Demographic Dividend- Boosting economic productivity and growth through declining fertility rates: A path for convergence?

Historical Model Review and recent Application to Russia

Econ 6470 Economic Growth and Development

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What is a Demographic Dividend?

First Dividend

- Demographic transition occurs: as fertility rates decline & life expectancy increases
- Share of working age pop, 15 to 64, increases
- More resources to support smaller families reaps larger economic benefits

What is a Demographic Dividend?

Second Dividend

- Change in age structure leads to increased short run savings
- In the long run, increase in investment and human capital
- Subsequently influence workforce productivity

Table 1: Recent Dividend Estimation

How Big Are the Dividends:
The Second Dividend Has Typically Been Larger Than the First[1]

Region	Demographic Dividends			Actual Growth in GDP/N*	Actual Dividend
	First	Second	Total		
Industrial	0.34	0.69	1.03	2.25	1.22
East Asia and Southeast Asia	0.59	1.31	1.90	4.32	2.42
South Asia	0.10	0.69	0.80	1.88	1.08
Latin America	0.62	1.08	1.70	0.94	-0.76
Sub-Saharan Africa	-0.09	0.17	0.08	0.06	-0.02
Middle East and North Africa	0.51	0.70	1.21	1.10	-0.11
Transitional**	0.24	0.57	0.81	0.61	-0.20
Pacific Islands	0.58	1.15	1.73	0.93	-0.79

The second dividend (second column) has been larger than the first dividend, and the combined effects of the two (third column) range as high as 1.9 percent a year in East and Southeast Asia. East Asia benefited greatly from the second demographic dividend: The combined effect of fewer children to support and increasing life expectancy is estimated to have led to an increase in gross national saving rates by approximately 14 percentage points.[2]

