

The Future of World Car Fleet: The Road Ahead

(A BBVA Research model for long-term automobile projections)

November, 2012

Cross-Country Emerging Markets Unit

Key Messages

Motivation: Analysis of long run determinants of car industry

- **Developing Models for tracking long term changes** (“pionering model”)
- Analysis of **long term trends which are shaping the new economic order**.
- **Wealth not population is driving the economic transformation**
- **Population+Wealth (“Middle Classes”) will be key for business opportunities**

Results: Car industry will experience an important transformation

- Population, Wealth, Middle Classes and Urbanization will **bias the future of Car Fleet to Emerging Markets**
- **East Asia will experience the highest increase followed by Latam**
- **Development Economies will experience moderate increases** except in the US economy
- **BBVA Markets will improve depending on where we focus**

Annex The BBVA Research Car Model

- **Motivation and alternative models**
- **The BBVA CAR Model: Especification, estimation and comparative results**
- **Comparative analysis**



BBVA

RESEARCH

A BBVA Research model for long-term automobile projections

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Car Fleet Determinants

BBVA Model: Car Fleet Determinants

Source: BBVA Research

World Car Fleet Determinants		
Population	Car Ownership	
	Long Run Saturation levels	Cyclical Determinants
	Real GDP per Capita	GDP Growth Acceleration
	Population Density	Economic Recessions (dummy)
	Urbanization Rates	
	Infrastructure (Roads Quality)	
	Financial Depth (Private Credit/ GDP)	

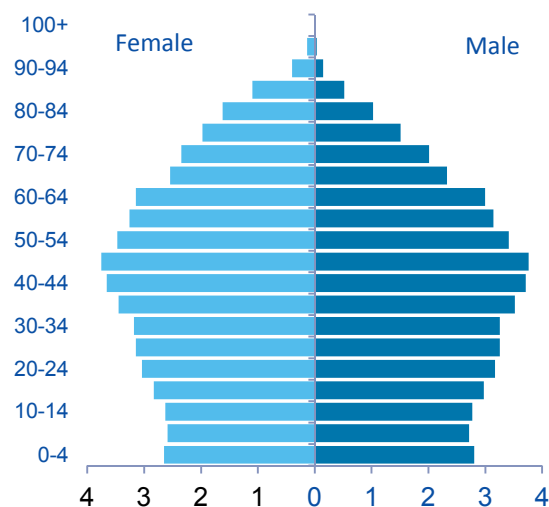


Different Population Dynamics

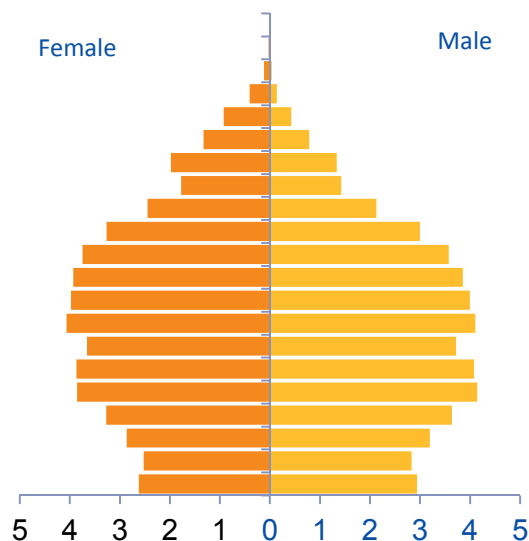
Population pyramids for selected economies (2010)

Source: BBVA Research and UN

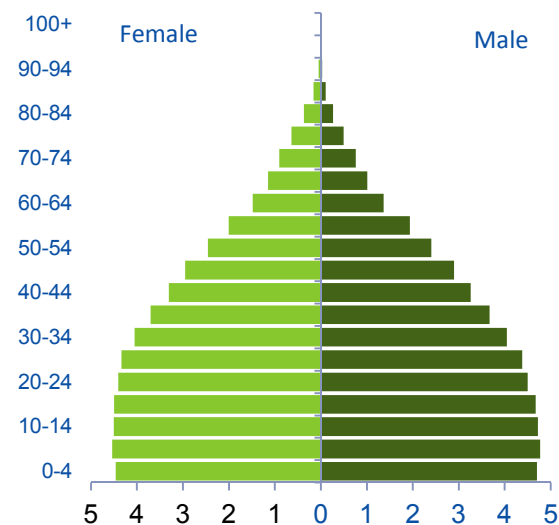
G7 Countries



Eagles Ageing Advanced



Eagles Populating Premium

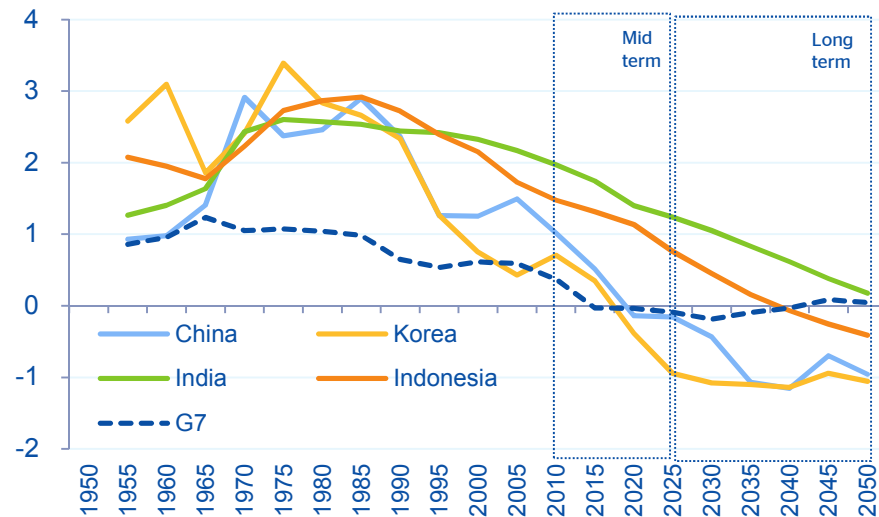


Labor force will gradually decline in EM but still maintains an important premium with Developed

Labor Force Population Population Growth

(% yoy)

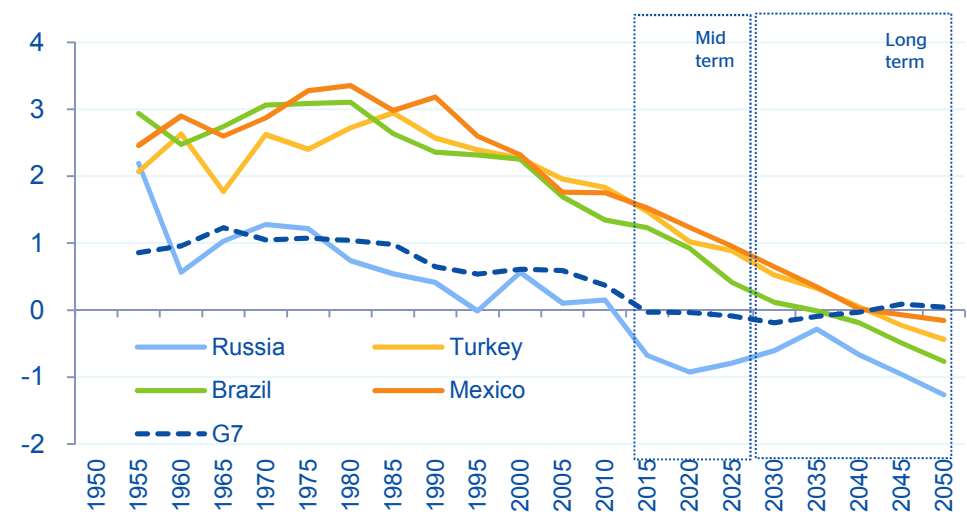
Source: BBVA Research and UN



Labor Force Population Population Growth

(% yoy)

