Vehicle Ownership and Income Growth, Worldwide: 1960-2030

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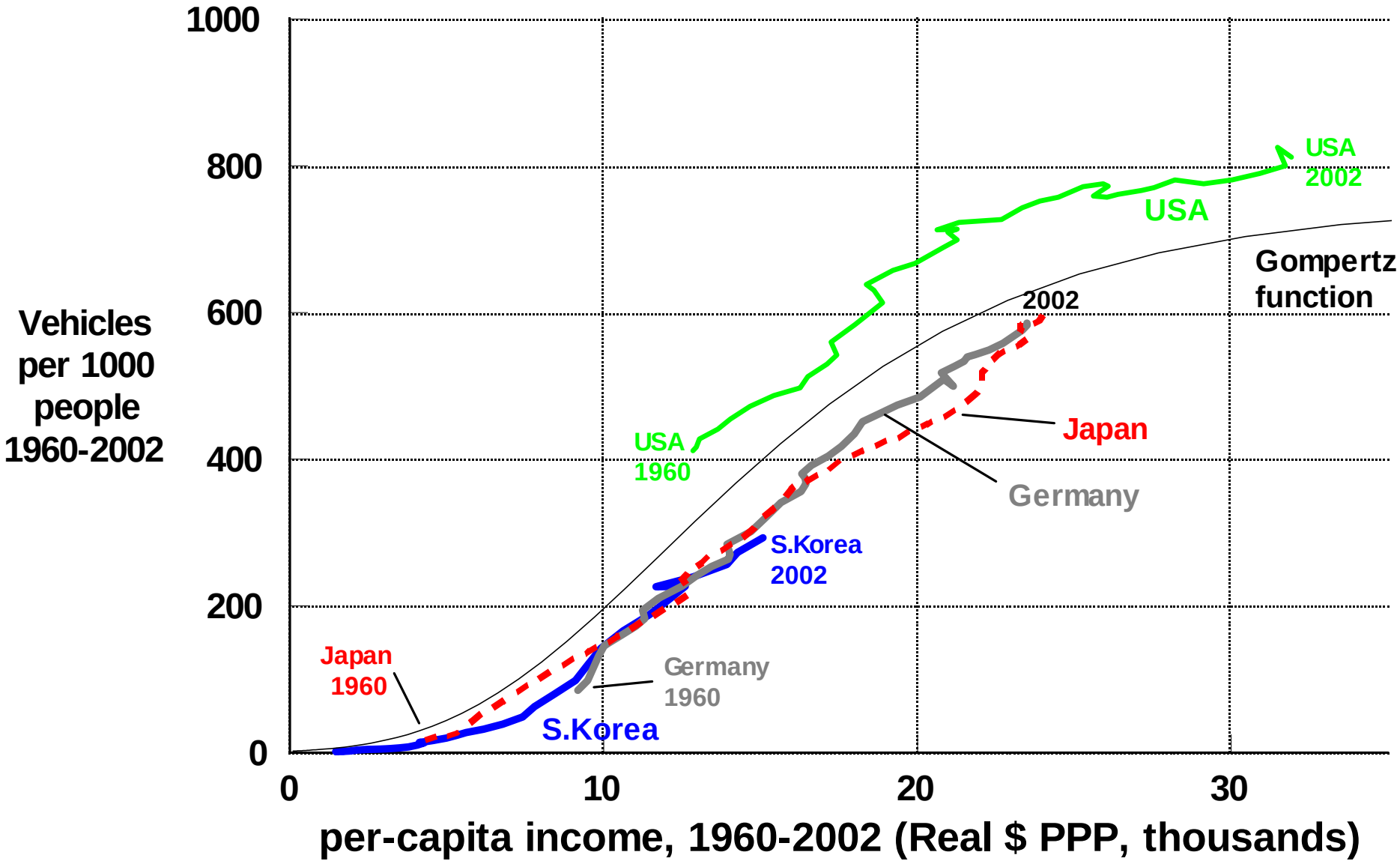
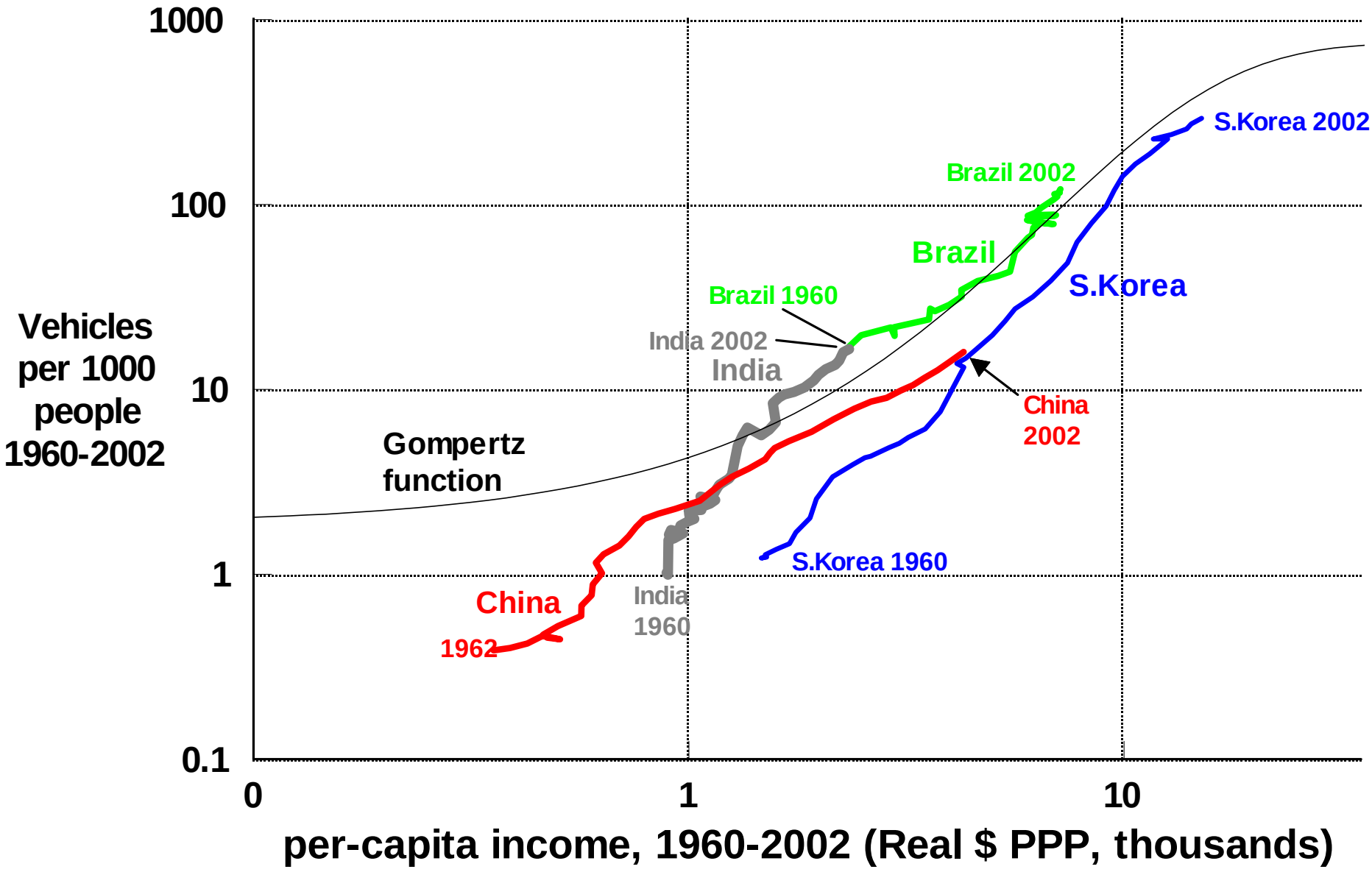
- **Use historical data 1960-2002 for 45 countries (75% of world's population) to model the relationship between vehicle ownership and per-capita income, and make projections 2002-2030**
- **Relationship between vehicle ownership and per-capita income is highly non-linear.**
- **We use an S-shaped Gompertz function to model this relationship.**