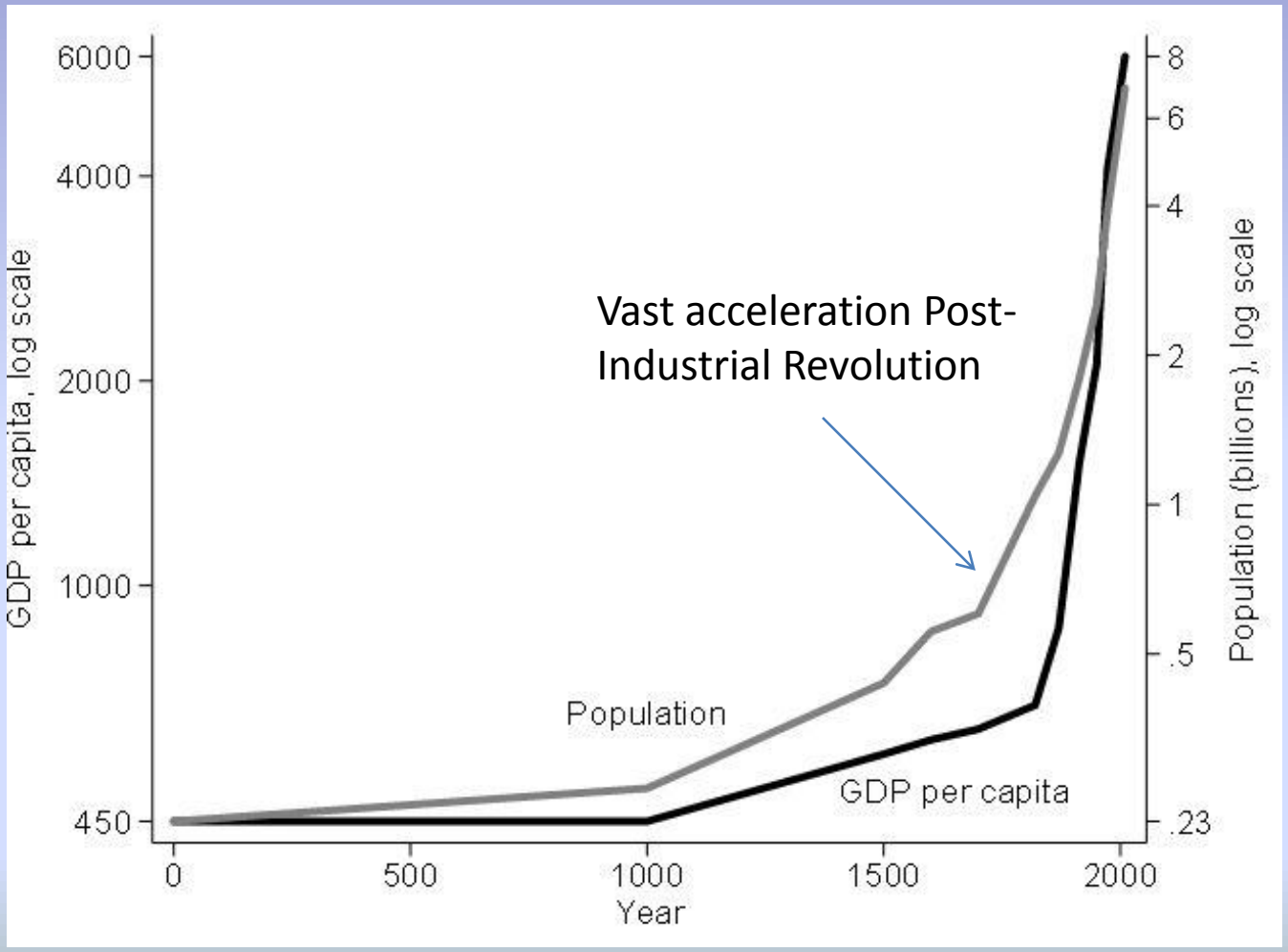
Population Reference Bureau, 2013

"In short, the first dividend yields a transitory bonus, and the second transforms that bonus into greater assets and sustainable development." Lee & Mason, 2006

Early expected dynamics of a population based model

- Malthus (1789): population growth will take up resources and create the demise of citizen's standards of living
  - Assuming a fixed stock of resources
  - Education during this time still served mainly cultural and political purpose, rather than formal human capital accumulation
  - Analysis did not anticipate innovation
  - Industrial Revolution quickly 'proved' him wrong

Figure 1: History of Income per Capita and Global Population



Jones & Vollrath, 2013, p. 183

Timing Matters

- Demographic transitions originated at different times globally
  - Europe: Early 20th century
  - Latin America: Middle of 20th century
  - Asia: shortly thereafter
  - Africa: Late 20th century/early 21st century

Post-Malthusian Era Model

Models with endogenous population growth were the origin of the demographic dividend.

- Linking decisions about the number of children to income levels
- Production function adjusted for stock of land rather than capital: $\mathbf{Y= B X^{\alpha} L^{\beta}}$