Source: BBVA Research and UN

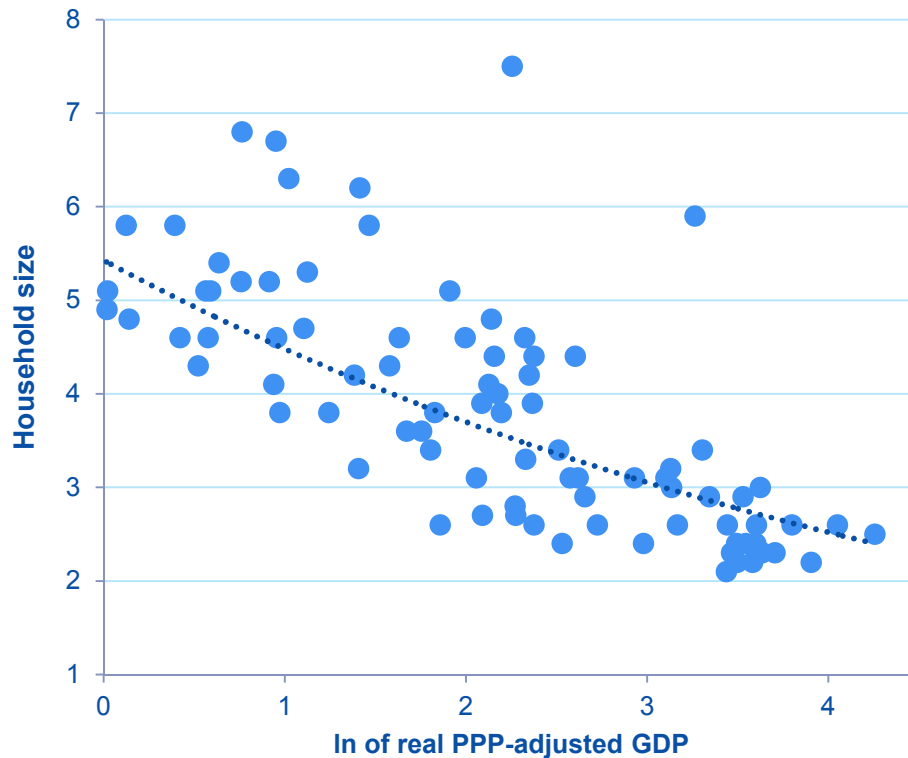


..But Household size will also decline limiting the population decline impact in some goods

Household Size and GDP Per cápita

(in members ans log of gdp per capita)

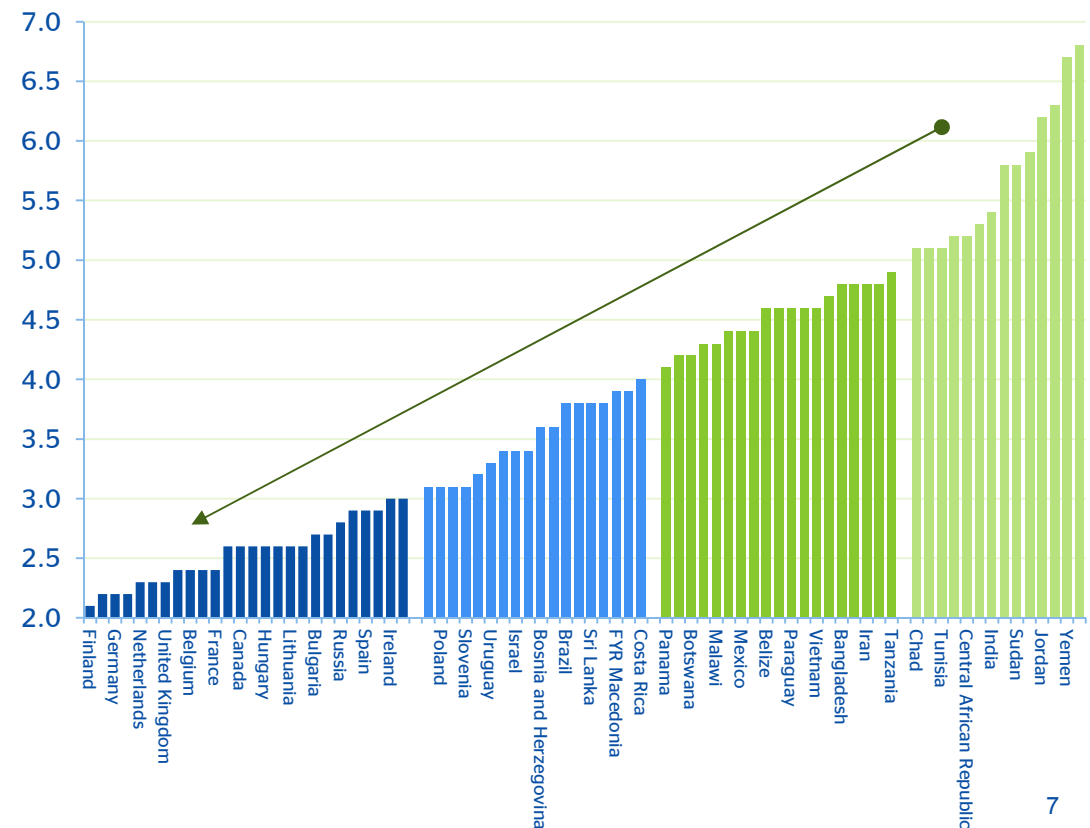
Source: BBVA Research and UN



World Household Size

(members per housold unit)

Source: BBVA Research and UN



The Wealth Effects: GDP per capita growth differences will remain important...

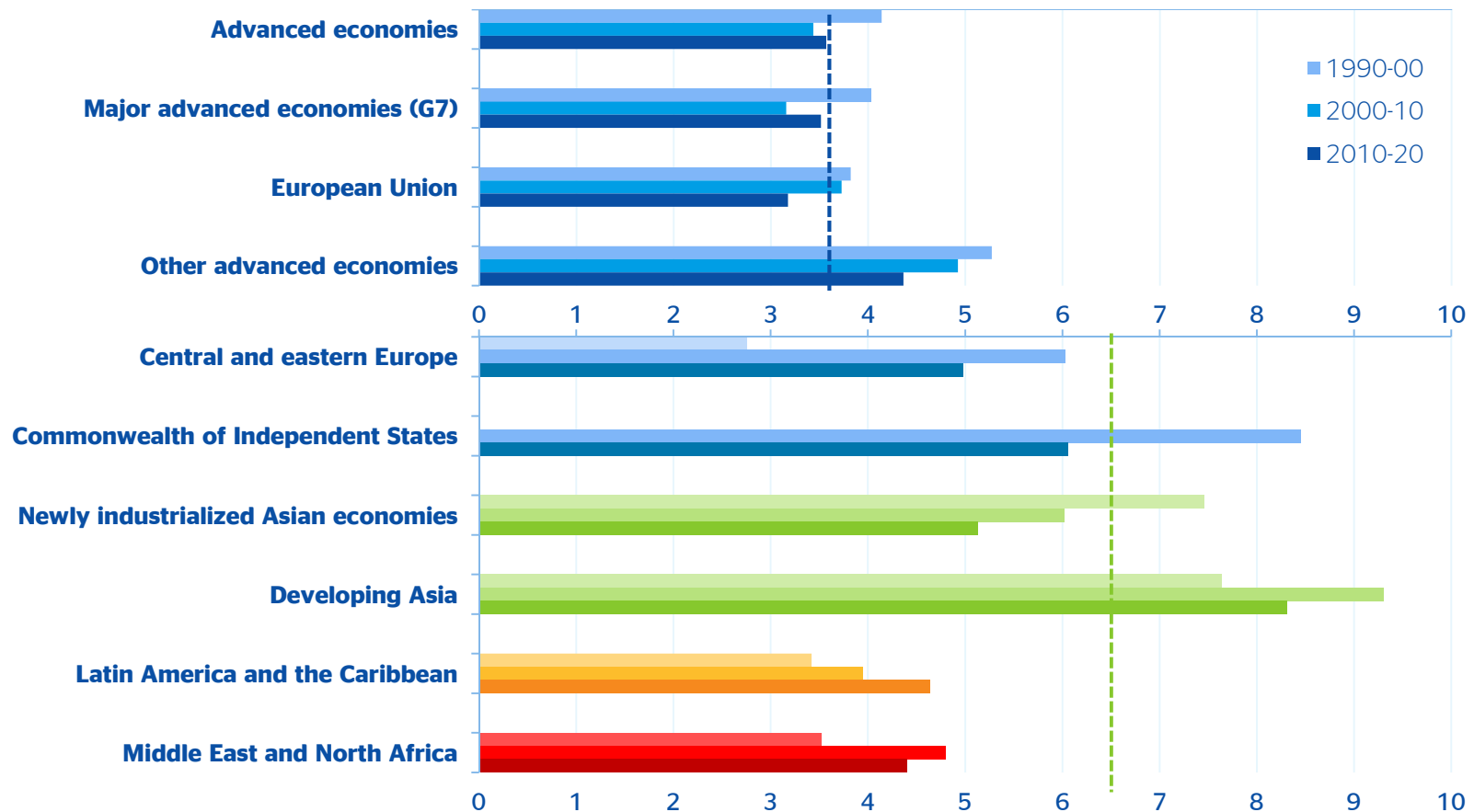
GDP per capita Growth Rate (1980-2020)

(% yoy, in nominal PPP-adjusted USD)