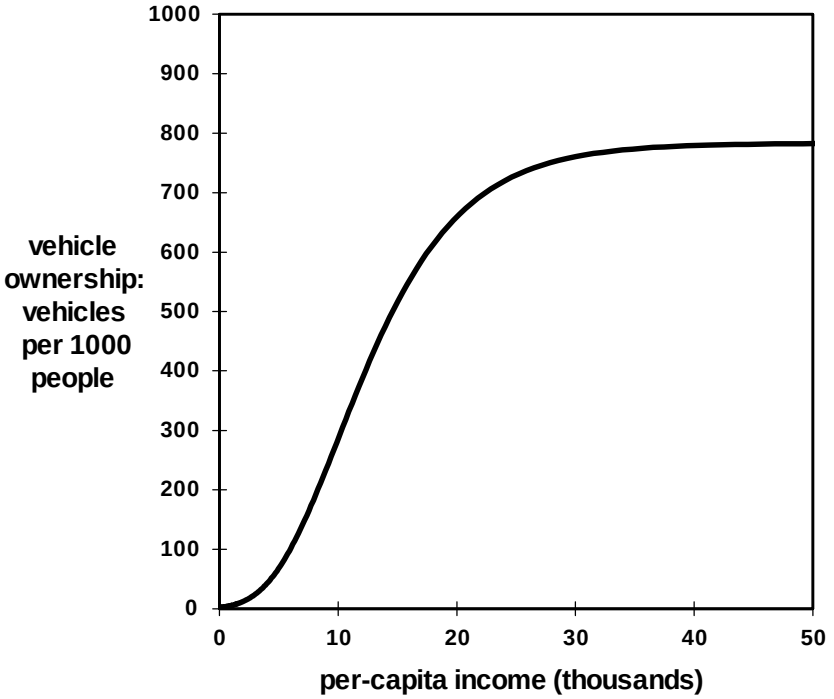
Growth in Vehicle Ownership and Per-Capita Income: Germany, Japan, South Korea, USA



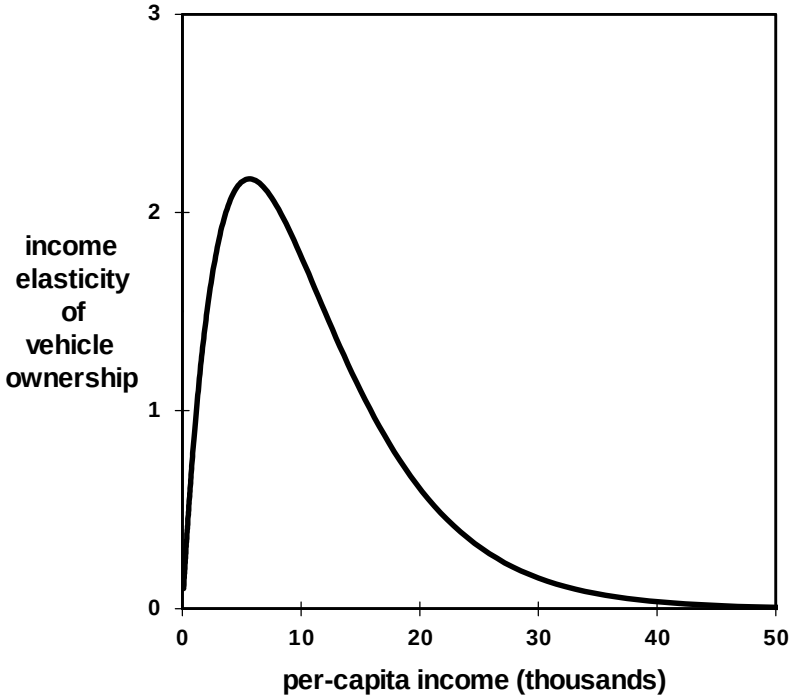
Growth in Vehicle Ownership and Per-Capita Income: Brazil, China, India, South Korea



Modeling Vehicle Ownership as a function of Per-Capita Income: An illustrative S-shaped Gompertz function



- Vehicle ownership grows slowly at lowest income levels
- about twice as rapidly as income in $3000-$10000 range
- about as fast as income in range of $12000-$18000
- quite slowly at highest income levels, as saturation is approached.



Vehicle model

Gompertz function relates
long-run vehicles per capita, V^*, to per capita income, GDP

$$V_{i,t}^{*} = \gamma_{i,t}\, e^{\alpha\, e^{\beta_i GDP_{i,t}}}$$

Dynamics: Partial Adjustment Mechanism

$$V_{i,t} = V_{i,t-1} + \theta\,(V_{i,t}^{*} - V_{i,t-1})$$

Saturation level (γ)