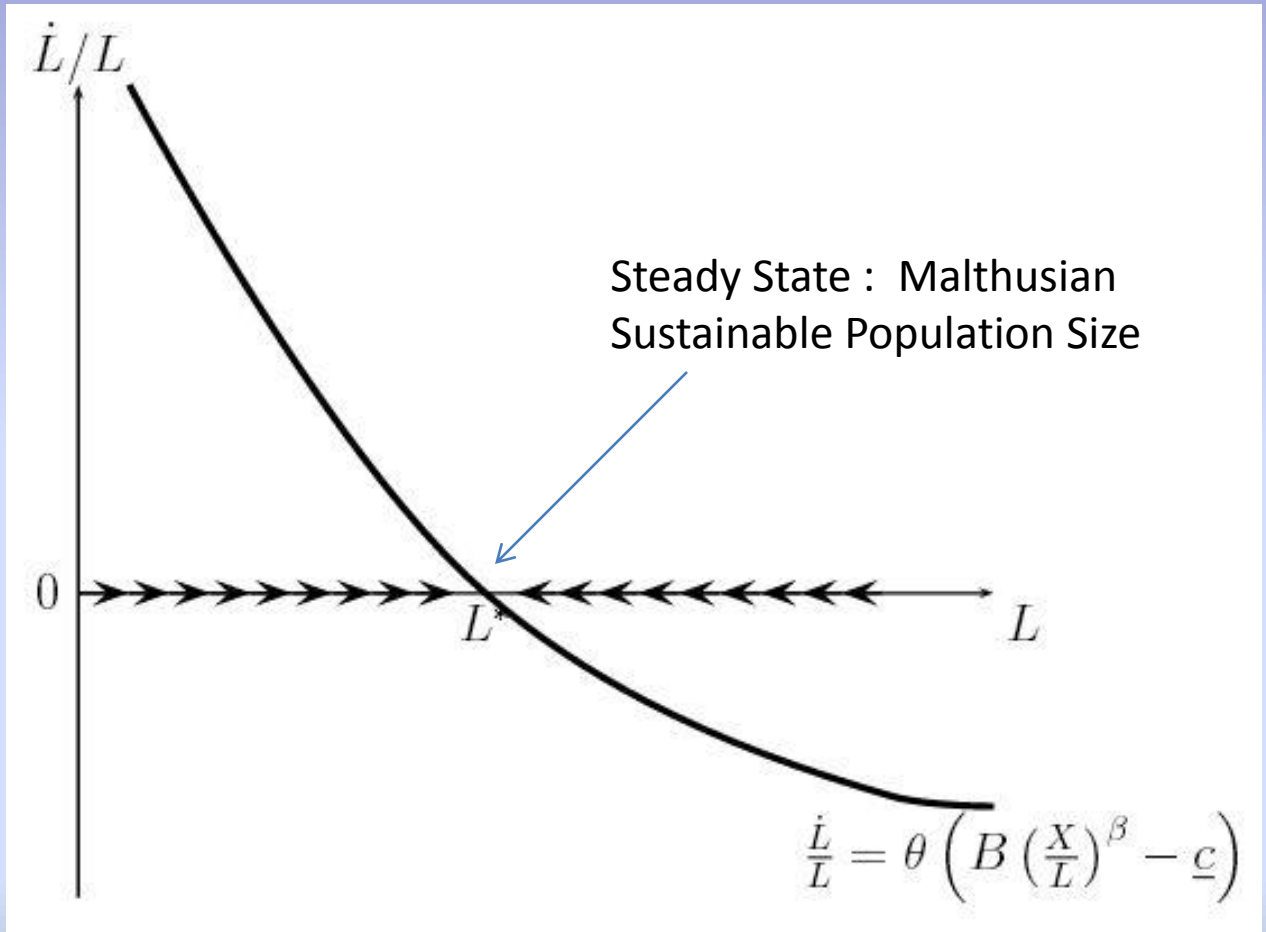
  ,where B equals the level of technology, X the stock of land, L the population, and constant returns to scale ($\alpha+\beta=1$).

Classic Model continued

- Dividing both sides by L to analyze per capita income gives us the Malthusian effect
  - Output per worker depends negatively on population size: $Y/L = B(X/L)^{\beta}$
- Adding a linear population process to turn exogenous population growth endogenous:

$$\frac{\dot{L}}{L} = \theta\left[\left(\frac{X^{\beta}}{L}\right) - \underline{c}\right]$$