Source: BBVA Research

Advanced Economies

Emerging Economies

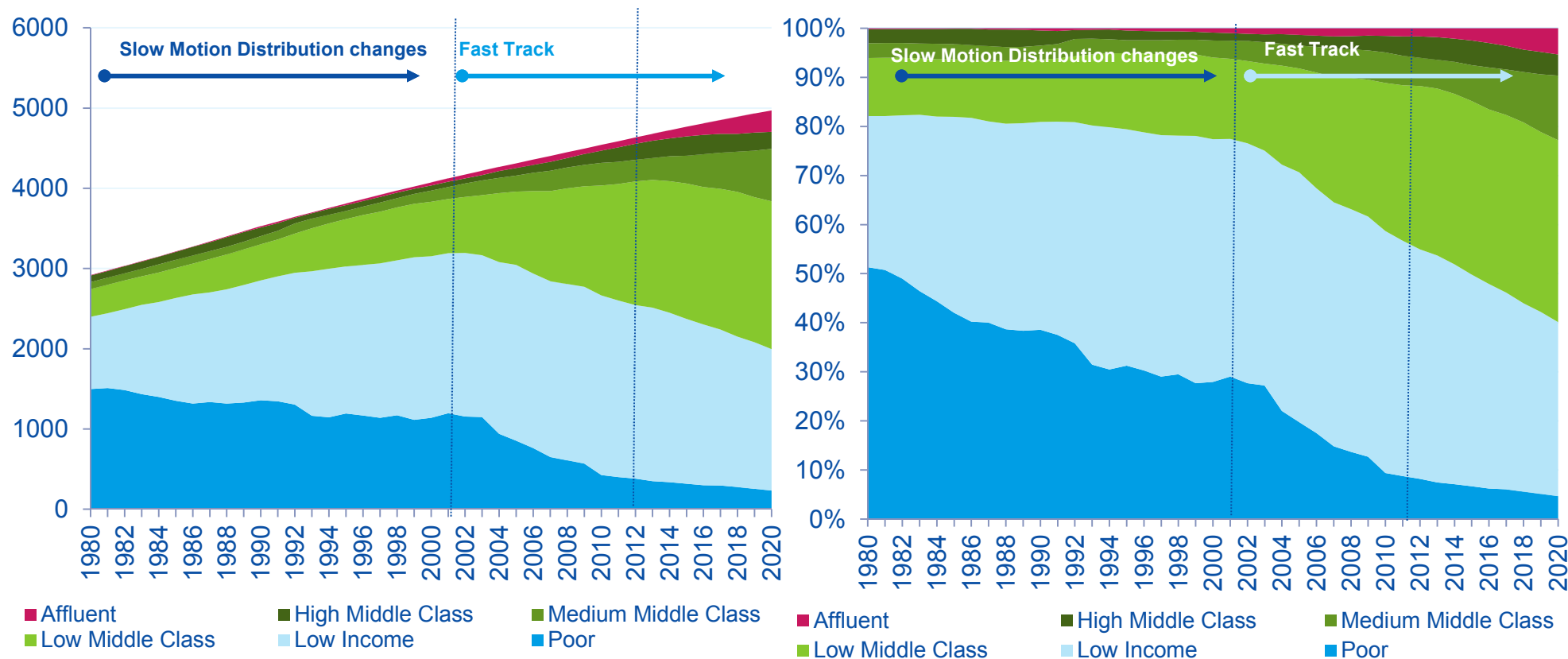


...With a Fast track in Middle Classes creation

Estimation of income distribution by GDP per capita in emerging economies (1980-2020)

(millions of people and % of total population; original data in real PPP-adjusted USD)

Source: BBVA Research



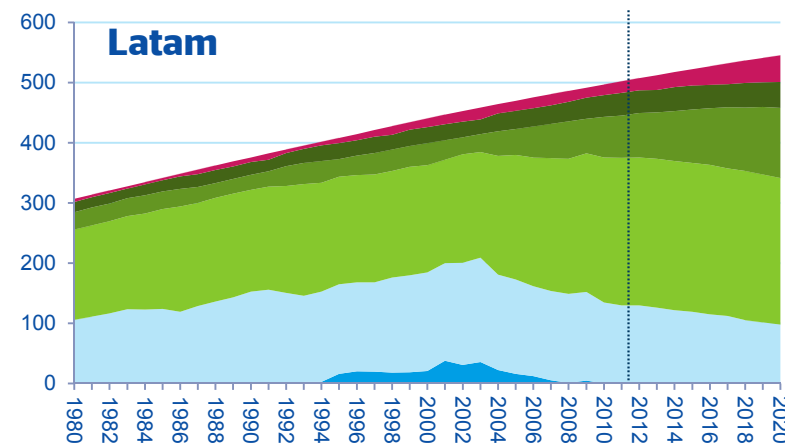
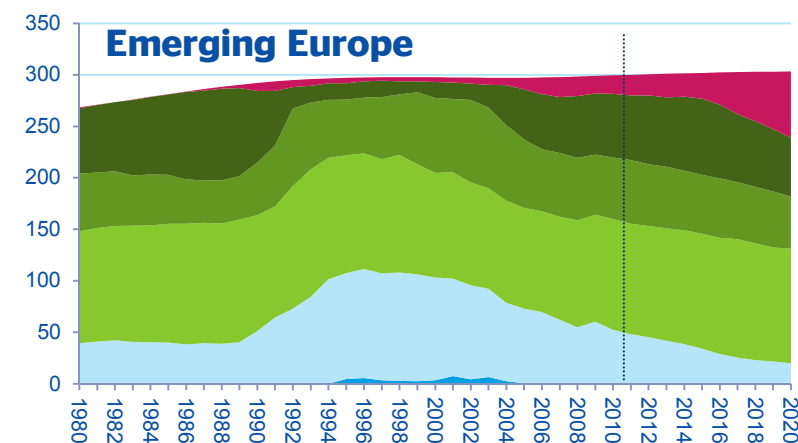
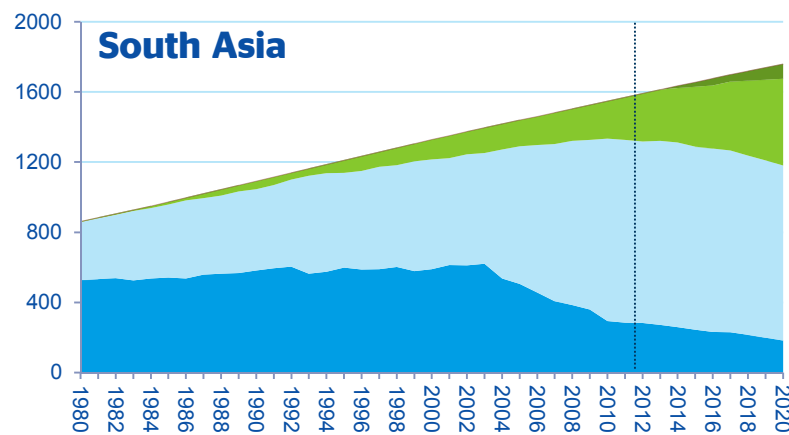
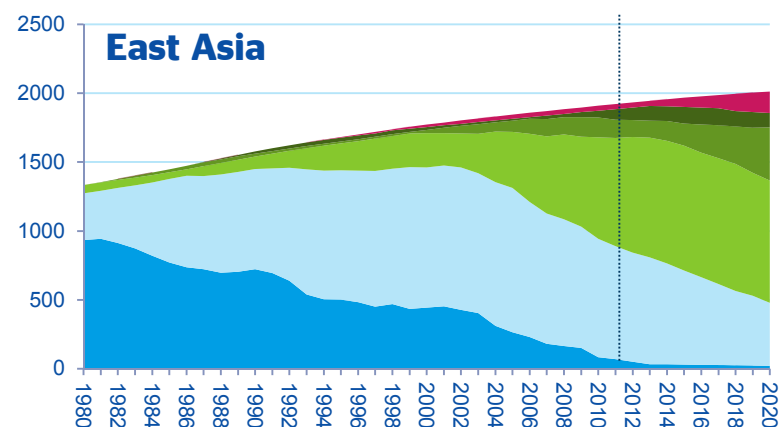
Affluent (>40000 USD) High Middle Income (25000 to 40000 USD) Medium Middle Income (15000 to 25000 USD) Low Middle Income (5000 USD to 15000 USD) 9
 Low Income (1000 USD to 5000 USD) Poor (<1000 USD)

... Specially in some areas...

