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EE462 DEVELOPMENT MACROECONOMICS

Growth at the Frontier

Table 1 The stability of US Growth

Period	Growth Rate	Period	Growth Rate
1870–2007	2.03	1973–1995	1.82
1870–1929	1.76	1995–2007	2.13
1929–2007	2.23		
1900–1950	2.06	1995–2001	2.55
1950–2007	2.16	2001–2007	1.72
1950–1973	2.50		
1973–2007	1.93		

Note: Annualized growth rates for the data shown in Fig. 1.

Growth Accounting

$$g_y = w_L g_L + w_K g_K + a$$

(-1.) (-1.) (-1.)

g_y = w_L (share of L) g_L (growth of L) + w_K (share of K) g_K (growth of K) + a (TFP)

Production function:

$$Y_t = \underbrace{A_t M_t}_{\text{TFP}} K_t^{\alpha} H_t^{1-\alpha}. \quad \Rightarrow \quad \frac{Y_t}{L_t} = \left(\frac{K_t}{Y_t}\right)^{\frac{\alpha}{1-\alpha}} \frac{H_t}{L_t} \cdot Z_t \qquad (*)$$

$$Y_t = A K_t^{\alpha} L_t^{1-\alpha}$$

$$y_t \equiv \frac{Y_t}{L_t} \; ; \; k_t \equiv \frac{K_t}{Y_t} \; ; \; h_t \equiv \frac{H_t}{L_t}$$

$$(*) \Rightarrow y_t = (k_t)^{\frac{\alpha}{1-\alpha}} \cdot h_t \cdot z_t$$

$$\ln(y_t) = \frac{\alpha}{1-\alpha} \cdot \ln(k_t) + \ln(h_t) + \ln(z_t)$$

Totally differentiate:

$$\frac{1}{y_t} \cdot \frac{dy_t}{dt} = \frac{\alpha}{1-\alpha} \cdot \frac{1}{k_t} \frac{dk_t}{dt} + \frac{1}{h_t} \frac{dh_t}{dt} + \frac{1}{z_t} \frac{dz_t}{dt}$$

growth rate

$$\frac{y_{t-1} - y_t}{y_t} = \frac{\Delta y_t}{y_t} = g_y$$

$$\frac{\Delta y_t}{y_t} \approx \frac{dy_t}{y_t} = g_y$$

$$\frac{1}{y_t} \cdot \underbrace{\frac{dy_t}{dt}}_{\dot{y}_t} = \frac{\alpha}{1-\alpha} \cdot \frac{1}{k_t} \cdot \underbrace{\frac{dk_t}{dt}}_{\dot{k}_t} + \frac{1}{h_t} \cdot \underbrace{\frac{dh_t}{dt}}_{\dot{h}_t} + \frac{1}{z_t} \cdot \underbrace{\frac{dz_t}{dt}}_{\dot{z}_t}$$

$$\underbrace{\frac{\dot{y}_t}{y_t}}_{g_y} = \frac{\alpha}{1-\alpha} \cdot \frac{\dot{k}_t}{k_t} + \frac{\dot{h}_t}{h_t} + \frac{\dot{z}_t}{z_t}$$

$$g_y = \frac{\alpha}{1-\alpha} g_k + g_h + a$$

TFP

Table 3 Growth accounting for the United States

Period	Output per hour	Contributions from: K/Y	Labor composition	Labor-Aug. TFP
1948–2013	**2.5**	**0.1**	**0.3**	**2.0**
1948–1973	3.3	−0.2	0.3	3.2
1973–1990	1.6	0.5	0.3	0.8
1990–1995	1.6	0.2	0.7	0.7
1995–2000	3.0	0.3	0.3	2.3
2000–2007	2.7	0.2	0.3	2.2
2007–2013	1.7	0.1	0.5	1.1

Note: Average annual growth rates (in percent) for output per hour and its components for the private business sector, following Eq. (3).

Source: Authors calculations using Bureau of Labor Statistics, *Multifactor Productivity Trends*, August 21, 2014.

Sources of Frontier Growth

Question: What are the main sources of growth?

- Physical capital
- Human capital
- Ideas → techno, R&D, Romer's model
- Misallocation

