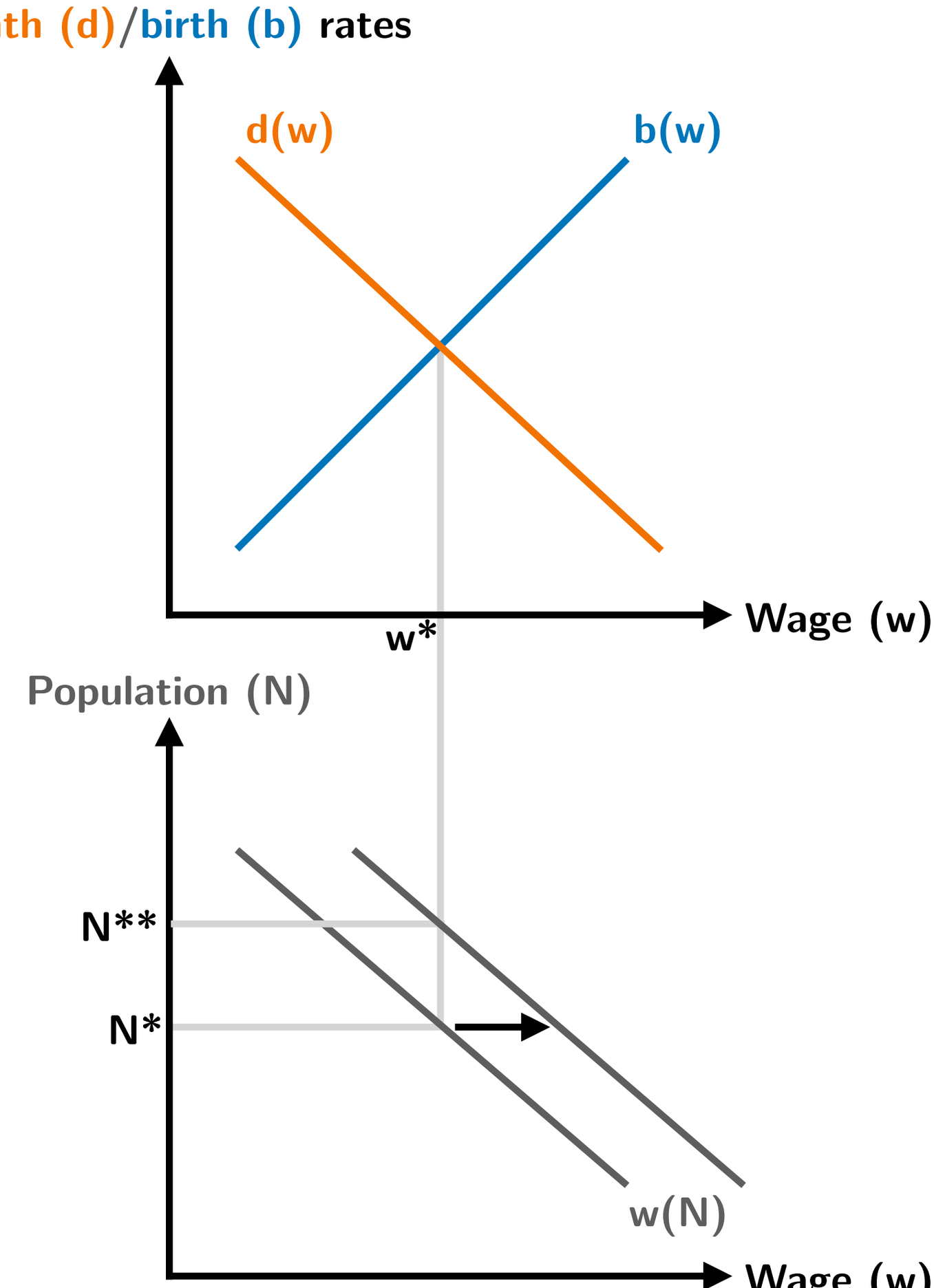
When **d(w)** = **b(w)**, population does not change