Estimation of income distribution by GDP per capita in emerging economies regions (1980-2020)

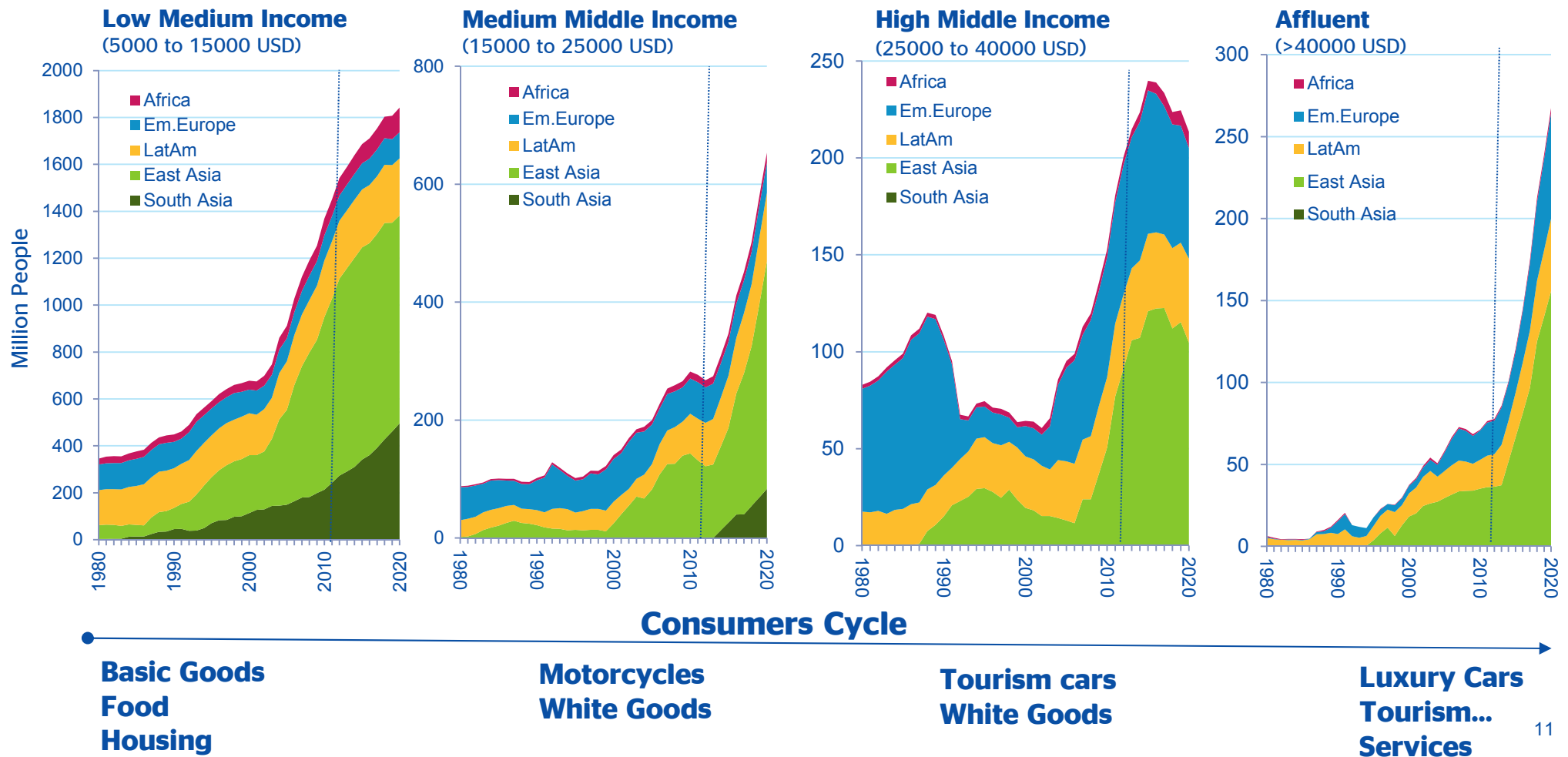
(millions of people and % of total population; original data in real PPP-adjusted USD)

Source: BBVA Research



■ Affluent (>40000 USD)
 ■ High Middle Income (25000 to 40000 USD)
 ■ Medium Middle Income (15000 to 25000 USD)
 ■ Low Middle Income (5000 USD to 15000 USD)
 ■ Low Income (1000 USD to 5000 USD)
 ■ Poor(<1000 USD)

... and in some segments related to different consumption patterns

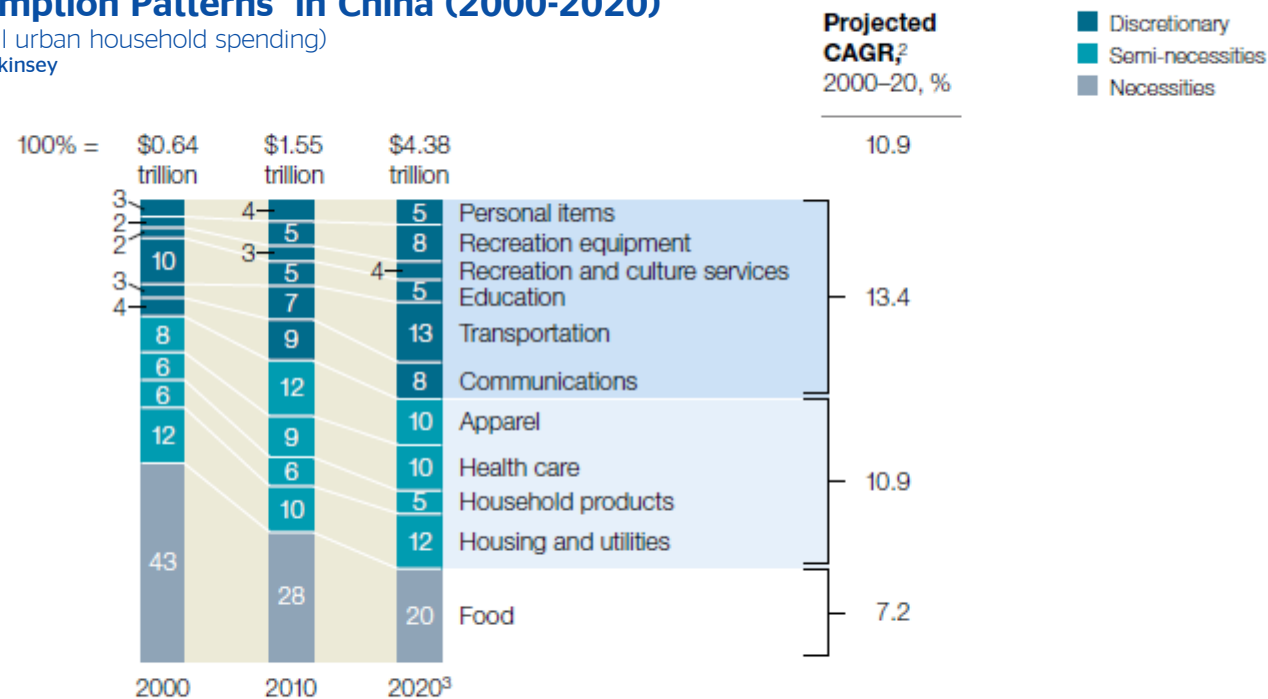


Middle classes will trigger demand for semi necessities and discretionary spending...

Consumption Patterns in China (2000-2020)

(% of total urban household spending)

Source: McKinsey


¹In real 2010 dollars; in 2010, \$1 = 6.73 renminbi. Figures may not sum to 100%, because of rounding.

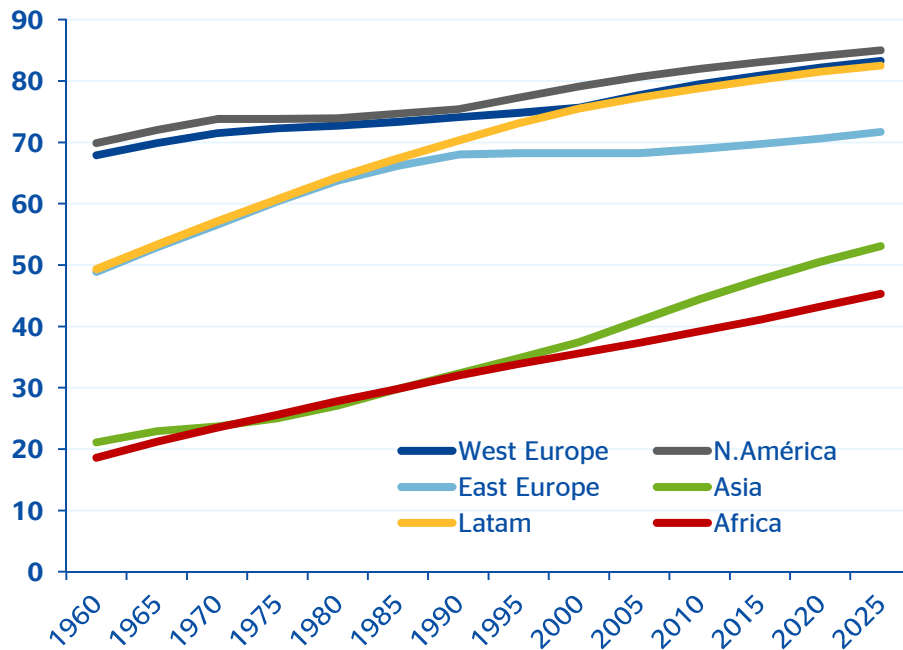
²Compound annual growth rate.