The Spread of Economic Growth in the Long Run

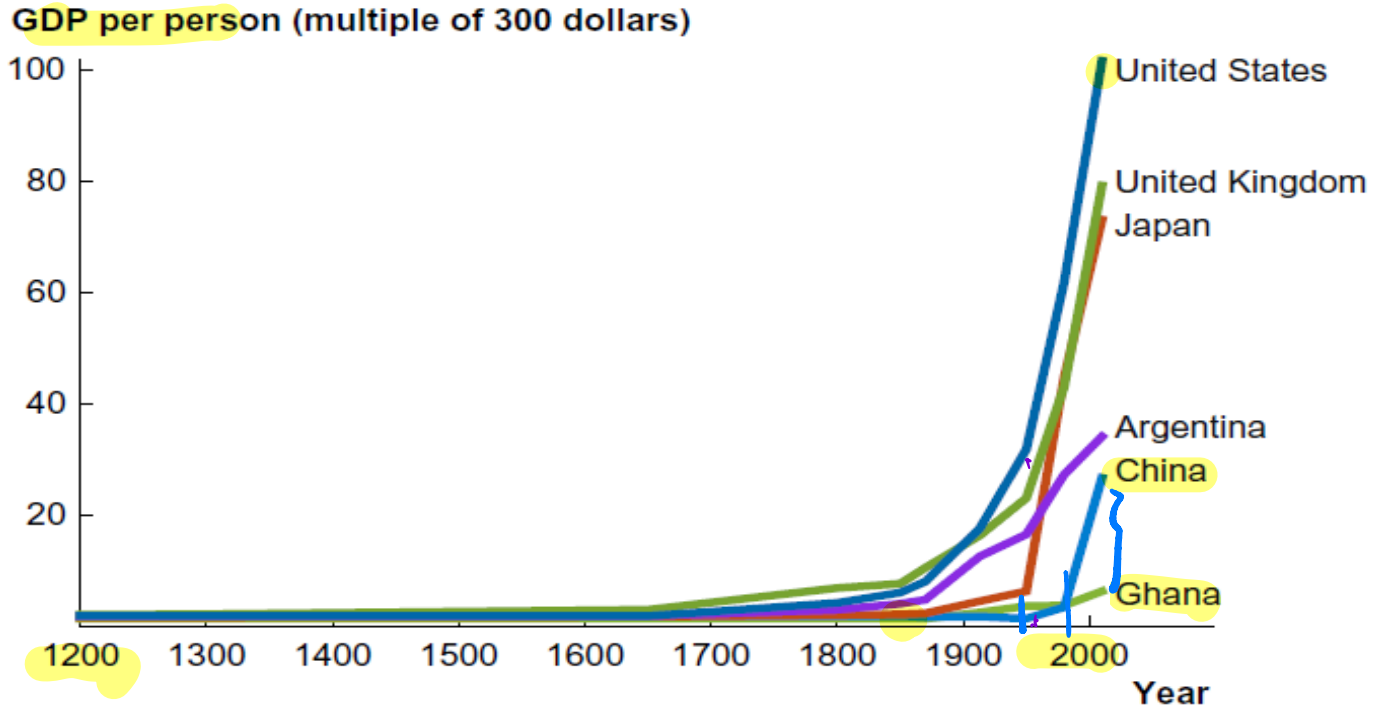

Fig. 21 The great divergence. *Note*: The graph shows GDP per person for various countries. The units are in multiples of 300 dollars and therefore correspond roughly to the ratio between a country's per capita income and the income in the poorest country in the world. Source: *Bolt, J., van Zanden, J.L. 2014. The Maddison Project: collaborative research on historical national accounts. Econ. Hist. Rev. 67 (3), 627–651.*