Figure 2: Malthusian Dynamics of Population push to Steady State



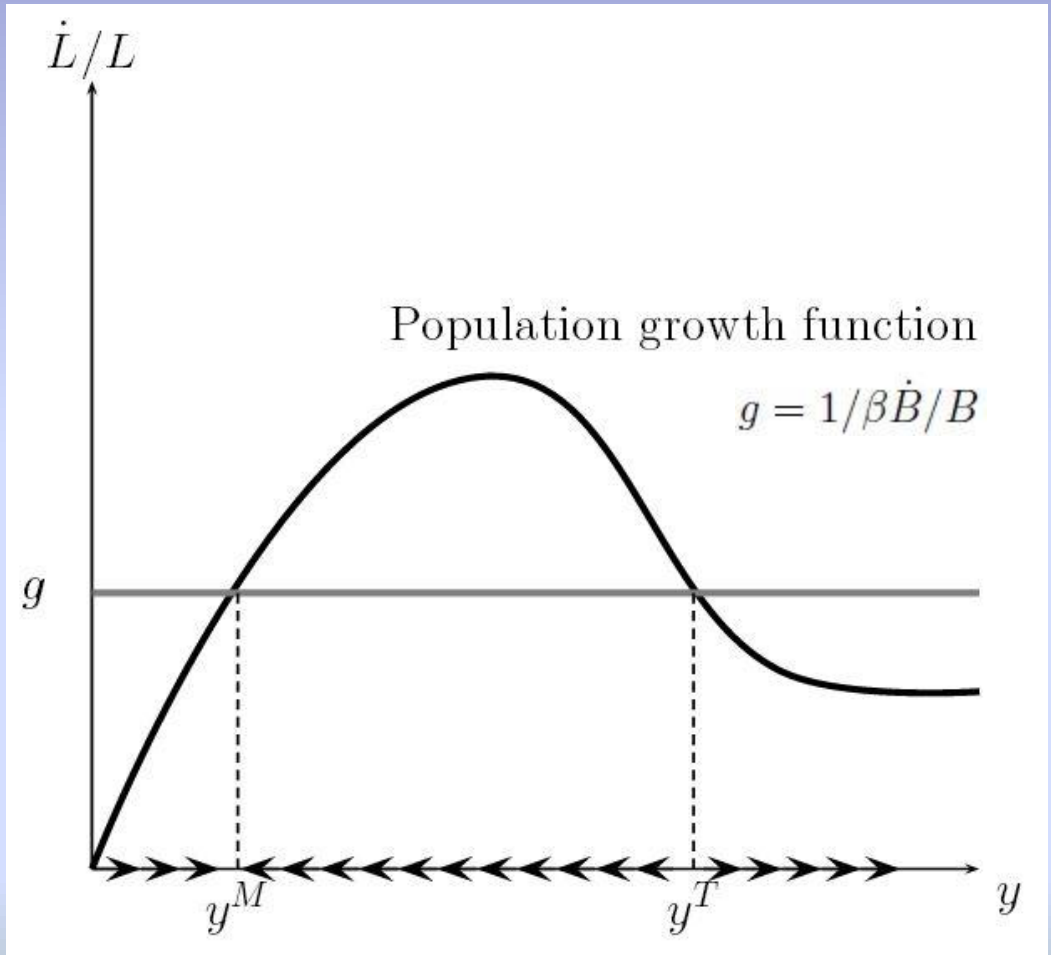
Jones & Vollrath, 2013, p. 189

Explaining today and the future

Expansion of the model to allow for technological change and debunk the positive income/population size assumption

- Replace prior assumptions with continuous technological growth and include different population dynamics
- Dynamics of income per capita now have several steady states, and we can consider sustained growth (Dynamic Transition)

Figure 3: Utilizing Continual Growth
(Post-Kremer model)



Jones & Vollrath, 2013, p. 201

Economic Growth Relevant Literature

- Classic literature highlights average growth over time (Solow (1956), Barro and Sala-i-Martin (1991), Mankiw et al. (1990), Bloom and Canning (2004))
- Focus on fertility rates enter literature (Barro and Becker (1989), Barro (1996), Sala-i-Martin (1996), Weil (1997)) and open path to demographic dividend research analyzing the benefits of fertility decline

Demographic Dividend (DD): Recent Application

The following paper examines the DD using data from Russian regions and finds evidence that demographic trends influence regional growth convergence.

- Standard Solow Swan Model conclusion that the poor areas grow faster than rich areas
- Authors conclude it is based on demographics