(w*, N*) is the "equilibrium"

- **w*** is the "equilibrium wage"
- **N*** is the "equilibrium population"



Effect of a Rise in Productivity



Effect of a Rise in Productivity

Suppose a new technology is developed, e.g., agriculture or the plow

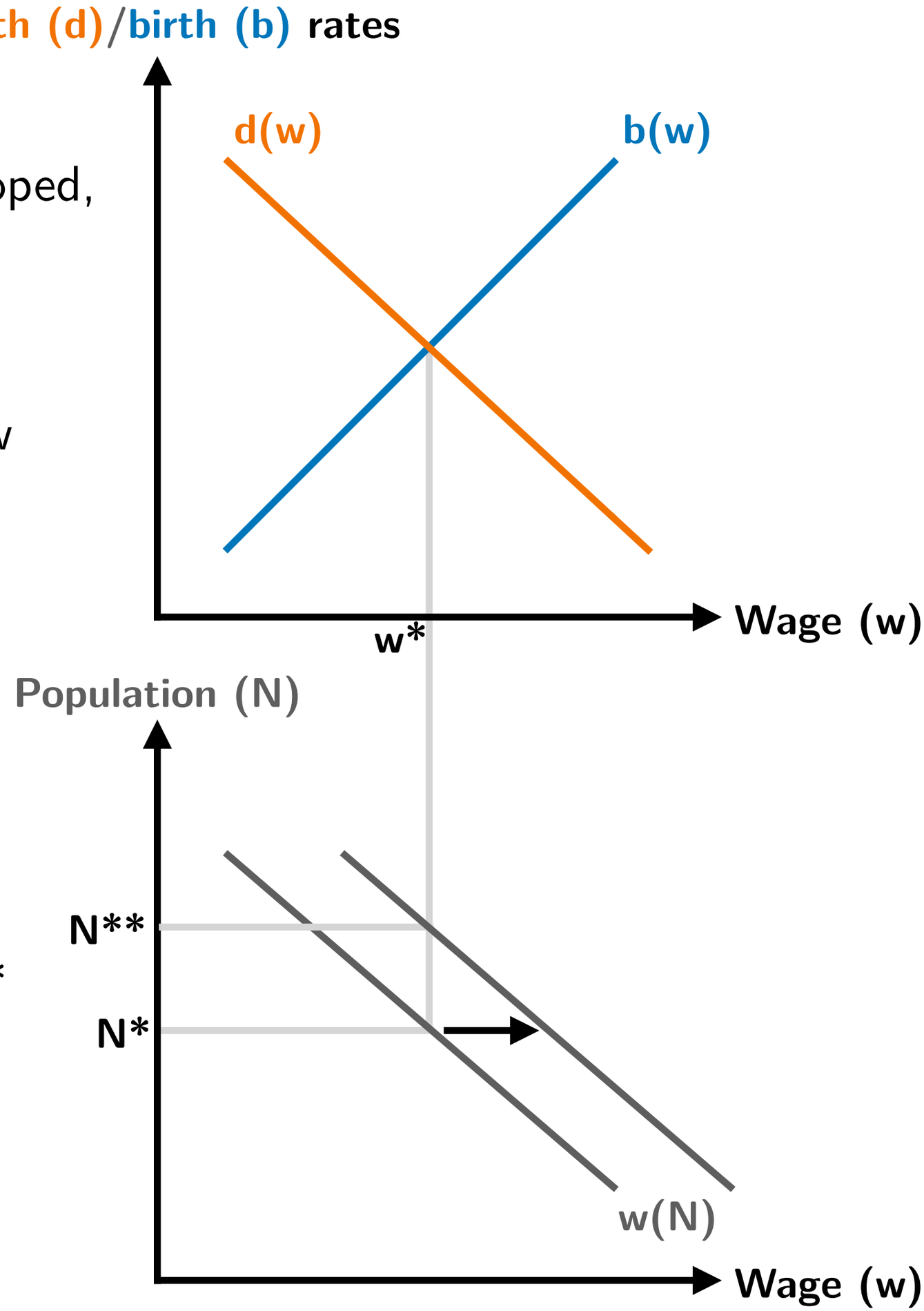
At a given population, the land now supports a higher wage