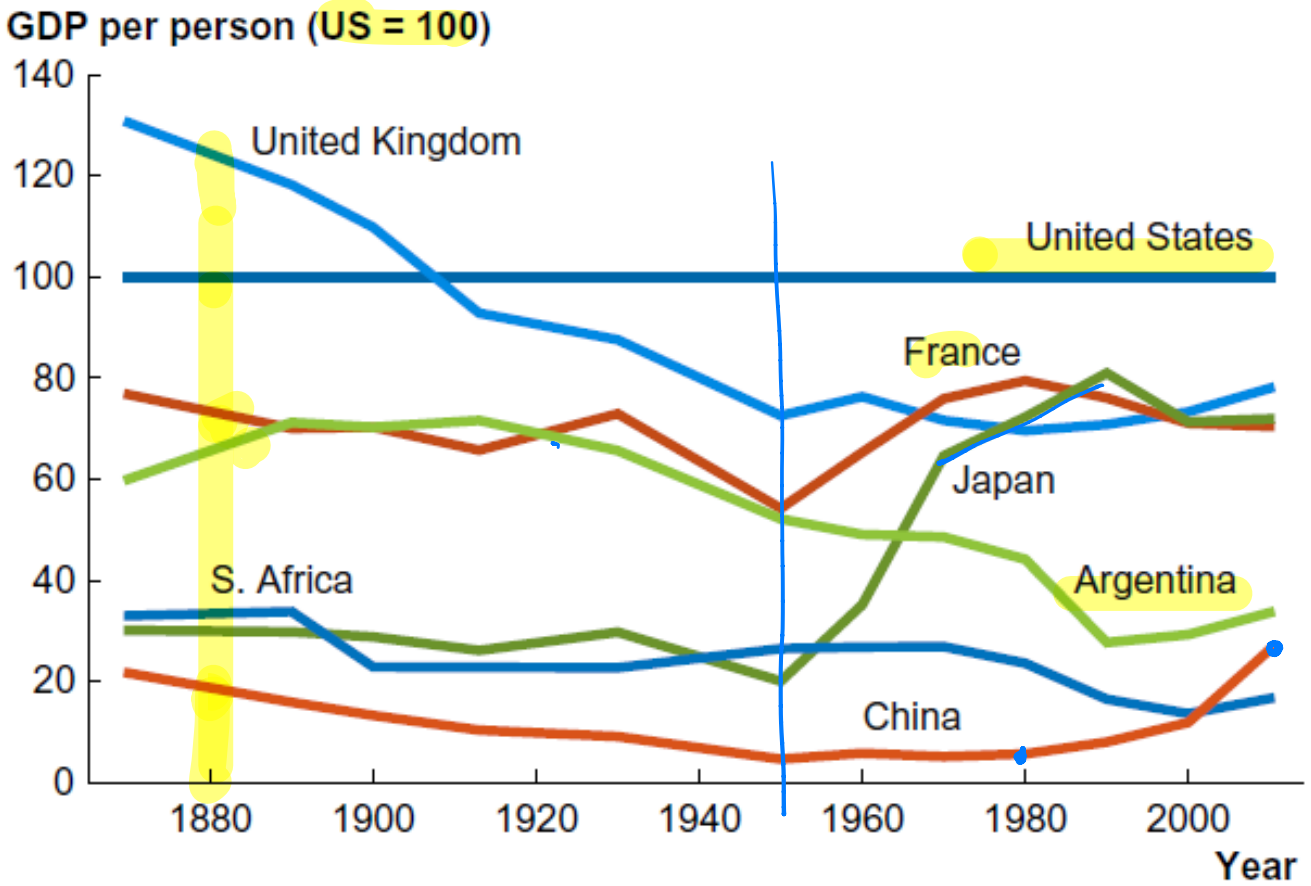

Fig. 22 The spread of economic growth since 1870. Source: *Bolt, J., van Zanden, J.L. 2014. The Maddison Project: collaborative research on historical national accounts. Econ. Hist. Rev. 67 (3), 627–651.*

The Spread of Economic Growth in Recent Decades

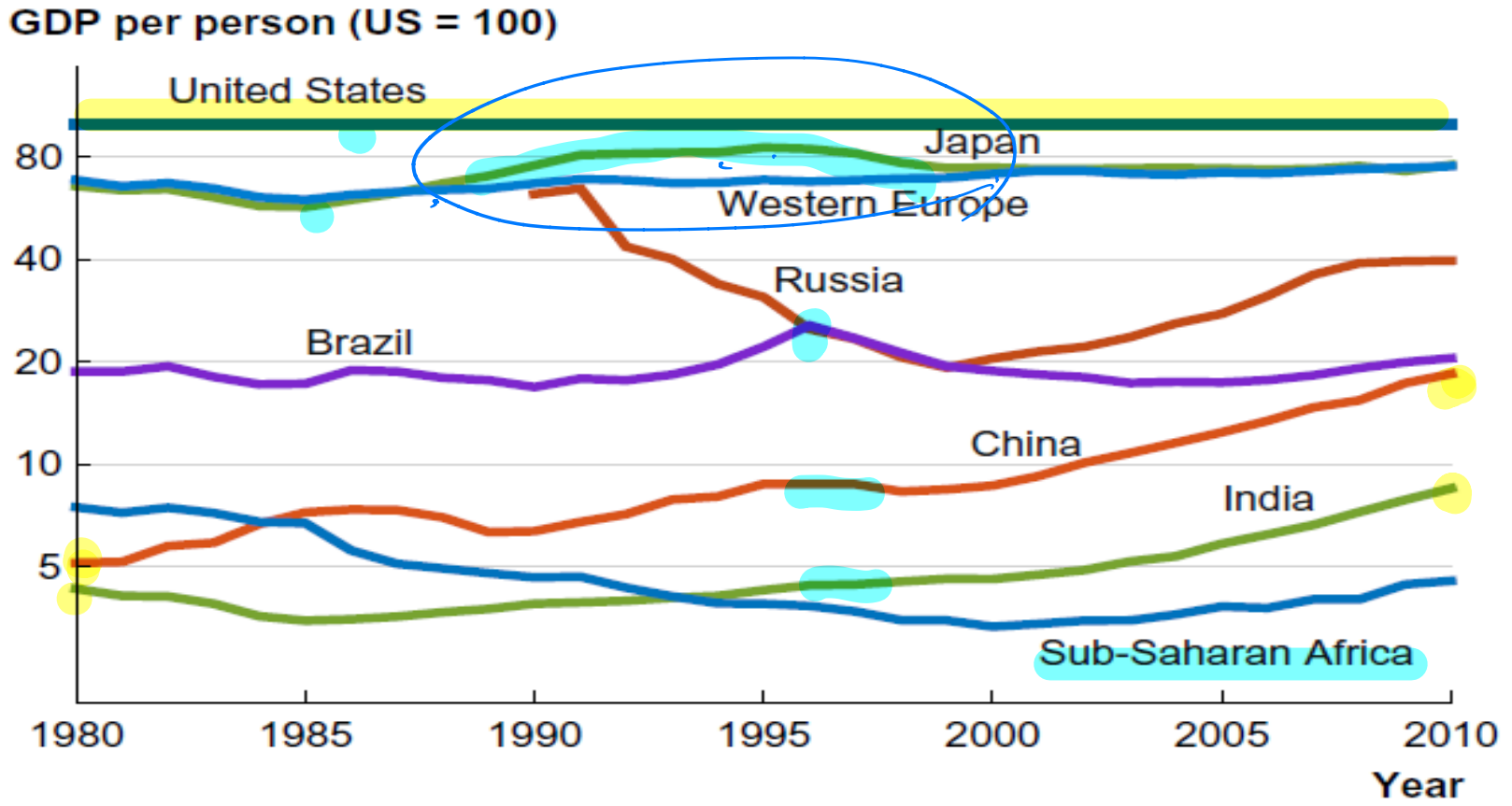

Fig. 23 The spread of economic growth since 1980. Source: *The Penn World Tables 8.0.*