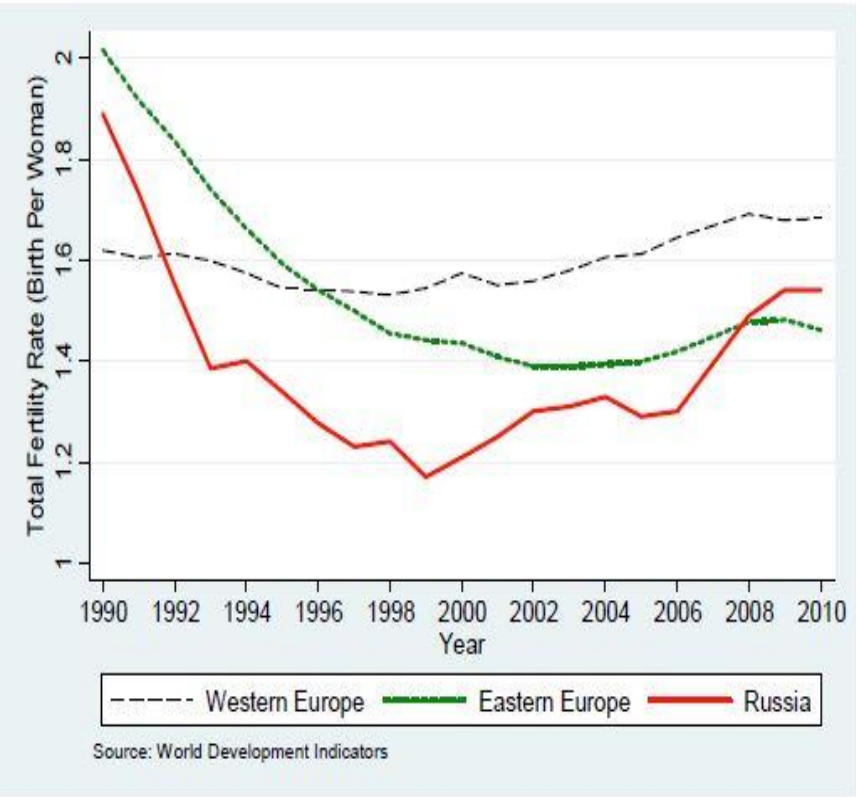
Demographic Dividend & Growth:

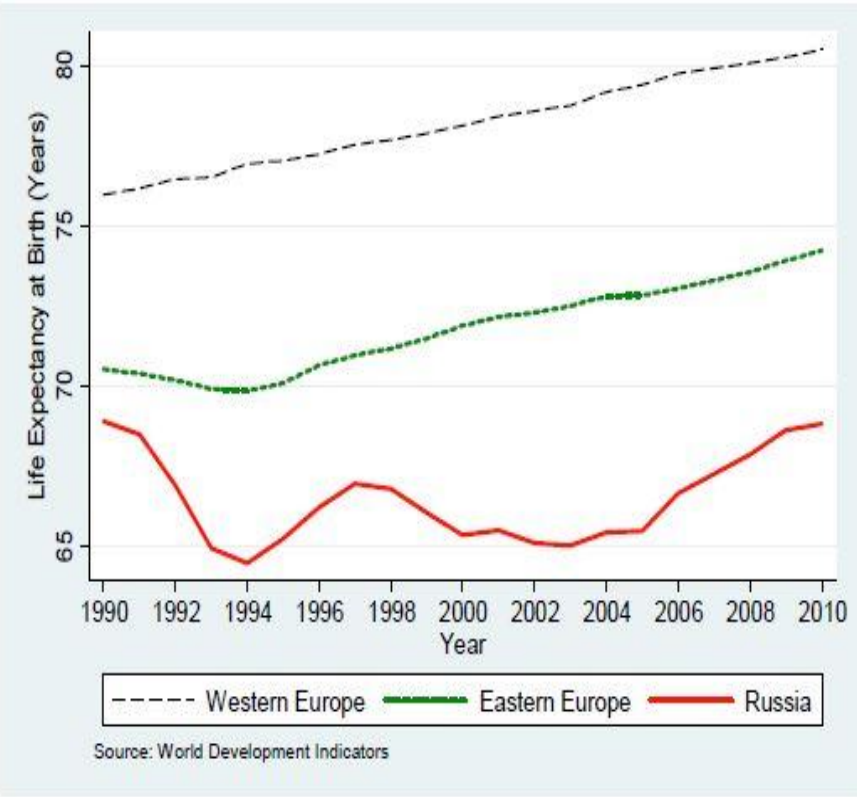
Matytsin, M., Moorty, L. M., & Richter, K. (2015). From demographic dividend to demographic burden? regional trends of population aging in Russia. *Regional Trends of Population Aging in Russia (November 23, 2015). World Bank Policy Research Working Paper*, (7501).