Short term: wages ↗

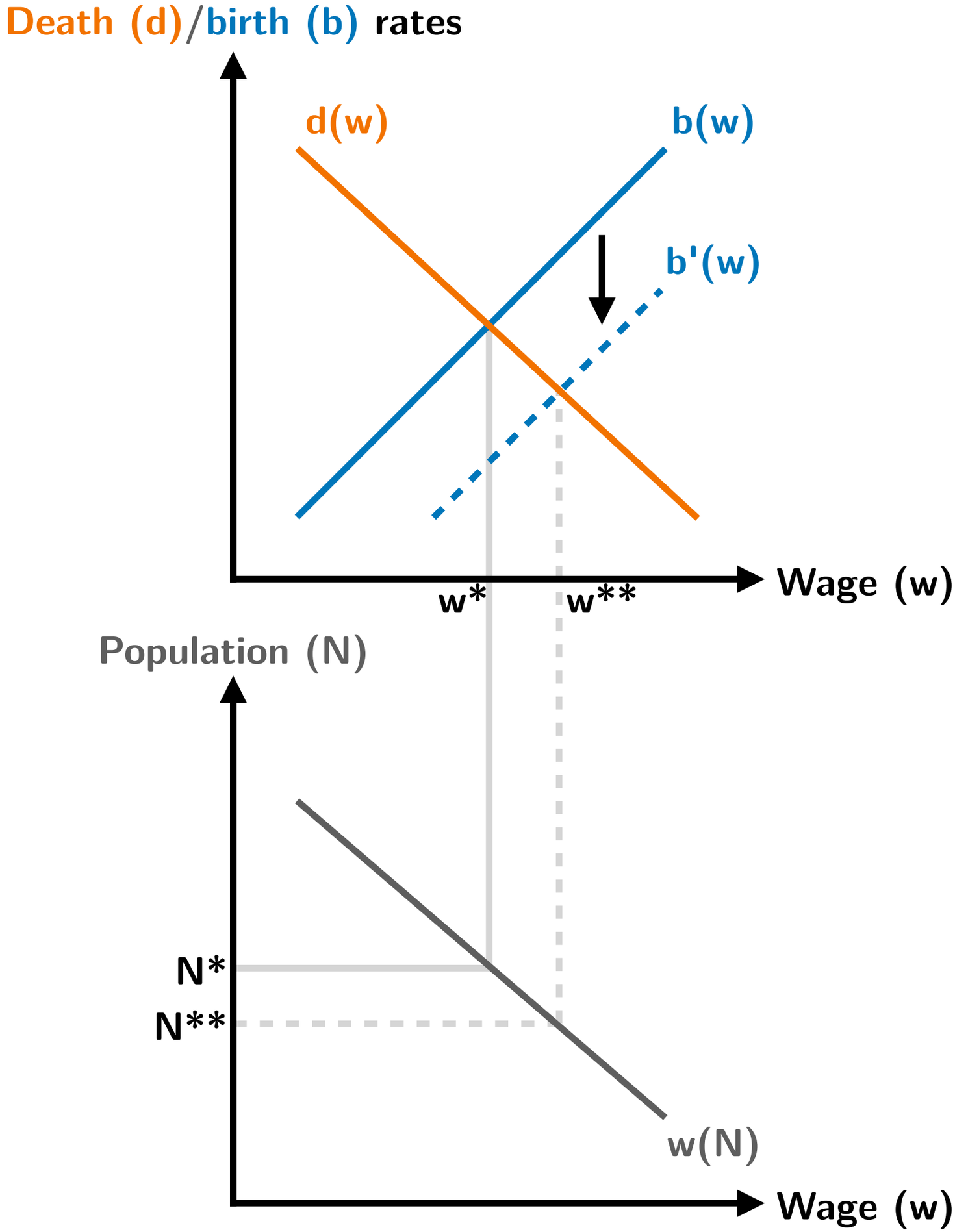
But then births ↗, deaths ↘,

pop rises to N**, wages back to w*

Long term: larger pop, same wage



Effect of "Moral Restraint"