³Forecast.

...Urbanization will increase very fast in some of the regions...

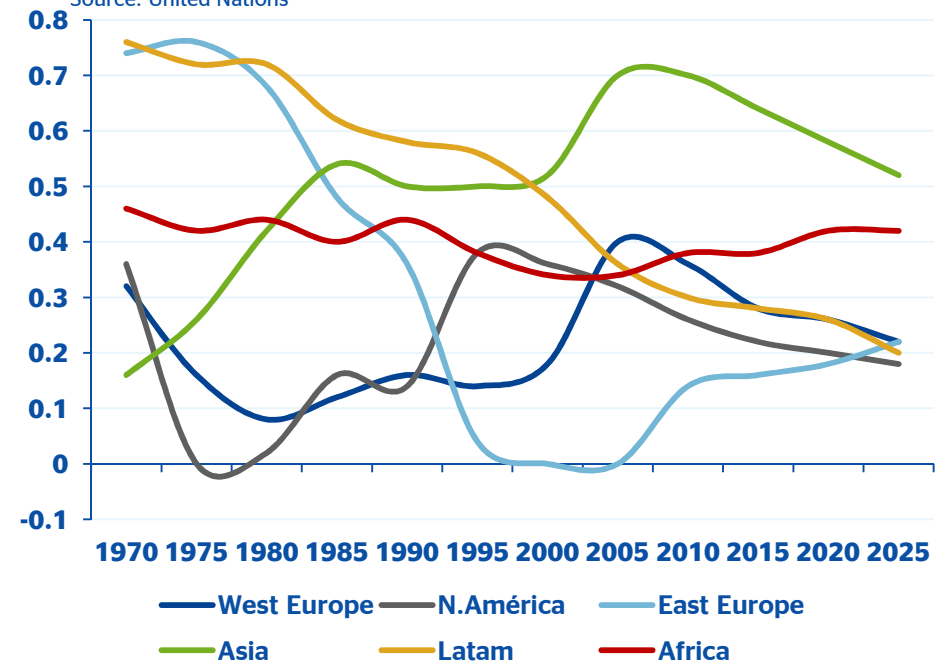
World Urbanization Rates(1980-2020)

(Urban population as a % of total)
Source: United Nations



World Urbanization Rates(1980-2020)

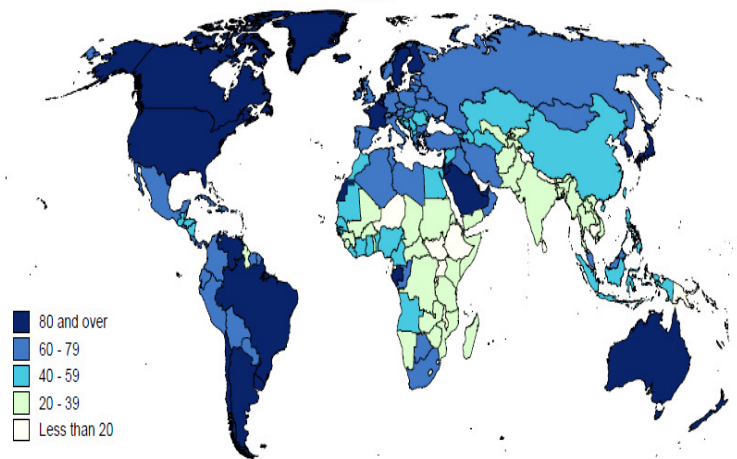
(Annual Change in Urbanization Rates)
Source: United Nations



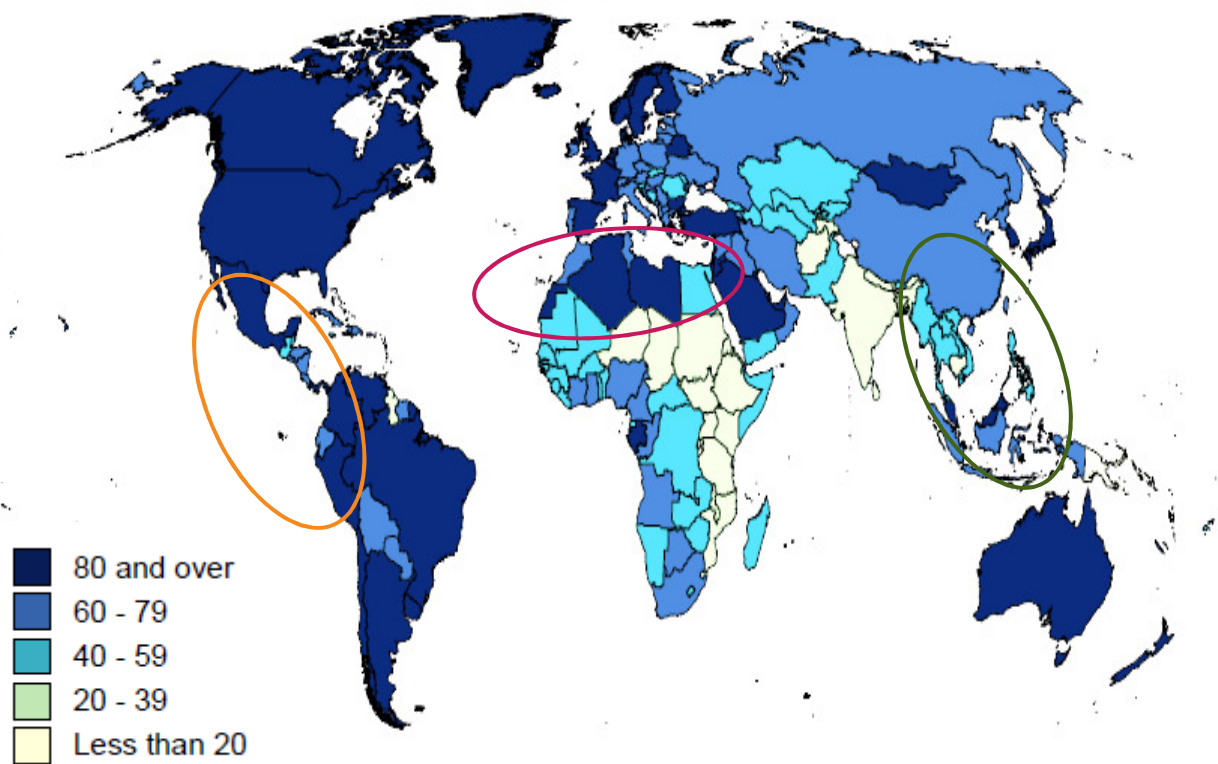
Regional Aggregates mask some rapid changes in some countries (Andeans & South East Asia)

World Urbanization Rates(2011)

(Urban population as a % of total)

**World Urbanization Rates(2030)**

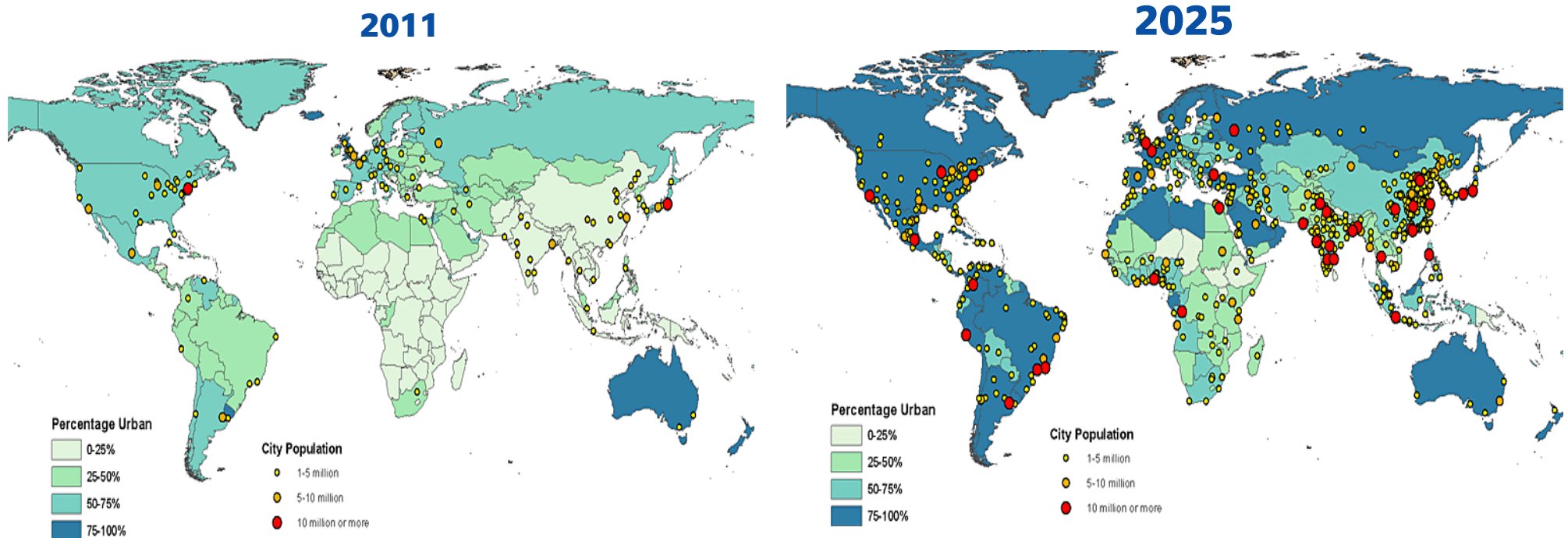
(Urban population as a % of total)