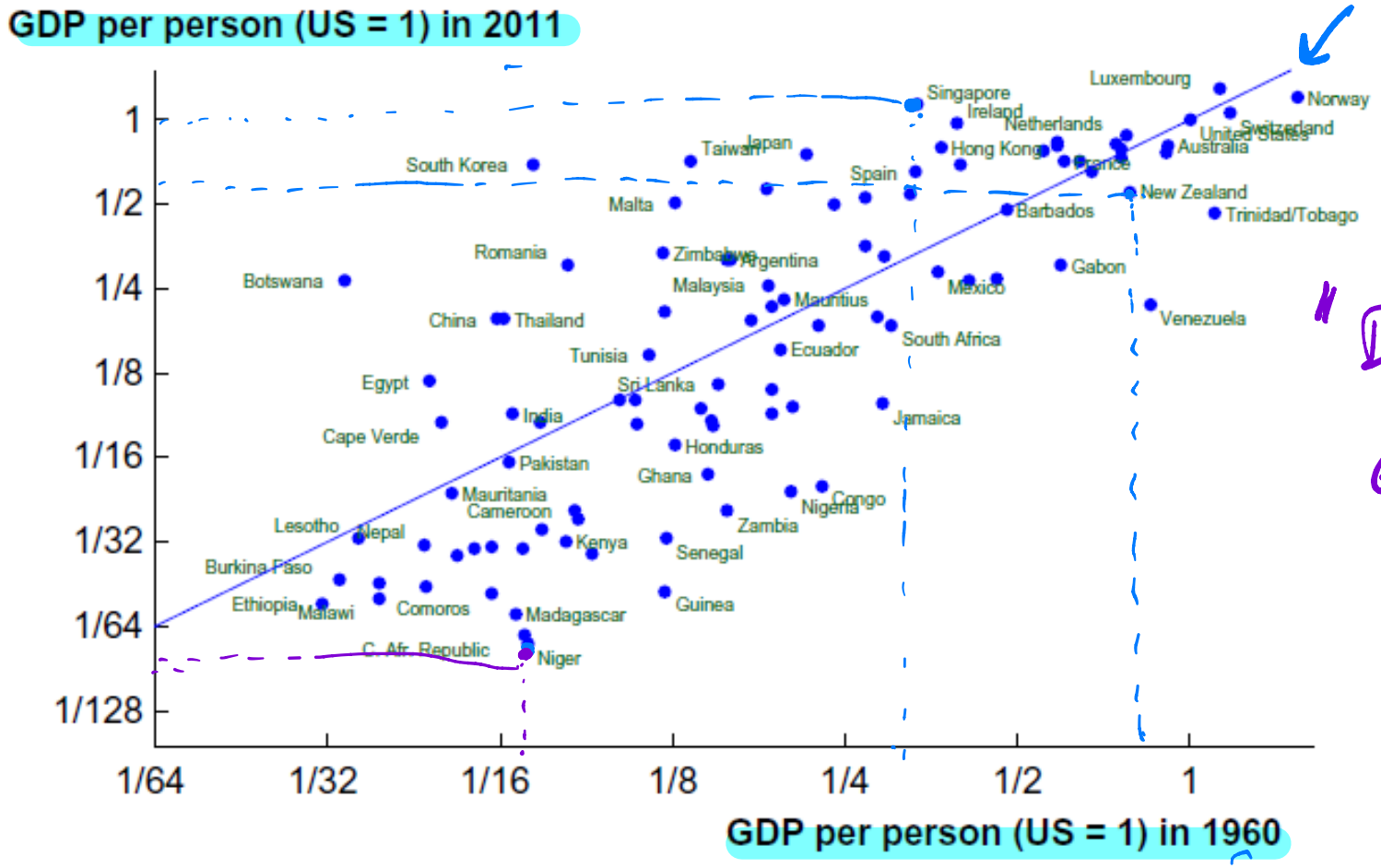

Fig. 24 GDP per person, 1960 and 2011. Source: *The Penn World Tables 8.0.*

45°. $\frac{GDP^{2011}}{GDP^{1960}} = 1$

"Divergent in GDP growth"