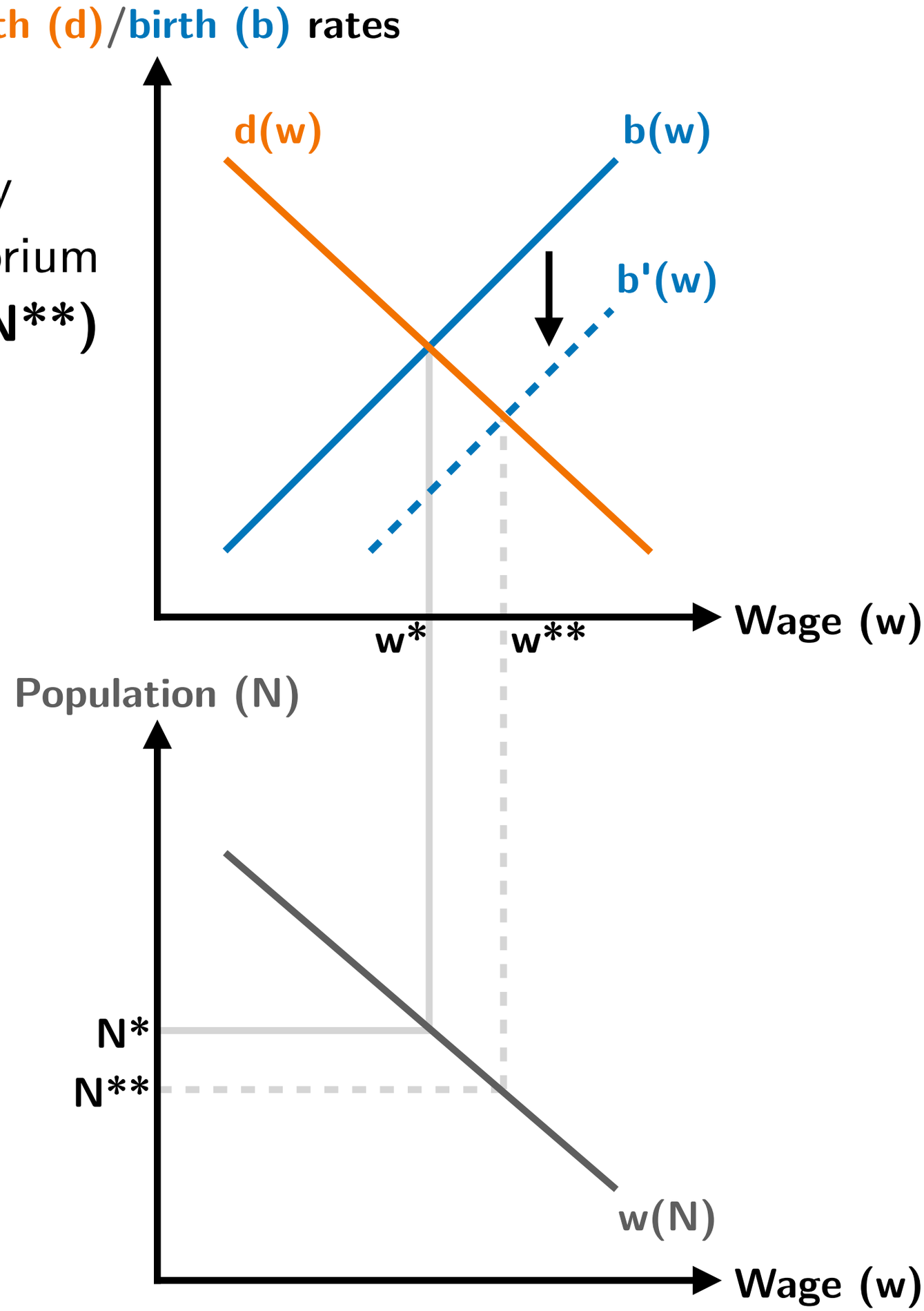
Effect of "Moral Restraint"