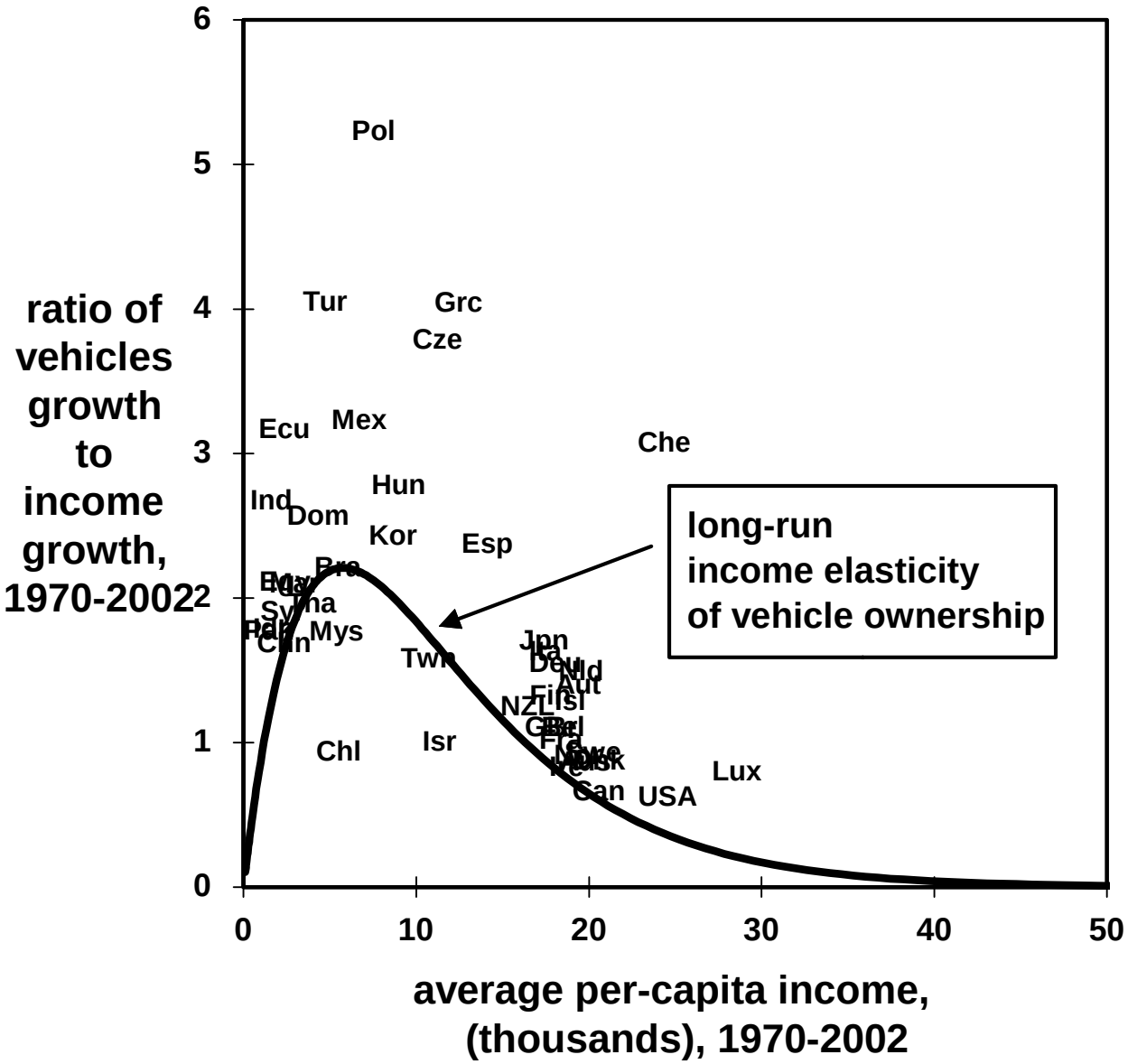
depends on population density (D) and urbanization (U)

$$\gamma_{i,t} = \bar{\gamma} + \lambda D_{i,t}^{a} + \varphi U_{i,t}^{a}$$

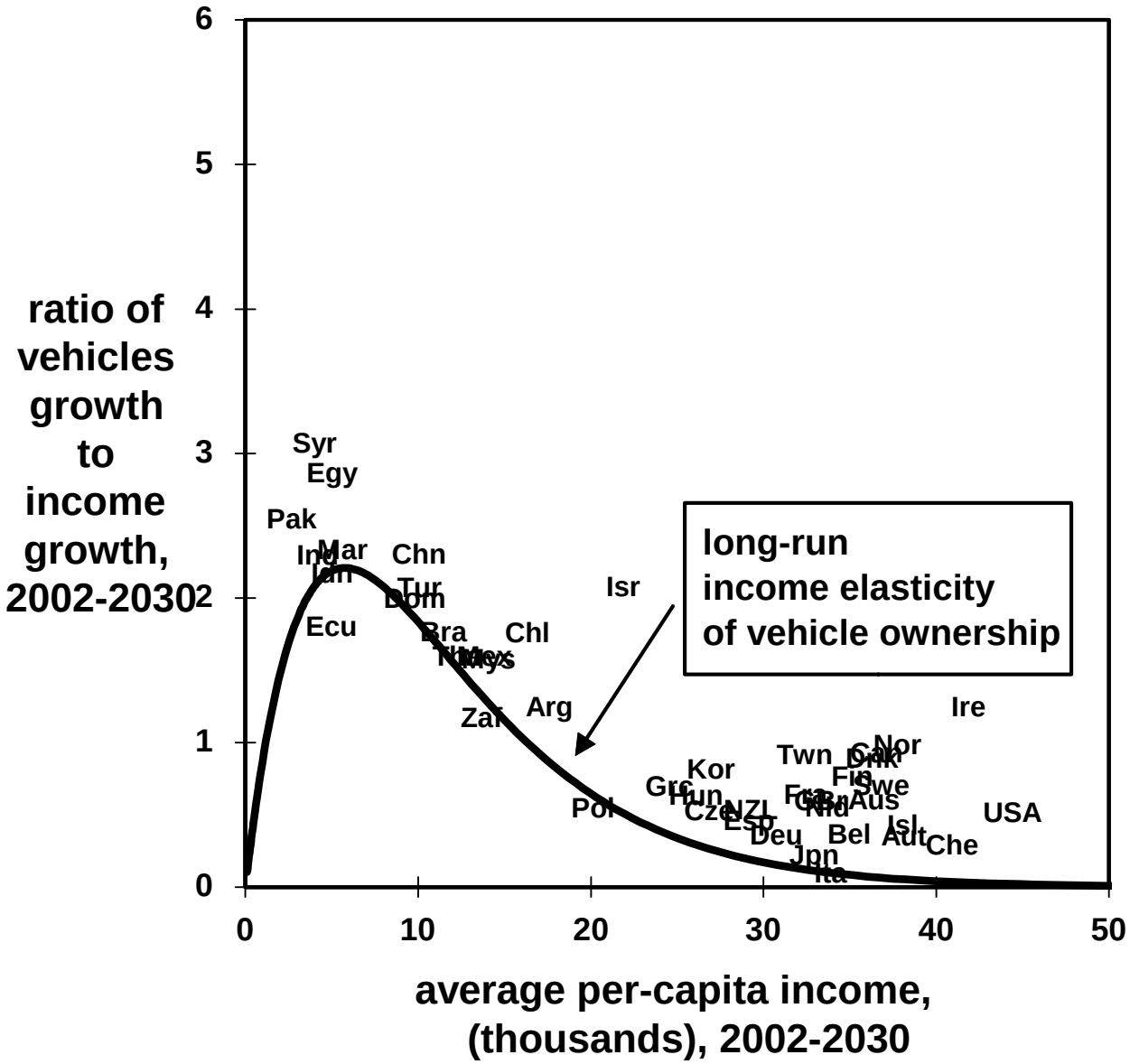
D and U adjusted so that USA defines maximum saturation