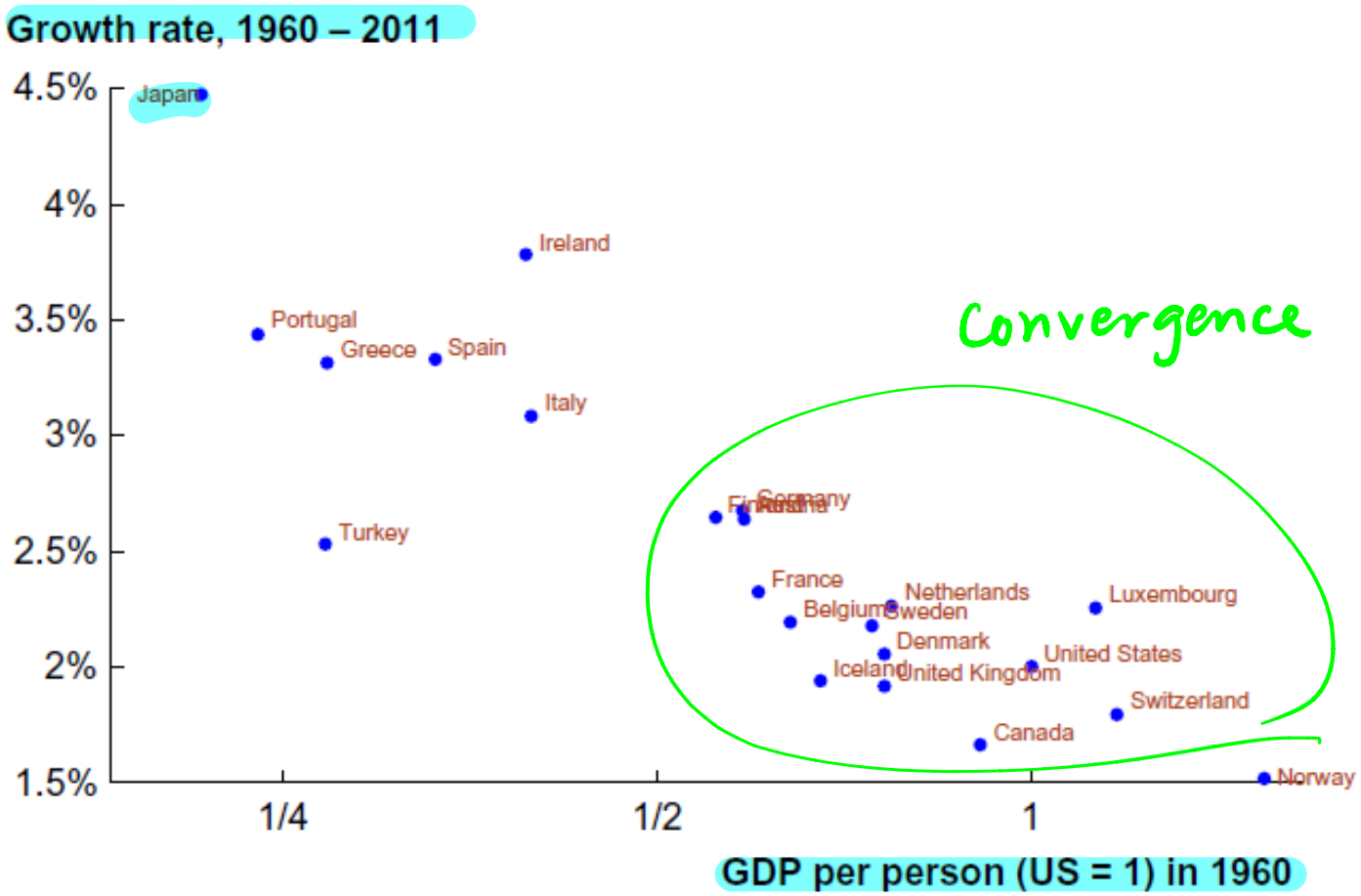

Fig. 25 Convergence in the OECD. Source: *The Penn World Tables 8.0. Countries in the OECD as of 1970 are shown.*