If people limit how many kids they have at a given wage, then equilibrium moves from **(w*, N*)** to **(w**, N**)**

New equilibrium has...

- Higher wages
- Smaller population

Hence Malthus's argument that "moral restraint" was desirable



Escaping the Malthusian Trap

As Malthus was writing, the Industrial Revolution was just starting

Scientific and technological advances increased economic productivity and made the world less deadly

Mortality fell, and eventually fertility too (not always in that order)

Living standards grew dramatically

Not everyone benefitted at once: progress staggered across the world

- Population growth and economic growth in the West post-1800
- Population growth and economic growth in the rest post-1950

Lee provides an overview

Mortality Decline

Mortality rates started ↘ in 1800s in Europe, 1900s in rest of the world

Drivers: (1) public health, (2) nutrition, (3) medicine

In Figure 1, 1950-2000 data versus 2000-2050 projection

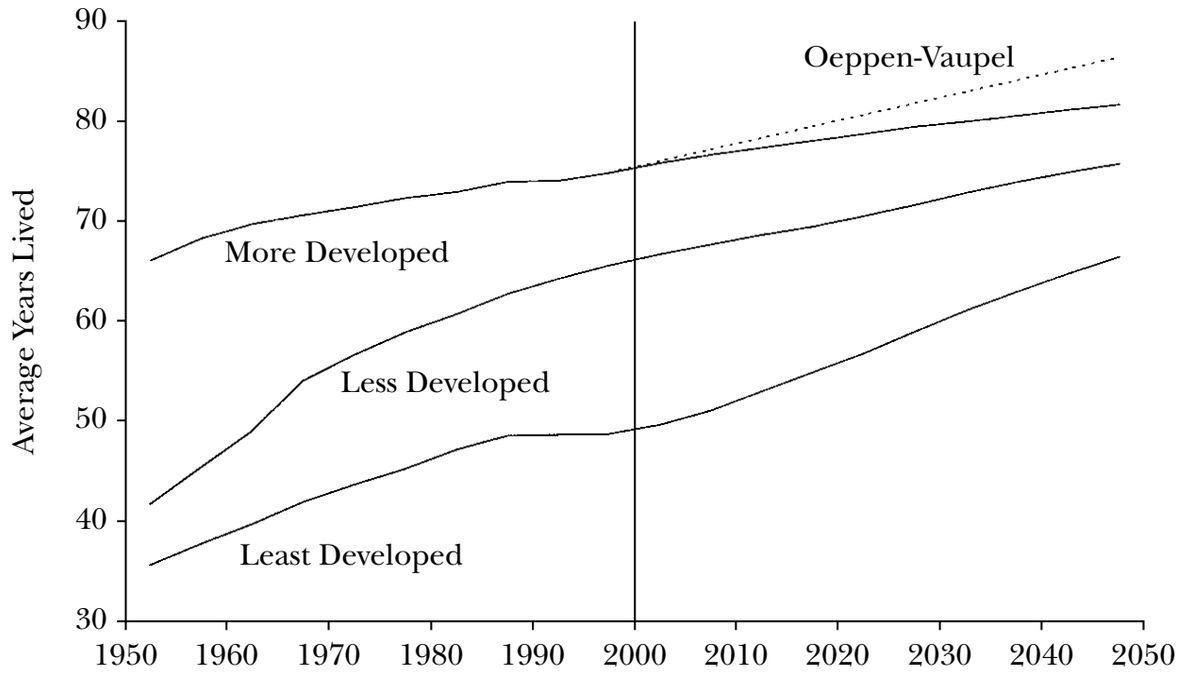
"Less developed" countries: life expectancy ↗ 20+, mostly (1) + (2)