Country	per-capita GDP (thousands, real, PPP)			Vehicles per 1000 population			Total Vehicles (millions)			ratio of growth rates: Veh.Own. to per-cap. GDP
	2002	2030	Average annual growth rate	2002	2030	Average annual growth rate	2002	2030	Average annual growth rate	
United States	32	57	2.1%	812	849	0.2%	234	314	1.1%	0.08
Germany	23	38	1.7%	586	705	0.7%	48	57	0.6%	0.38
France	24	41	2.0%	576	779	1.1%	35	50	1.3%	0.54
Great Britain	24	43	2.2%	515	685	1.0%	31	44	1.3%	0.47
Japan	24	42	2.0%	599	716	0.6%	76	87	0.5%	0.31
Brazil	7	16	2.9%	121	377	4.1%	21	84	5.1%	1.43
China	4	16	4.8%	16	269	10.6%	21	390	11.1%	2.20
Indonesia	3	7	3.4%	29	166	6.5%	6	46	7.4%	1.89
India	2	6	3.5%	17	110	7.0%	17	156	8.1%	1.98
OECD Total	**22**	**42**	**1.5%**	**548**	**713**	**0.6%**	**617**	**908**	**1.4%**	**0.42**
Non-OECD Total	**4**	**9**	**2.2%**	**38**	**169**	**3.6%**	**195**	**1172**	**6.6%**	**1.61**
Total World	**7**	**14**	**1.7%**	**130**	**254**	**1.6%**	**812**	**2080**	**3.4%**	**0.94**

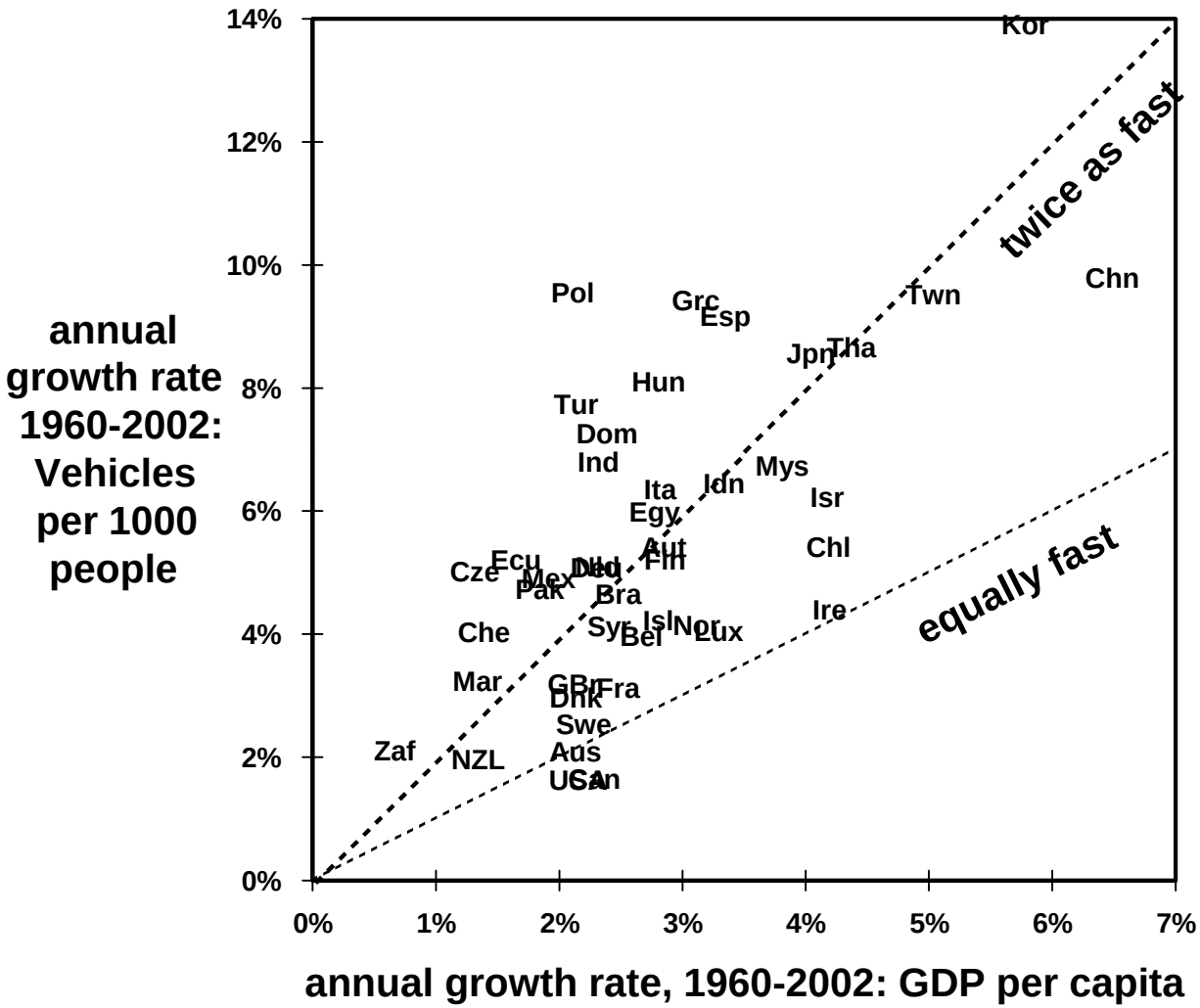
Income Elasticity of Vehicle Ownership and Level of Per-capita Income: Historical, 1970-2002