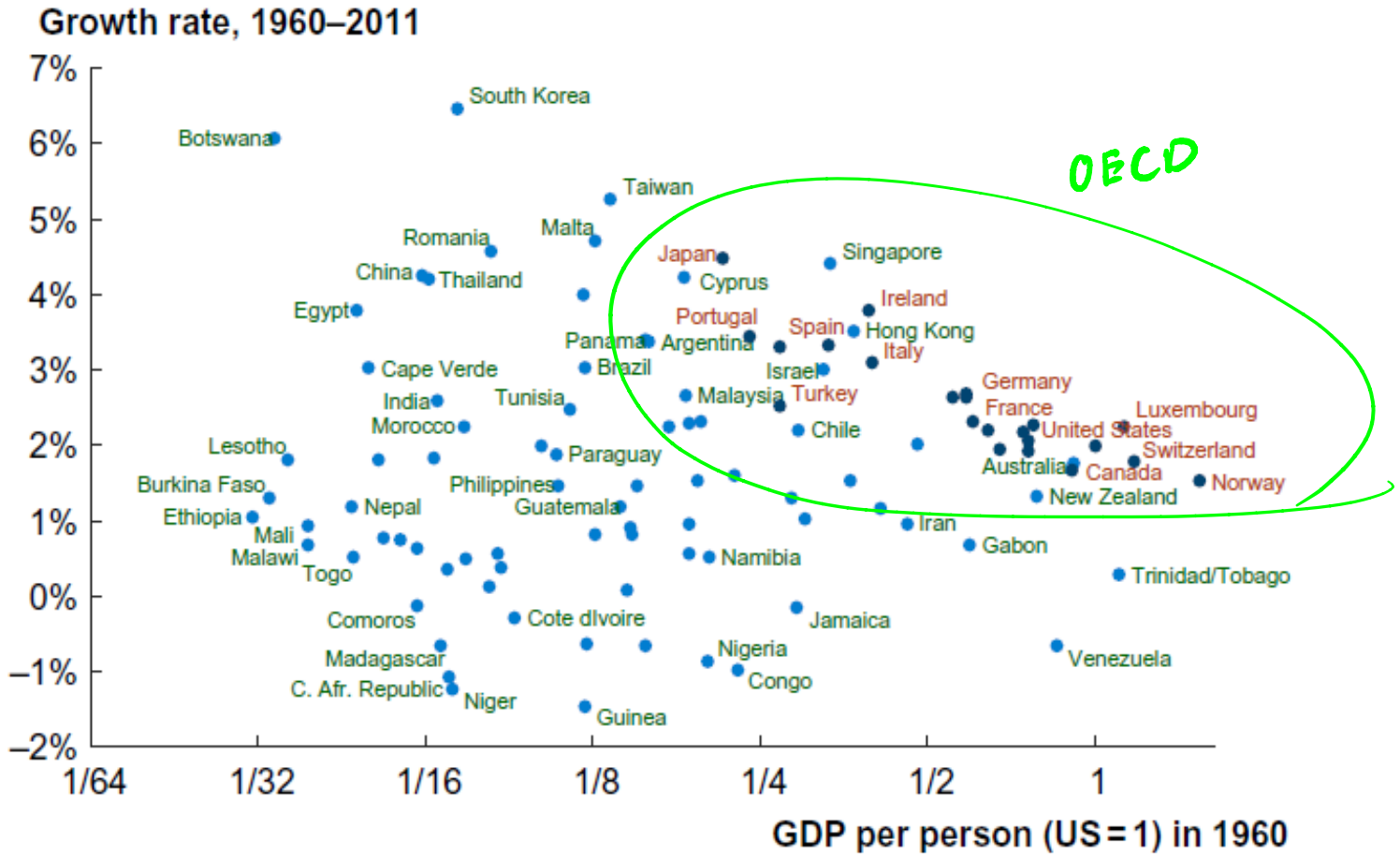

Fig. 26 The lack of convergence worldwide. Source: *The Penn World Tables 8.0.*

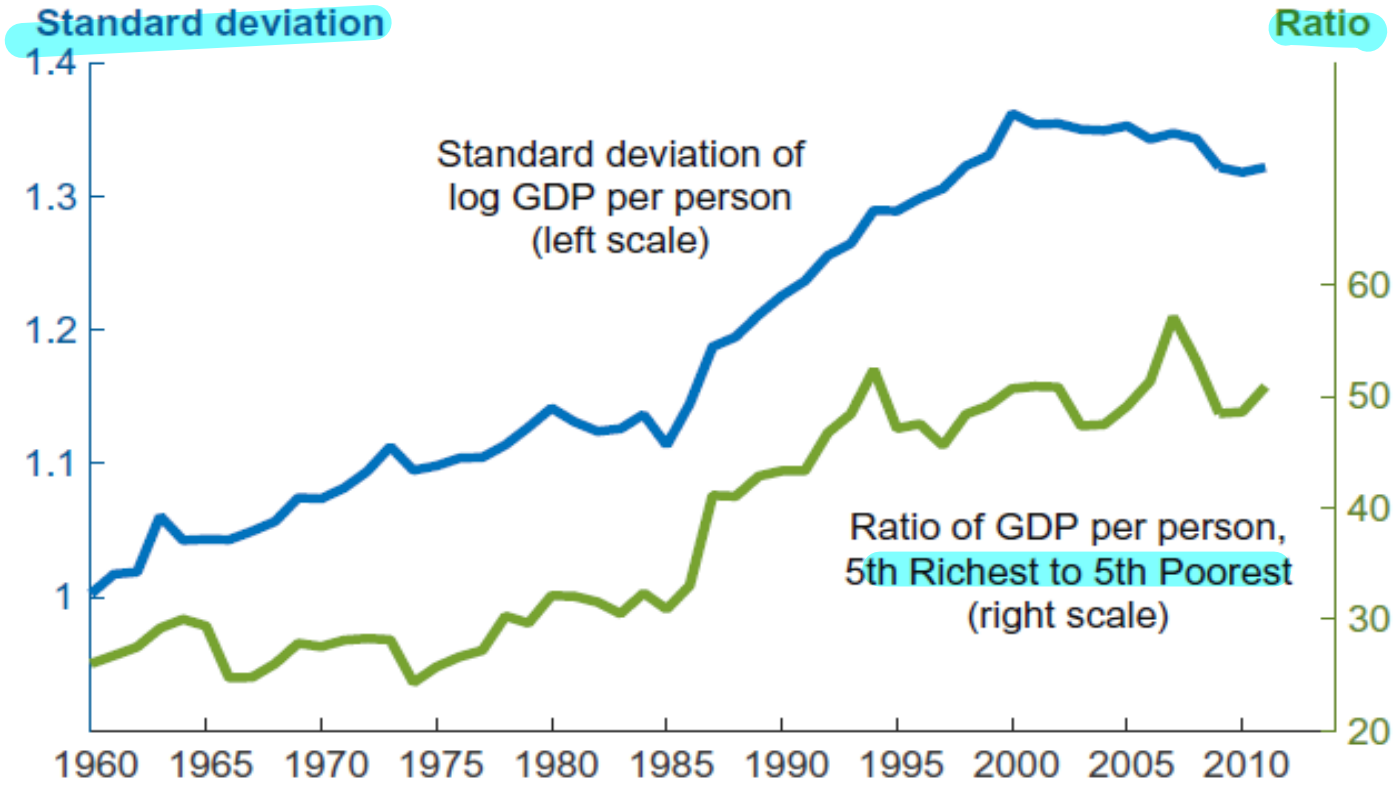

Fig. 27 Divergence since 1960. Source: *The Penn World Tables 8.0, calculated across a stable sample of 100 countries.*