...and we will observe an intensive Urban agglomeration process specially in Asia

Percentage of urban population and agglomerations by size class

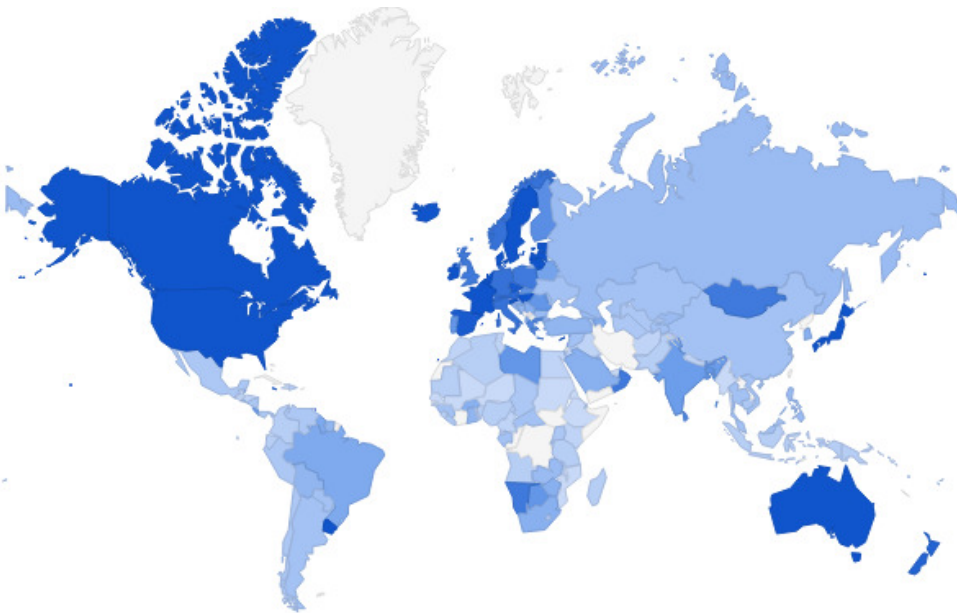
Source: UN Urbanization Prospects, 2011 revision



... But Emerging Markets still lags in transport infrastructure ...

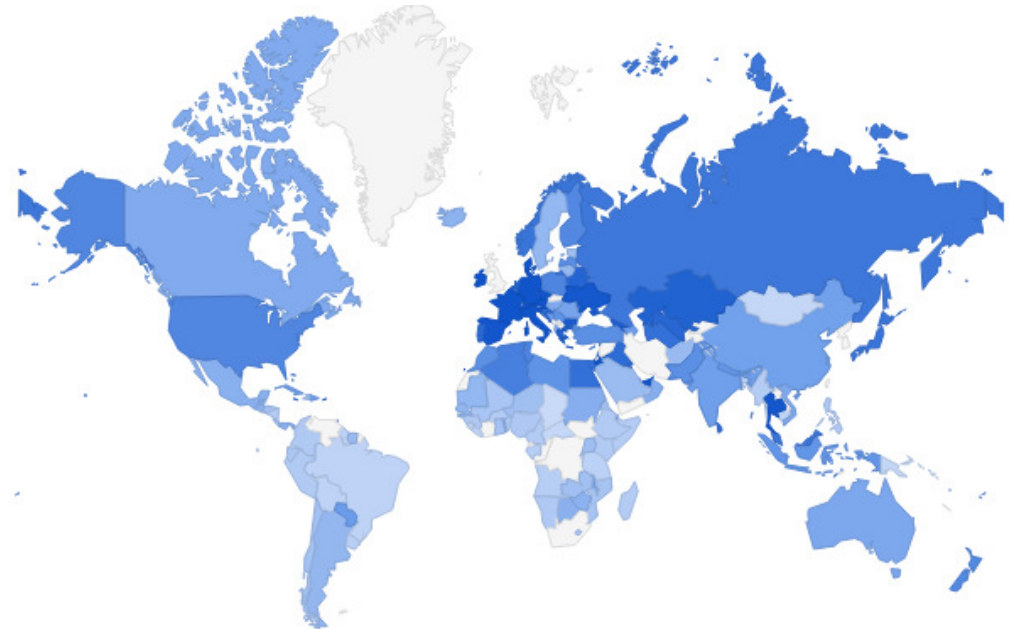
Road Density World Map

(Synthetic indicator, from -1=lighter to 1= Darker)
Source:World Bankand BBVA Research



Paved Road World Map

(% of total roads, from 0=lighter to 100= Darker)
Source:World Bank Development Indicators



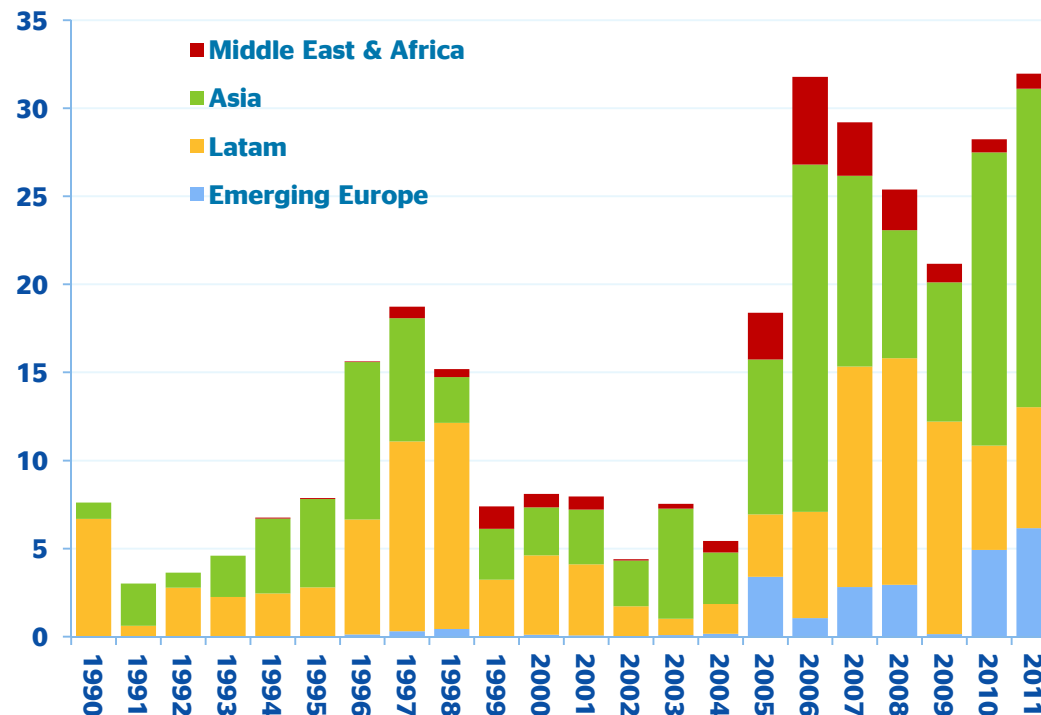


.. and this leads to important opportunities of investment in this segment...