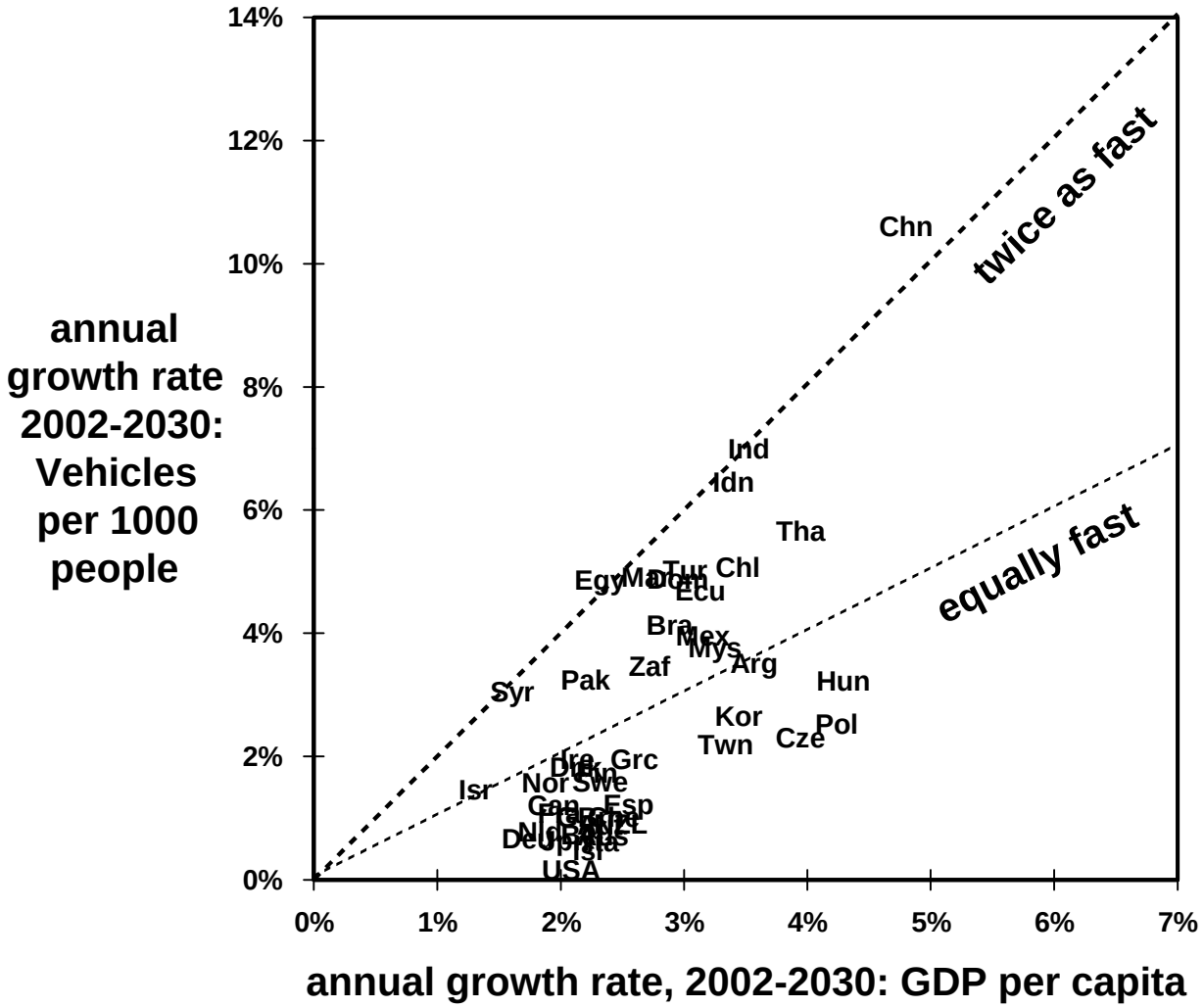
Income Elasticity of Vehicle Ownership and Level of Per-capita Income: Projected, 2002-2030



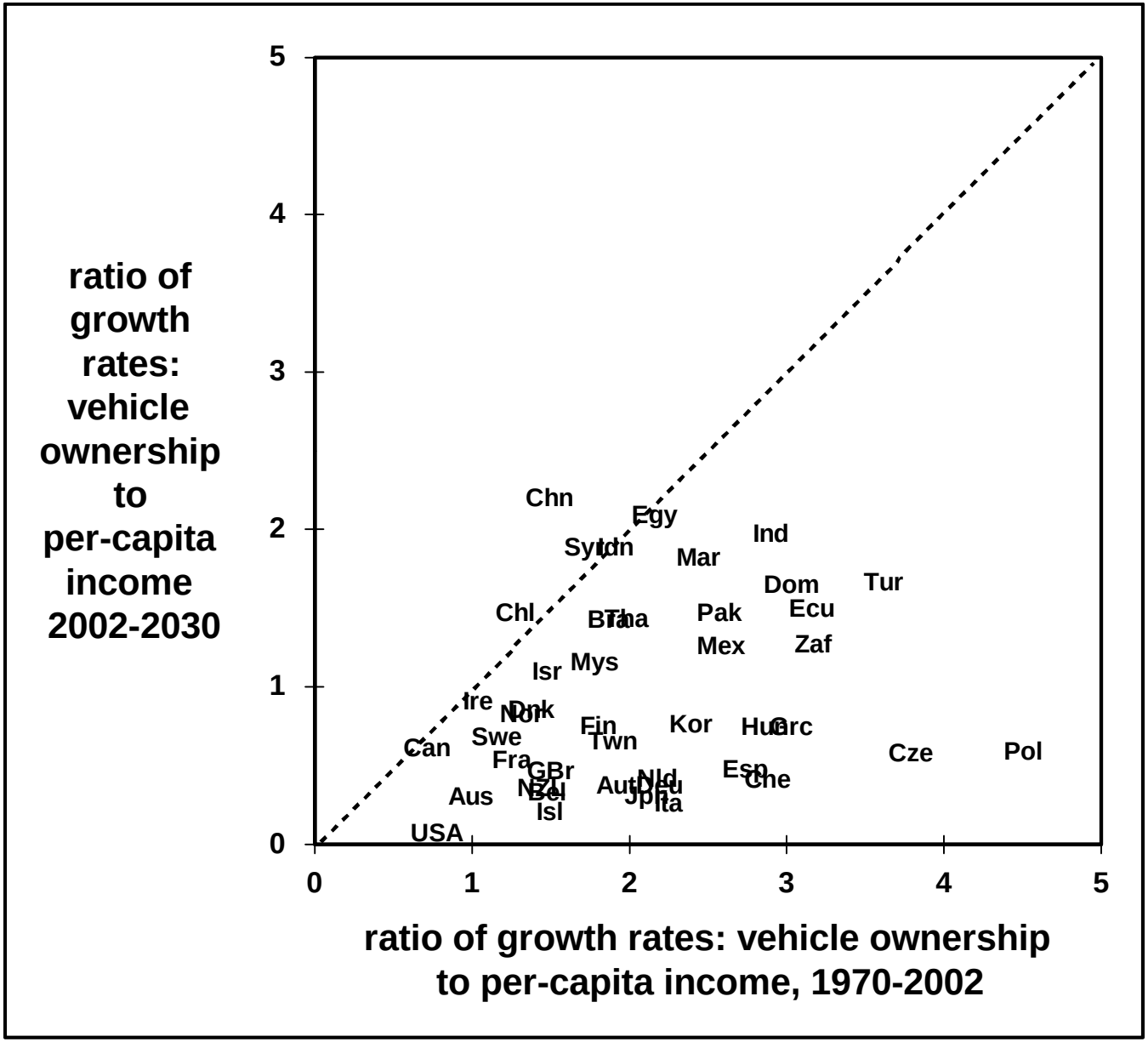
Growth in Vehicle Ownership and Per-Capita Income,
Historical: 1960-2002