"More developed" countries: smaller ↗, mostly (3)

"Least developed" countries: stagnation in 90s, HIV/AIDS

Figure 1

Past and Projected Life Expectancy at Birth, by Major Development Groups, 1950–2050



Sources: Historical and Middle Series forecasts are taken from United Nations (2003). Record life expectancy trend is taken from Oeppen and Vaupel (2002).

Fertility Decline

Fertility rates started ↘ c. 1900 in Europe, later in rest of the world

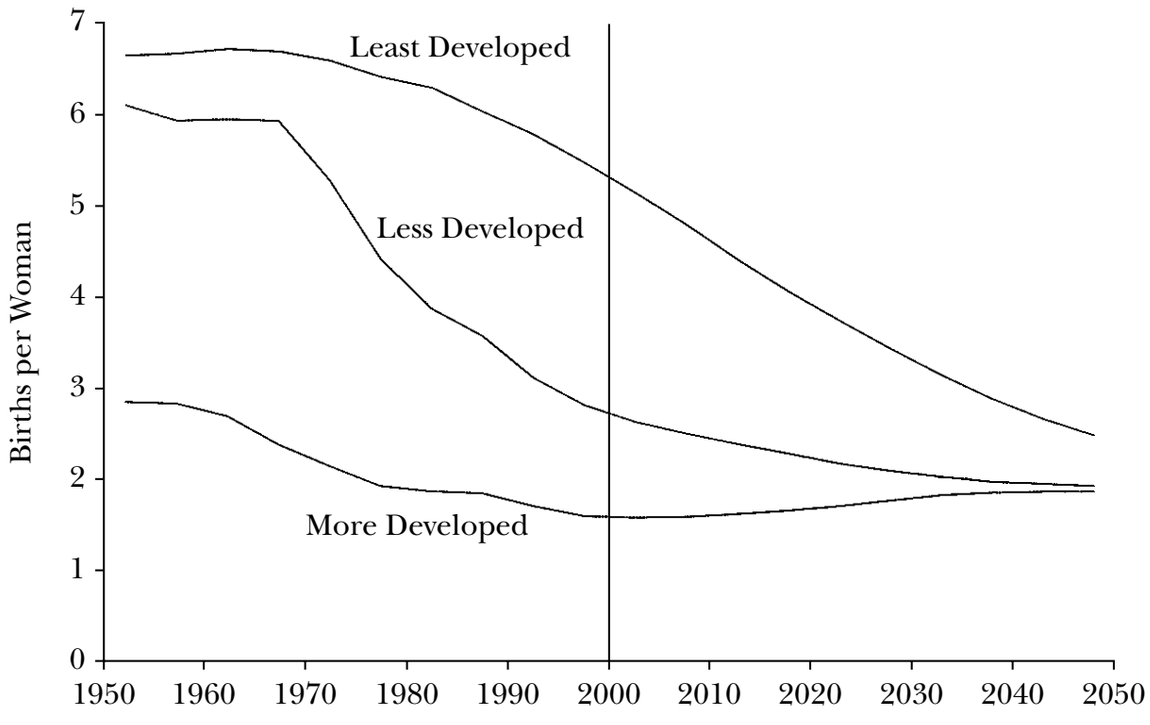
Explanations: child mortality, women's work, children's schooling, contraceptive access, others Lee does not discuss

"Less developed" countries: massive ↘ 1970-2000, 6 children to 3

"More developed" countries: ↘ after postwar baby boom, then projected rebound that did not happen

"Least developed" countries: slower, later decline

Figure 2
Past and Projected Total Fertility Rate by Major Development Groups, 1950–2050



Source: Historical and Middle Series forecasts are taken from United Nations (2003).