Table 6 Basic development accounting, 2010

	GDP per worker, y	Capital/GDP $(K/Y)^{\alpha/(1-\alpha)}$	Human capital, h	TFP	Share due to TFP
United States	1.000	1.000	1.000	1.000	–
Hong Kong	0.854	1.086	0.833	0.944	48.9%
Singapore	0.845	1.105	0.764	1.001	45.8%
France	0.790	1.184	0.840	0.795	55.6%
Germany	0.740	1.078	0.918	0.748	57.0%
United Kingdom	0.733	1.015	0.780	0.925	46.1%
Japan	0.683	1.218	0.903	0.620	63.9%
South Korea	0.598	1.146	0.925	0.564	65.3%
Argentina	0.376	1.109	0.779	0.435	66.5%
Mexico	0.338	0.931	0.760	0.477	59.7%
Botswana	0.236	1.034	0.786	0.291	73.7%
South Africa	0.225	0.877	0.731	0.351	64.6%
Brazil	0.183	1.084	0.676	0.250	74.5%
Thailand	0.154	1.125	0.667	0.206	78.5%
China	0.136	1.137	0.713	0.168	82.9%
Indonesia	0.096	1.014	0.575	0.165	77.9%
India	0.096	0.827	0.533	0.217	67.0%
Kenya	0.037	0.819	0.618	0.073	87.3%
Malawi	0.021	1.107	0.507	0.038	93.6%
Average	0.212	0.979	0.705	0.307	63.8%
1/Average	4.720	1.021	1.418	3.260	69.2%

The product of the three input columns equals GDP per worker. The penultimate row, "Average," shows the geometric average of each column across 128 countries. The "Share due to TFP" column is computed as described in the text. The 69.2% share in the last row is computed looking across the columns, ie, as approximately 3.5/(3.5 + 1.5).
Source: Computed using the Penn World Tables 8.0 for the year 2010 assuming a common value of $\alpha = 1/3$.