Public Private Initiatives Infrastructure Transport Projects

(US Billions)

Source: World Bank





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A brief reminder on the composition of aggregates

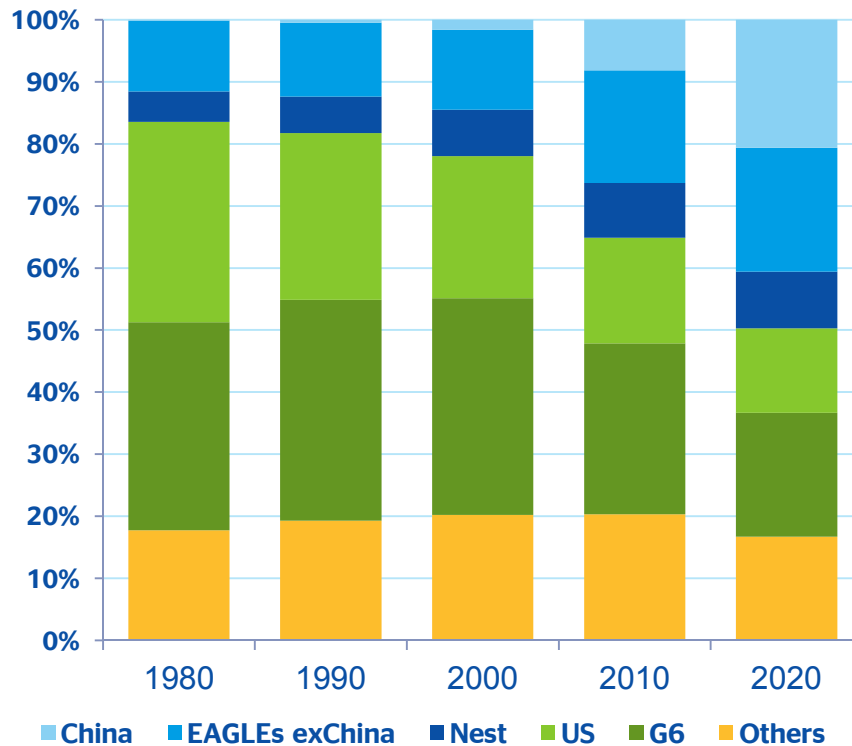
	EAGLEs	Nest	G7	Other
Europe	Russia Turkey	Poland Ukraine	France Germany Italy UK	Spain
America	Brazil Mexico	Argentina Chile Colombia Peru	Canada USA	
Asia Pacific	China India Indonesia Korea Taiwan	Bangladesh Malaysia Pakistan Philippines Thailand Vietnam	Japan	Australia
Middle E. & Africa		Egypt Nigeria S.Africa		Iran S.Arabia

Increase and distribution of world car fleet by decades: Eagles (China) will lead the next decade

Distribution of world car fleet (1980-2020)

(% of total world car fleet)

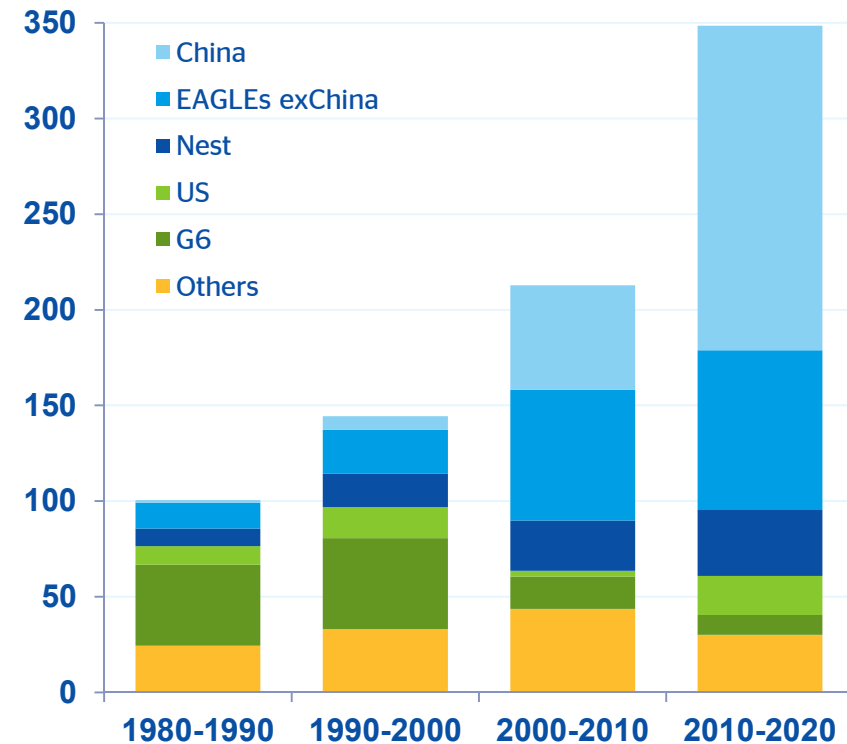
Source: BBVA Research



Increase of world car fleet by decades (mn)

(Million cars)

Source: BBVA Research

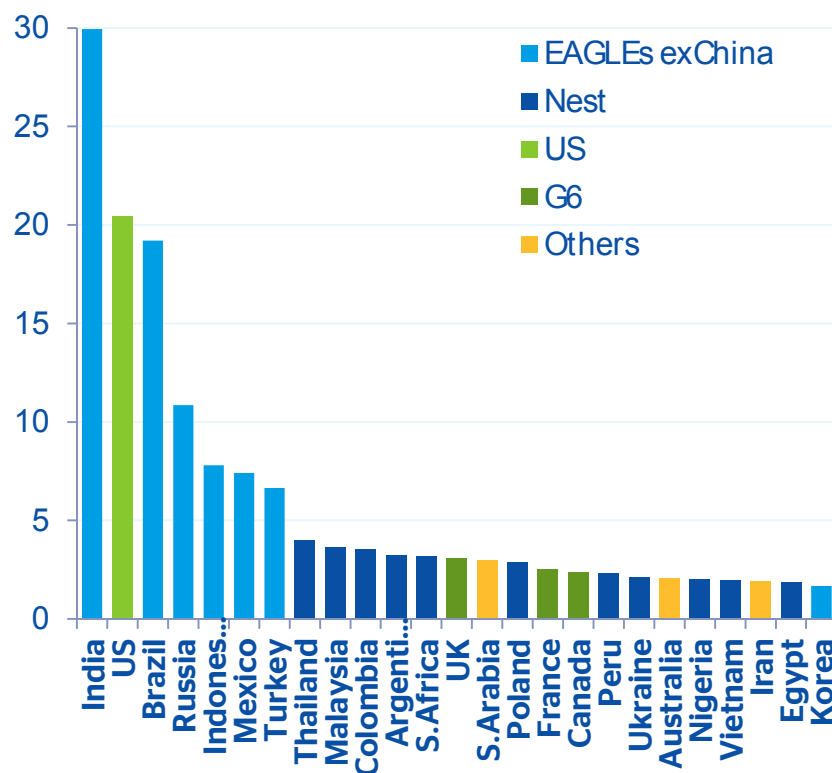


Expected increase in 2010-2020 and levels of car fleet by 2020

Increase of world car fleet ex China (2020 vs 2010)

(Million cars)

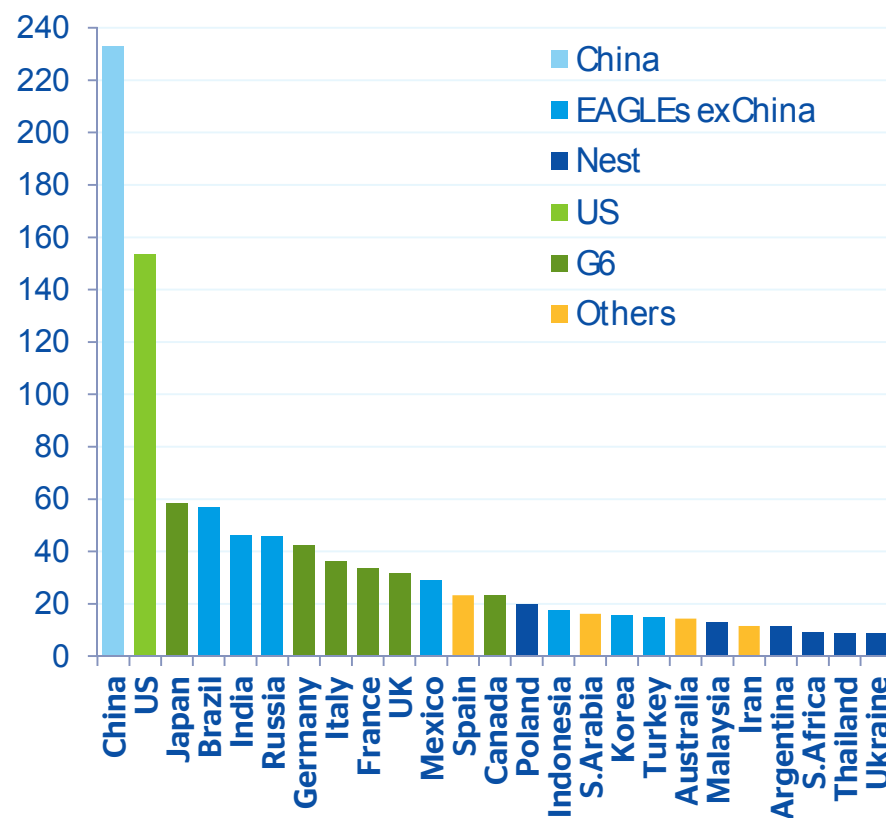
Source: BBVA Research



Car fleet of largest markets in 2020 (mn)

(Million cars)