Russia's Path

- Russia's population declined since 1995, roughly at the same pace as Eastern Europe
- The decline is set to continue over the next 40 years; this is in contrast to the rise of the population in Western Europe
- However, working age population is set to decrease over the next ten years. [According to UN projections, the working age population in Russia is set to decline from 103 million in 2010 to 76 million in 2050.]

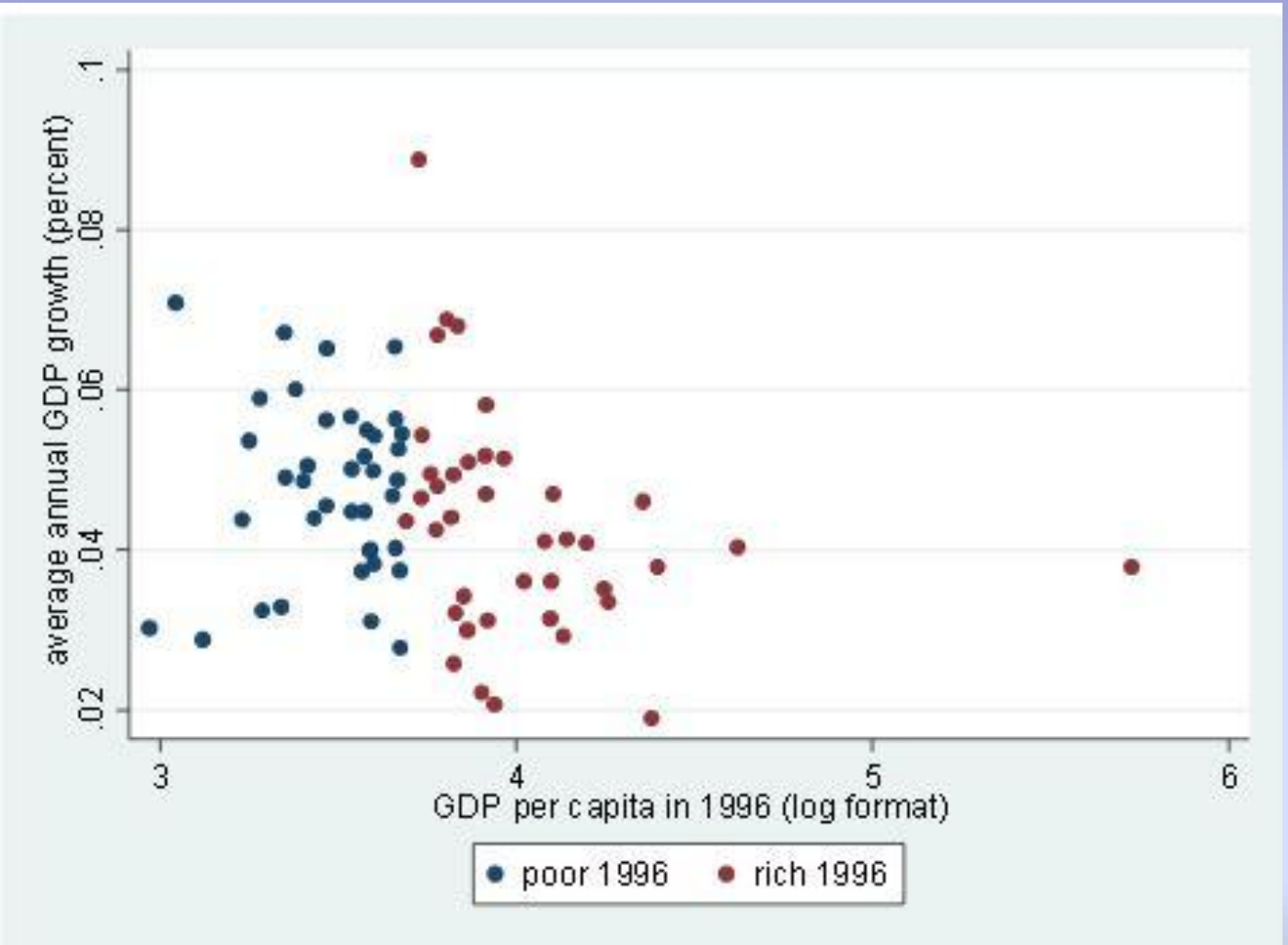
Figure 4: Total Fertility Rate and Life Expectancy in Russia, Eastern and Western Europe, 1990-2010