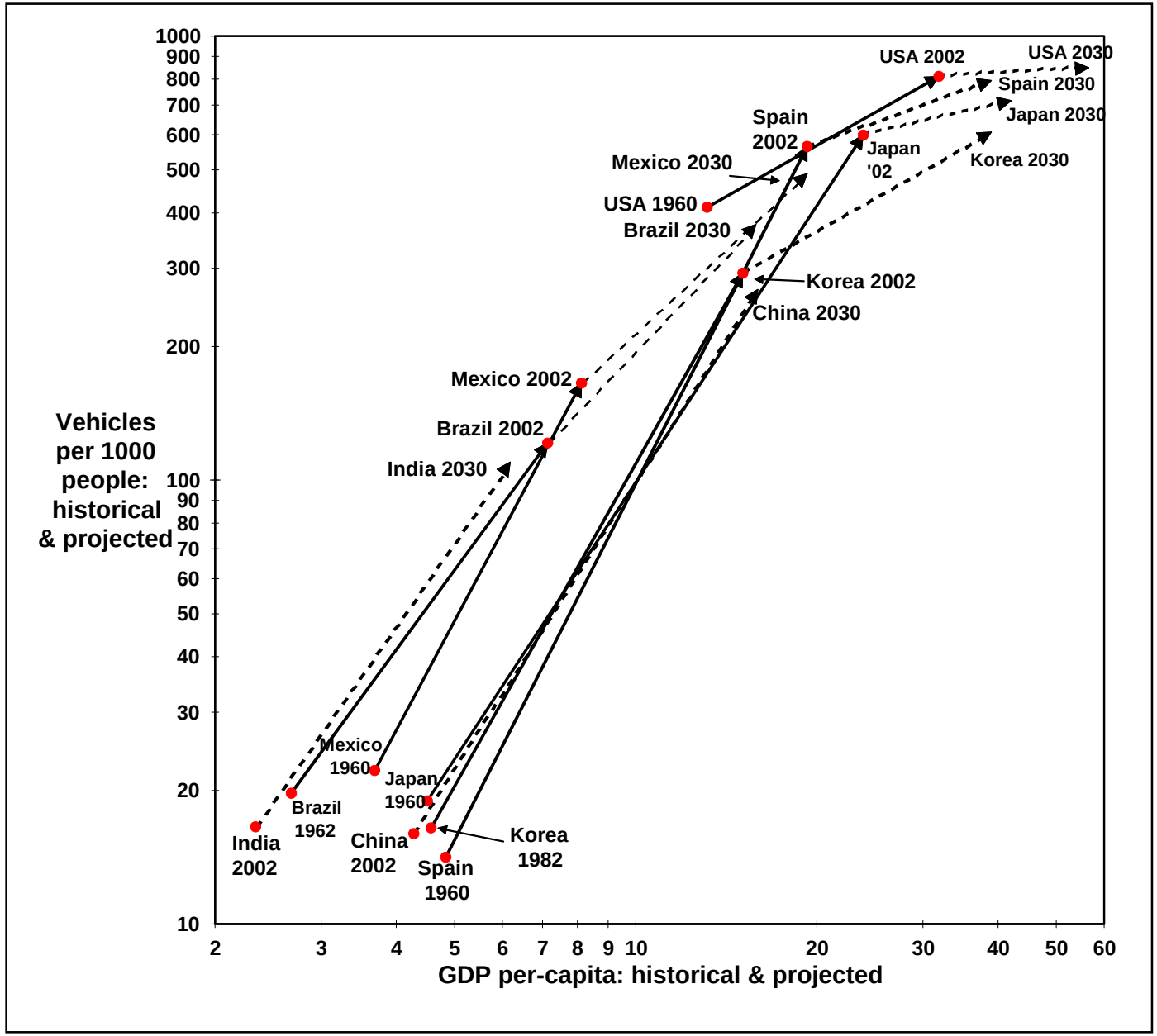
Growth in Vehicle Ownership and Per-Capita Income,
Projected: 2002-2030



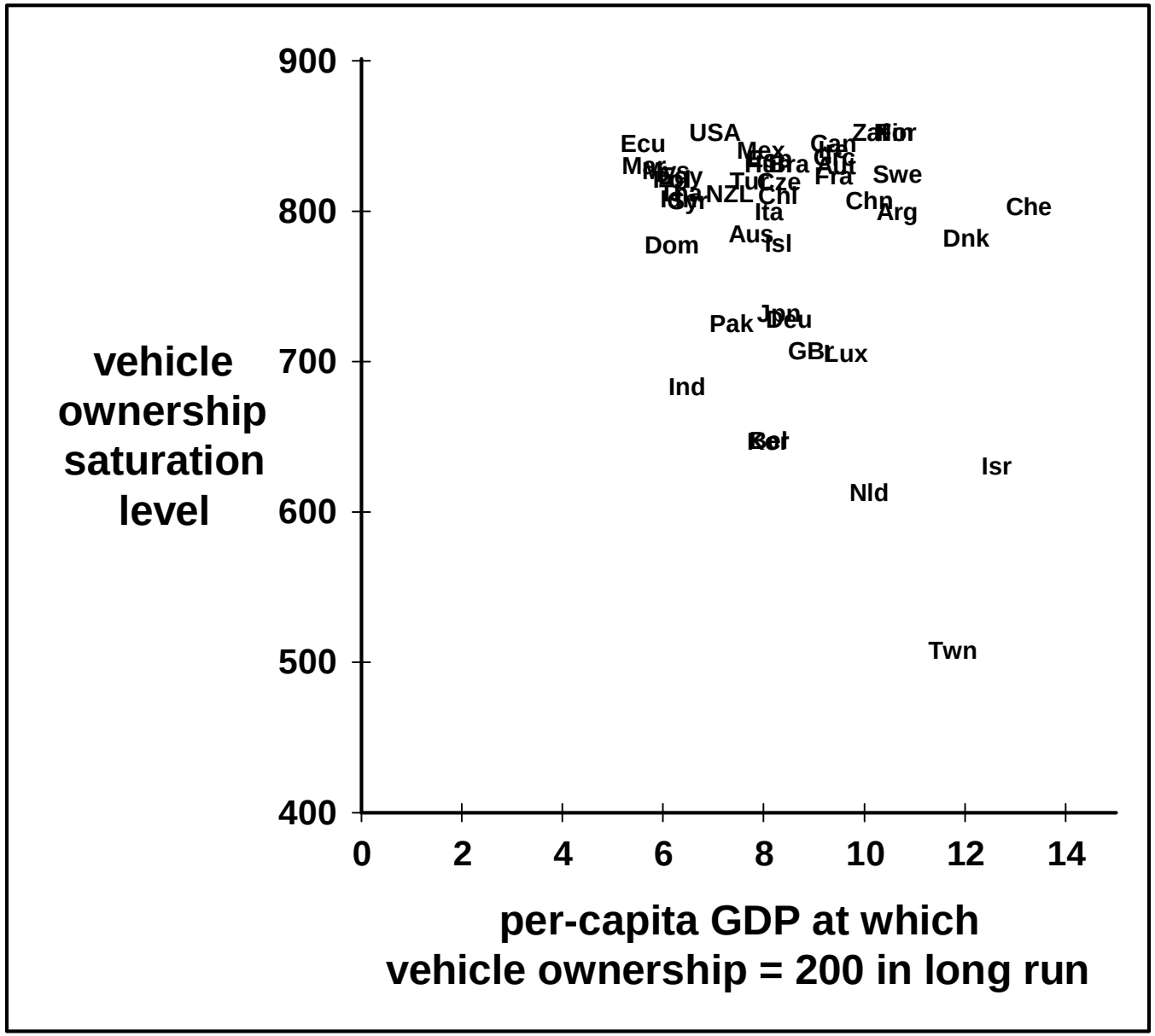
Ratio of Growth Rate of Vehicle Ownership to Growth Rate of Per-Capita Income, Historical and Projected