Population Growth

Here, Lee gives a longer time series but notes sketchy data before 1950

"Less developed" countries: peak in 1960s

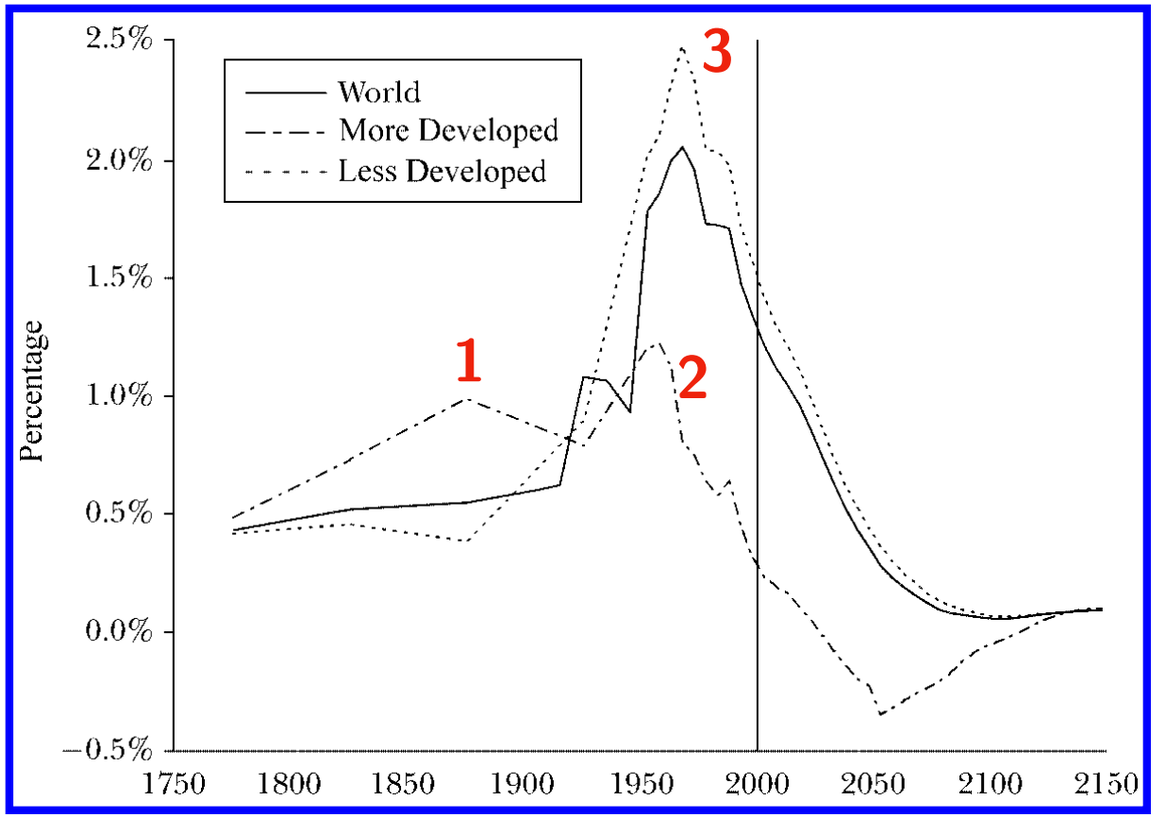
"More developed" countries: peak in late 1800s, baby boom in 1950s

"Less developed" countries larger, so "world" looks similar

1 and **3** reflect mortality decline preceding fertility decline

2 is a separate phenomenon unrelated to the Demographic Transition

Figure 4
Population Growth Rates, 1750–2150



Source: The population growth rates are calculated as instantaneous (exp(rt)) rates based on population data. The data for 1750–1950 are taken from Tables 1 and 2 of United Nations (1999) and for 1950–2150 are taken from United Nations (2000).