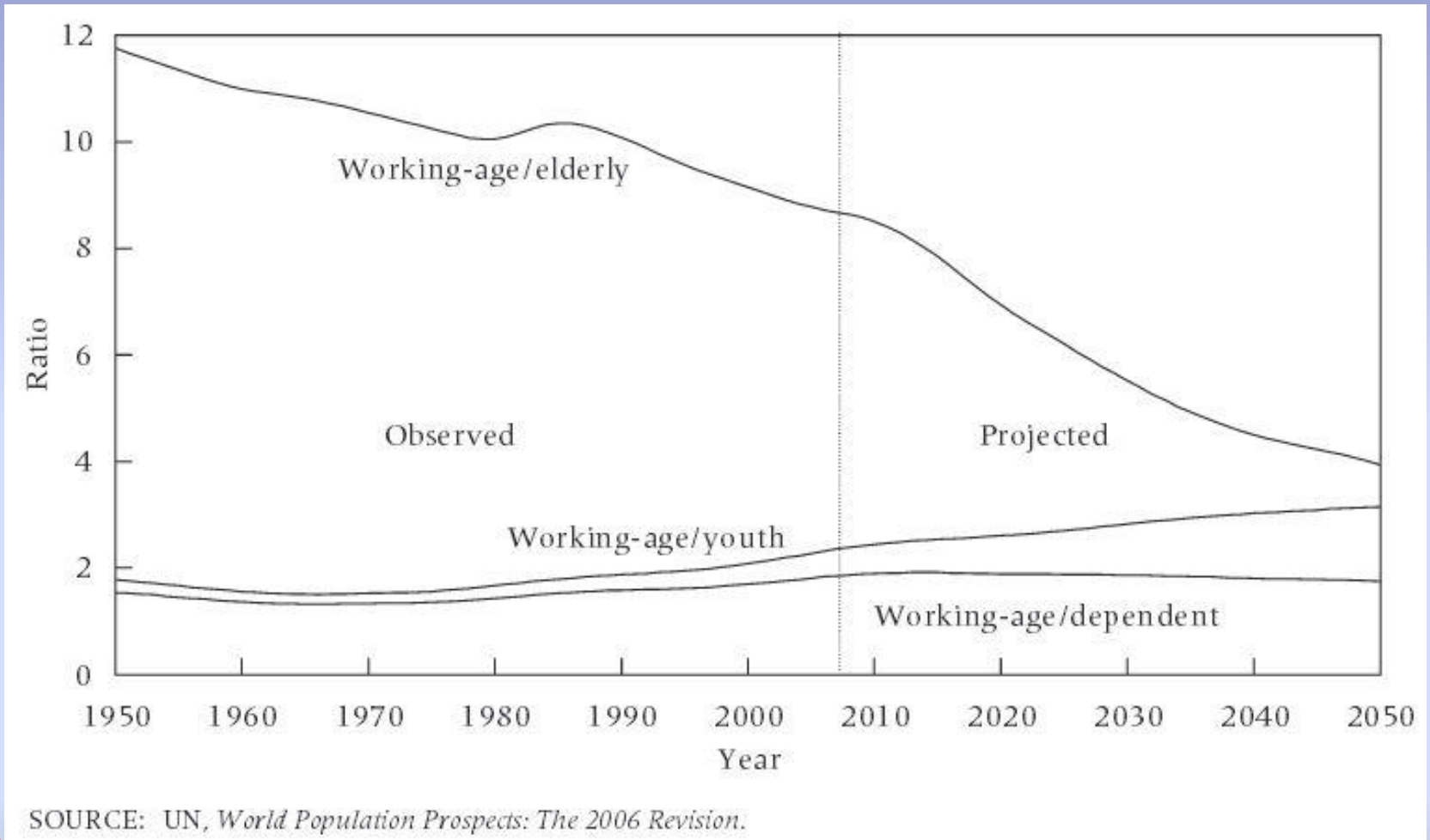
Matytsin, Moorty, & Richter,2015, p. 5

Figure 5: Russian Regional GDP Growth



Matytsin, Moorty, & Richter, 2015, p. 6

Figure 6: Ratios of working-age WORLD population to dependent, youth, & elderly population, 1950–2050



SOURCE: UN, *World Population Prospects: The 2006 Revision.*

Bloom and Canning, 2004, p. 24

Matytsin, Moorty & Richter Model

Following Aiyar and Mody (2011), the paper follows a conditional β-convergence equation to study the effect of demographic trends on regional GDP growth per worker in logarithmic form:

$$g_z = \lambda (z^* - z_0)$$

g= growth in regional GDP per worker

z= log of regional GDP per worker

λ= speed of convergence

Matytsin, Moorty & Richter Model (cont'd)

- Demographic Variables: Y/N= (Y/L)(L/W)(W/N)

  where Y= regional GDP (in 2003 rubles), N= regional population, L= labor force (# of employed & unemployed), W=Working age population

- Rewriting the equation to include all regions and time gives: [Equation 7 in the paper]

$$d(y_{i,t}) = \rho y_{i,0} + \alpha_1 w_{i,0} + \alpha_2 d(w_{i,t}) + \beta_1 p_{i,0} + \beta_2 d(p_{i,t})$$

$$+ y' X_{i,t} + \mu_i + \tau_t + \varepsilon_{i,t}$$

Variables

$y_{i,t}$ = Level of per capita GDP in the region in period t

$w_{i,t}$ = Working age ratio in the region in period t

$P_{i,t}$ = Participation in the region in period t

d(.) = Growth rate (difference in log)

$X_{i,t}$ = Matrix of control variables

μ_i = individual effects

τ_i = time effects

$\varepsilon_{i,t}$ = shocks (iid, mean zero)

Table 2: Matytsin, Moorty & Richter Model Results

	VARIABLES (in logs)	(1) Panel Estimation Growth in GDP per capita	(2) Panel Estimation Growth in GDP per capita (Adjusted for migration)