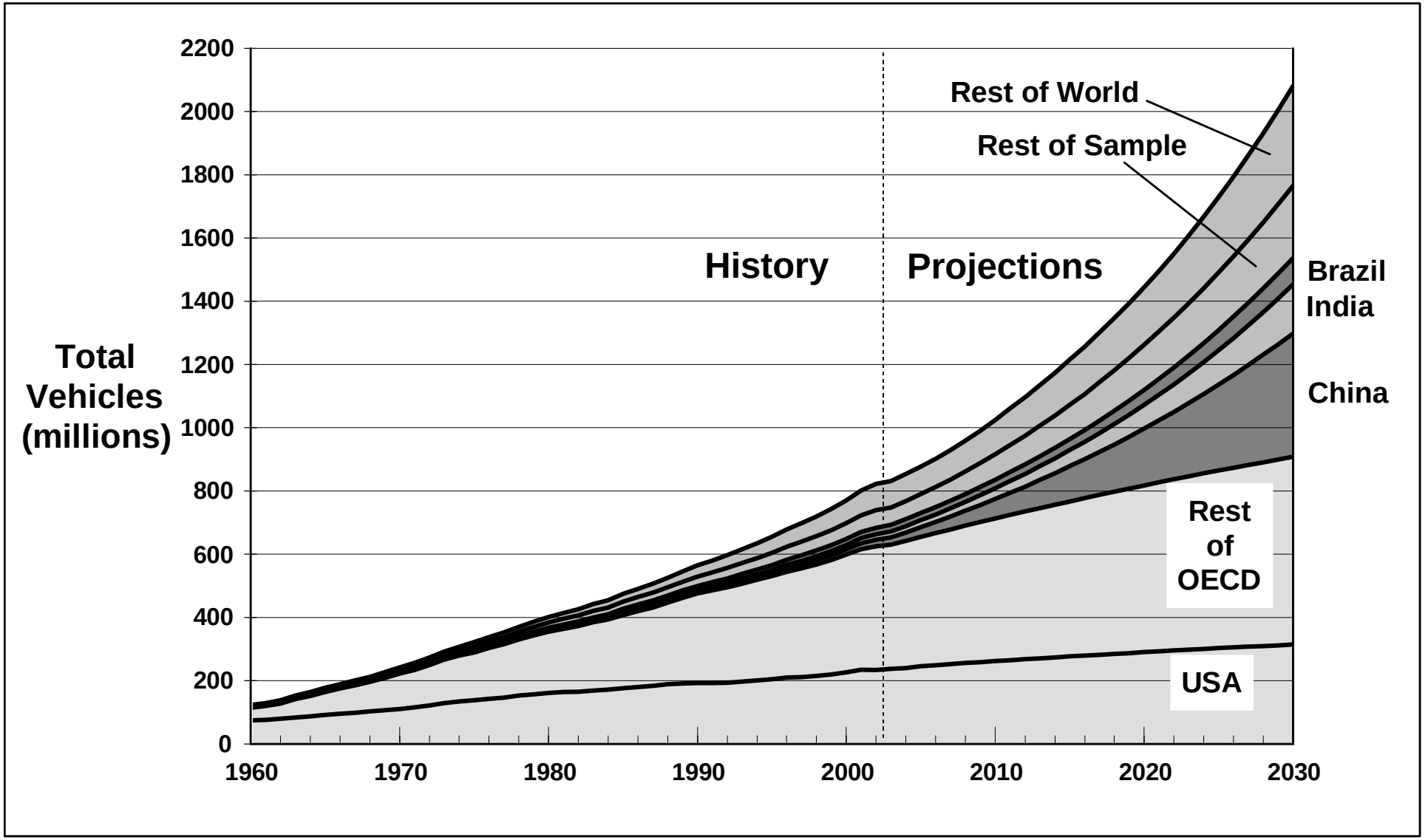
Vehicle Ownership and Per-Capita Income: 8 countries