Shifts in Age Distribution

Demographic Transition alters the age structure of the population: First many babies, then many working-age adults, then many elderly

$$\text{Dependency ratio (DR)} = \frac{\text{People under 15 or over 65}}{\text{People between 15 and 64}}$$

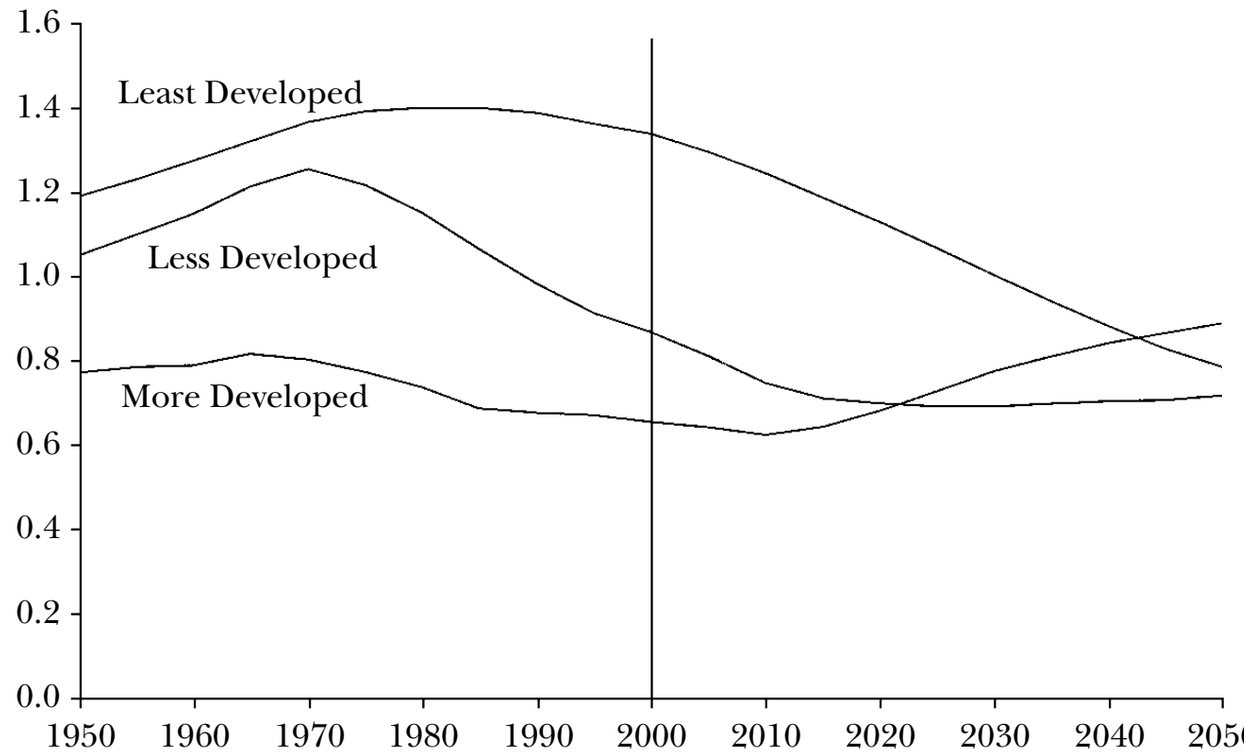
Mortality decline initially raises DR: more kids survive

Fertility decline reduces DR: fewer kids

Continued mortality decline raises DR again: more elderly

Figure 7

Total Dependency Ratio by Level of Development, 1950–2050



Source: Historical and Middle Series forecasts are taken from United Nations (2003).

Summarizing and Looking Forward

Lee's article is a bit out of date but nicely summarizes key aspects of the Demographic Transition

In the coming weeks, we will delve further into the empirical trends he reports, the measures he uses, and the theories he describes

Some open questions:

- Why did mortality and fertility fall when they did?
- What enabled the departure from the Malthusian equilibrium?
- What is life expectancy? What is the total fertility rate?
- How correct were the projections over the last 20 years, and how different are the projections today?