1	initial GDP per capita	-0.056***	-0.048**
		(0.019)	(0.019)
2	initial working-age ratio	0.190	0.244*
		(0.150)	(0.139)
3	working-age ratio growth	0.993	
		(0.892)	
4	adjusted working-age ratio growtl		1.627***
			(0.601)
5	initial participation rate	0.102	0.099
		(0.065)	(0.064)
6	participation rate growth	0.700***	0.620***
		(0.194)	(0.171)
	Observations	234	234
	R-squared	0.481	0.494
	Number of reg	78	78
	Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1		

Matytsin, Moorty, & Richter, 2015, p. 12

Conclusion

- This model confirms the conclusions from their dynamic panel approach.
- “Absent policy changes, the aging of the Russian population is likely to have an adverse impact on growth and convergence. Russia's economy benefited from favorable demographic trends from the mid-1990s until the last few years. In the coming decades, however, Russia’s population is expected to age, which could dampen prospects for growth and convergence among Russia’s regions.“ Matytsin, Moorty, & Richter, 2015, p. 16

Selected References

- Barro, R. J., & Becker, G. S. (1989). Fertility choice in a model of economic growth. *Econometrica: journal of the Econometric Society*, 481-501.
- Barro, R. J. (1996). *Determinants of economic growth: A cross-country empirical study* (No. w5698). National Bureau of Economic Research.
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- Sala-i-Martin, X. X. (1996). Regional cohesion: evidence and theories of regional growth and convergence. *European Economic Review*, *40*(6), 1325-1352.
- Weil, D. N. (1997). The economics of population aging. In *Handbook of population and family economics*.