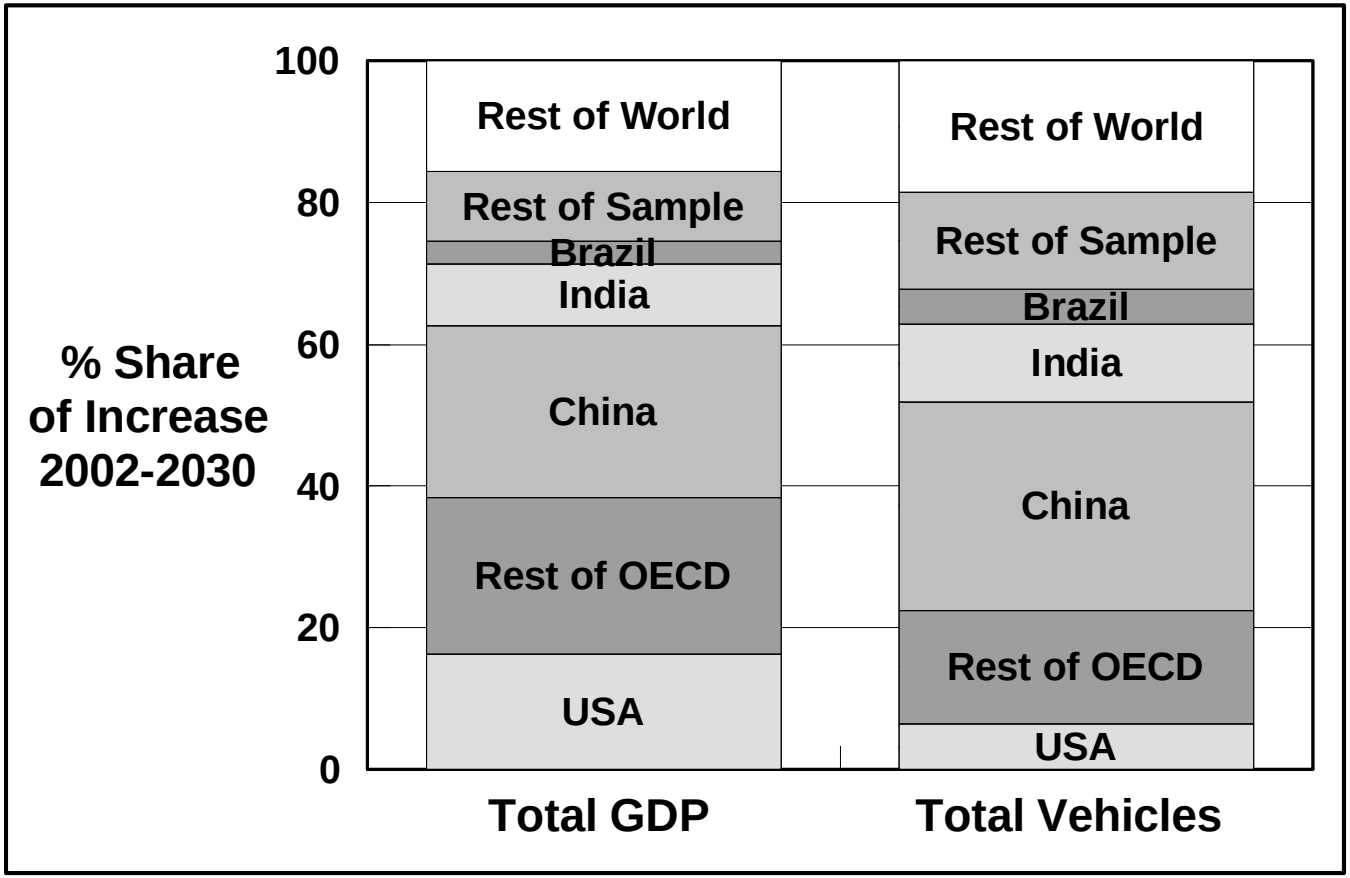
Countries' Estimated Vehicle Ownership Saturation Levels and Income Levels at which Vehicle Ownership = 200



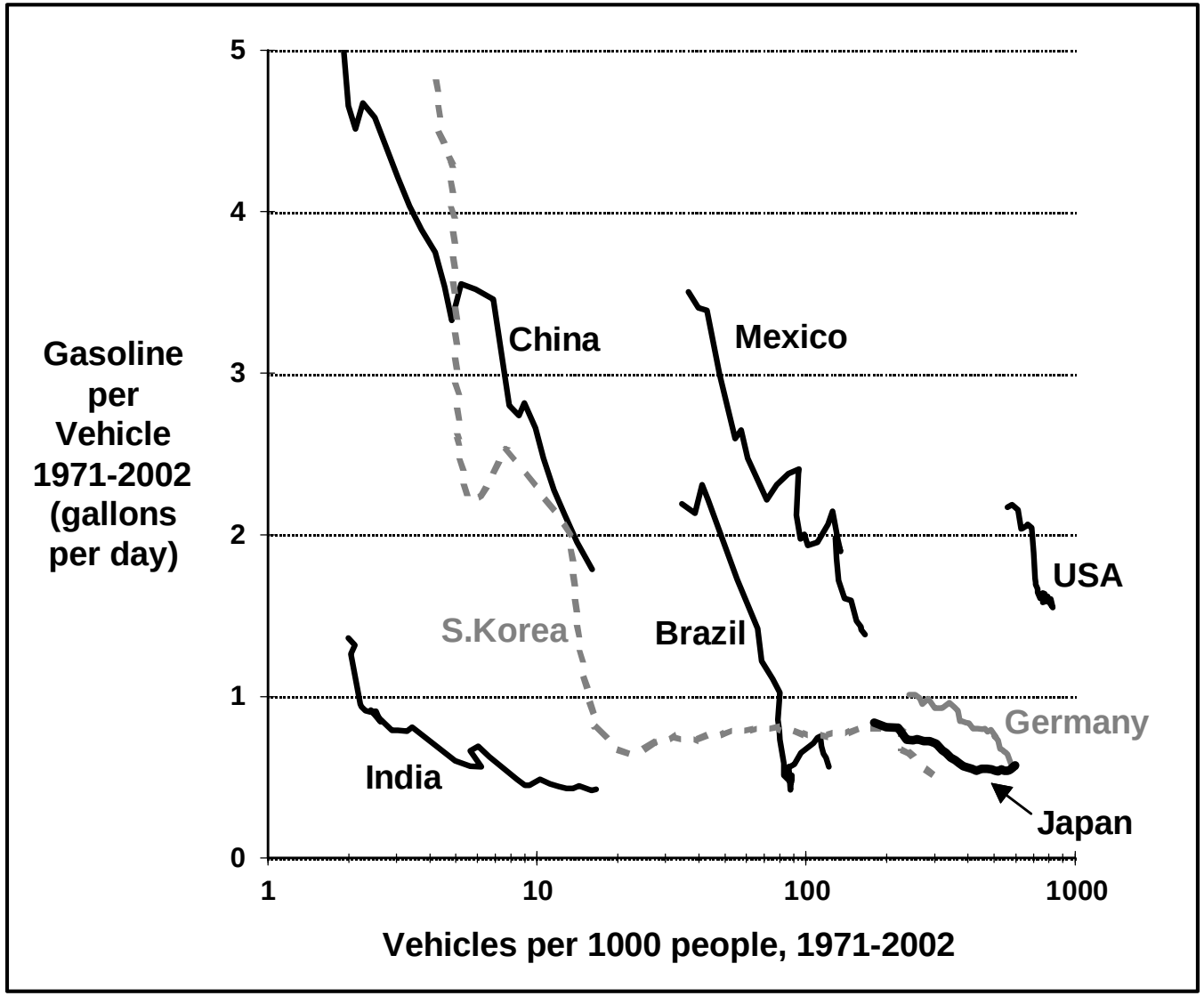
History 1960-2002 and Projections 2002-2030: Total Vehicles



Regional Shares of the Absolute Increase in GDP and Total Vehicles, 2002-2030



Fuel per Vehicle and Vehicle Ownership for Selected Countries, 1971-2002. As vehicle ownership increases, fuel per vehicle declines.



Projected Ratios of Vehicle Ownership Growth to Per-capita Income Growth, 2002-2030. Comparison of D-G-S Projections with IEA(2004) and OPEC(2004)

Region	D-G-S	IEA(2004)	OPEC(2004)
OECD	0.42	0.57	0.39
Non-OECD	1.61	1.12	0.97
China	2.20	1.38	1.28
India	1.98	0.39	
Egypt	2.09	1.21	
World	0.94	0.61	0.57

If these vehicles are oil driven, this would mean a growth of demand by 2.5% annually

0.9% OECD and 5.2% in the rest of the world