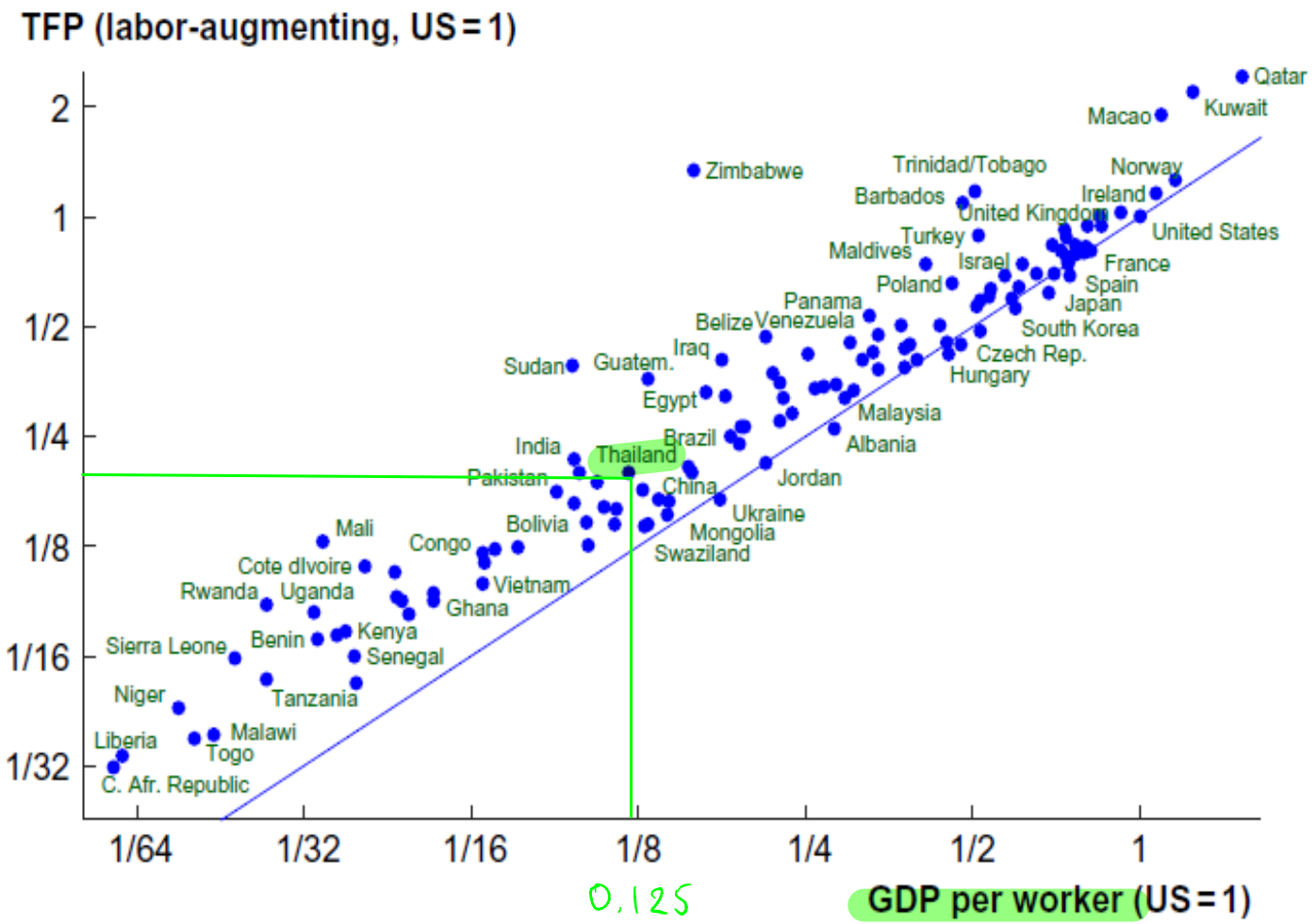

Fig. 29 Total factor productivity, 2010. Source: *Computed using the Penn World Tables 8.0 assuming a common value of* $\alpha = 1/3$.

measurement error

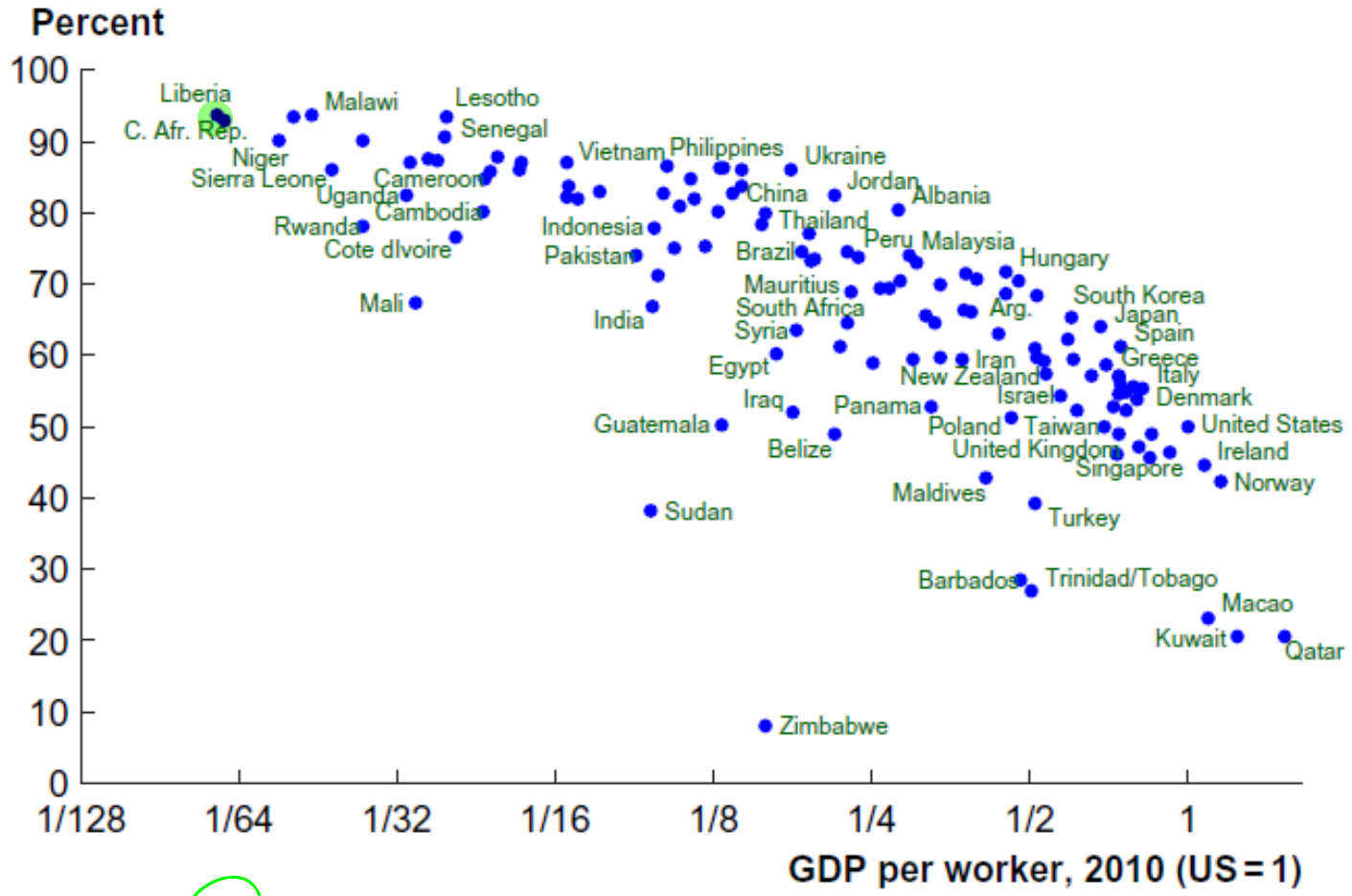

Fig. 30 The share of TFP in development accounting, 2010. Source: *Computed as described in the text and in Table 6 using the Penn World Tables 8.0 assuming a common value of* $\alpha = 1/3$.