Source: BBVA Research

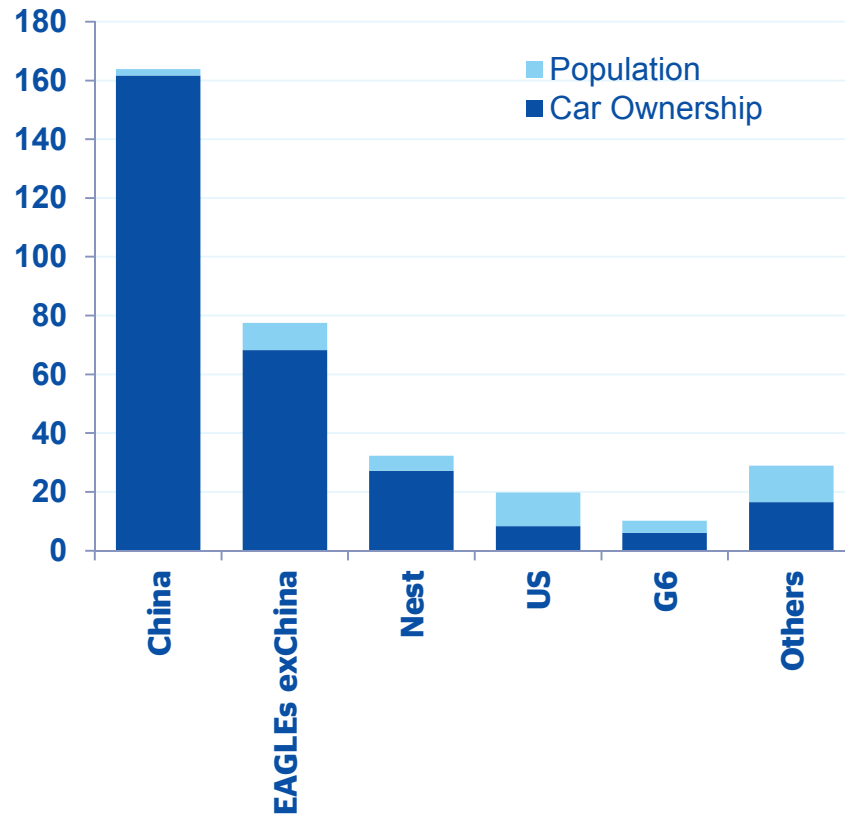


Determinants of the expected increase in the car fleet. Wealth not population as the main driver

Determinants of Car Fleet Expansion (1980-2020)

(million Cars)

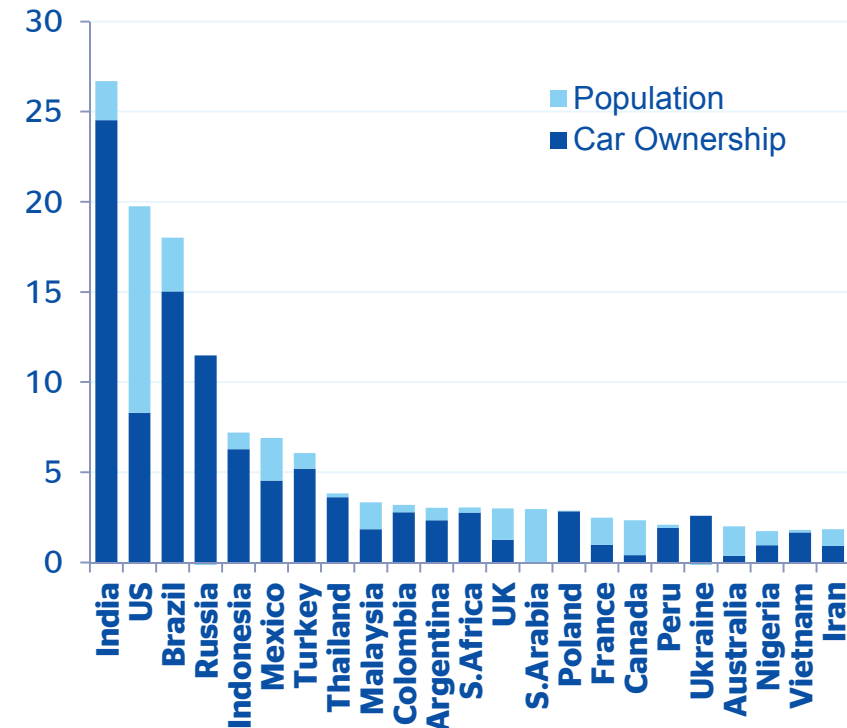
Source: BBVA Research



Determinants of Car Fleet Expansion (1980-2020)

(million Cars)

Source: BBVA Research

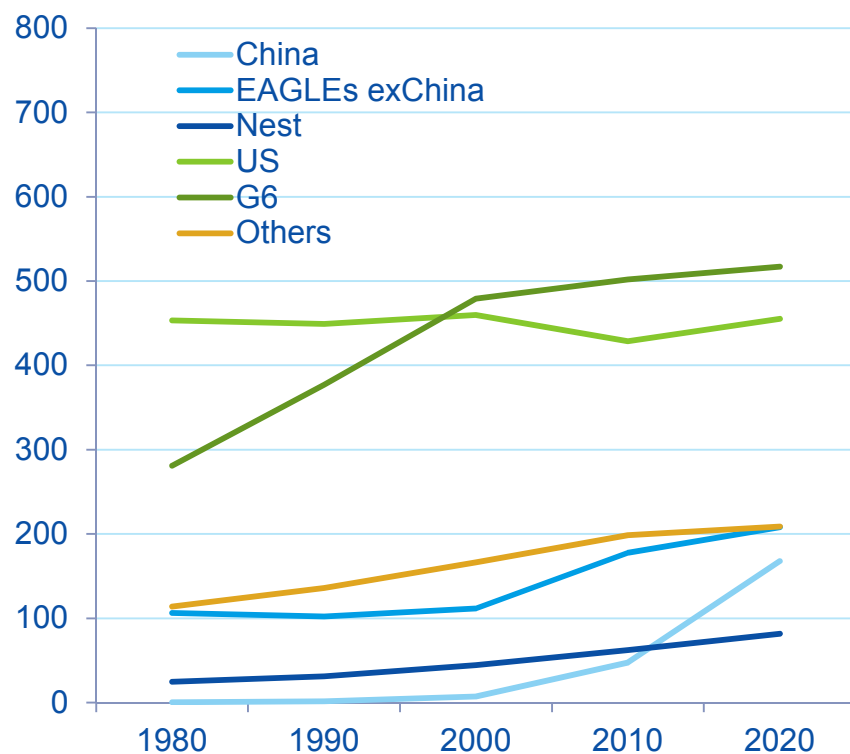


Change and levels of car ownership

Car ownership Evolution(1980-2020)

(Cars Units per 1000 people)

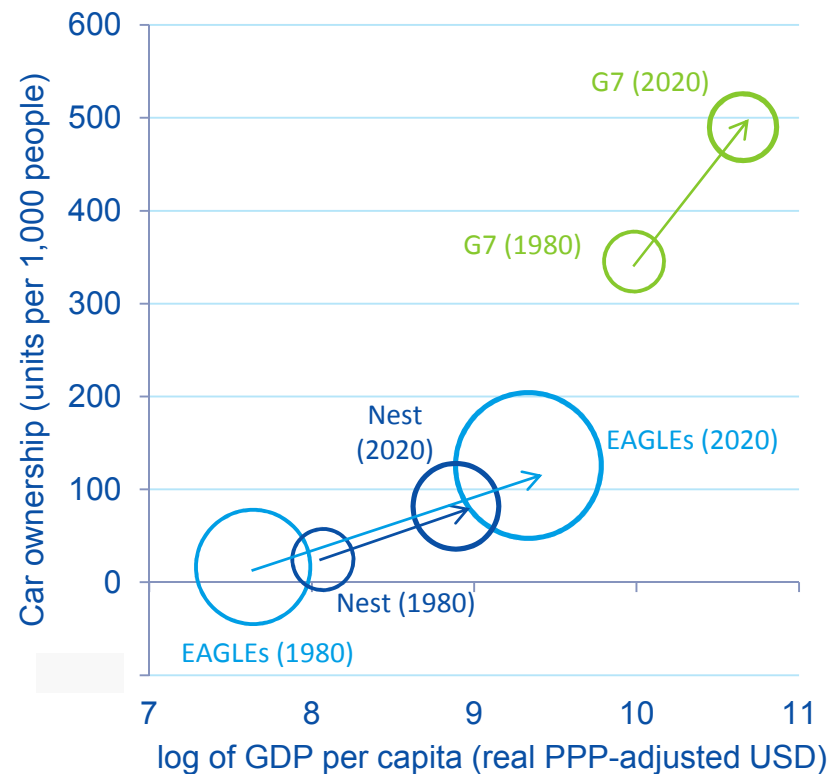
Source: BBVA Research



Car ownership Groups Evolution(1980-2020)

(Cars Units per 1000 people. Bubble size proportional to car fleet)

Source: BBVA Research

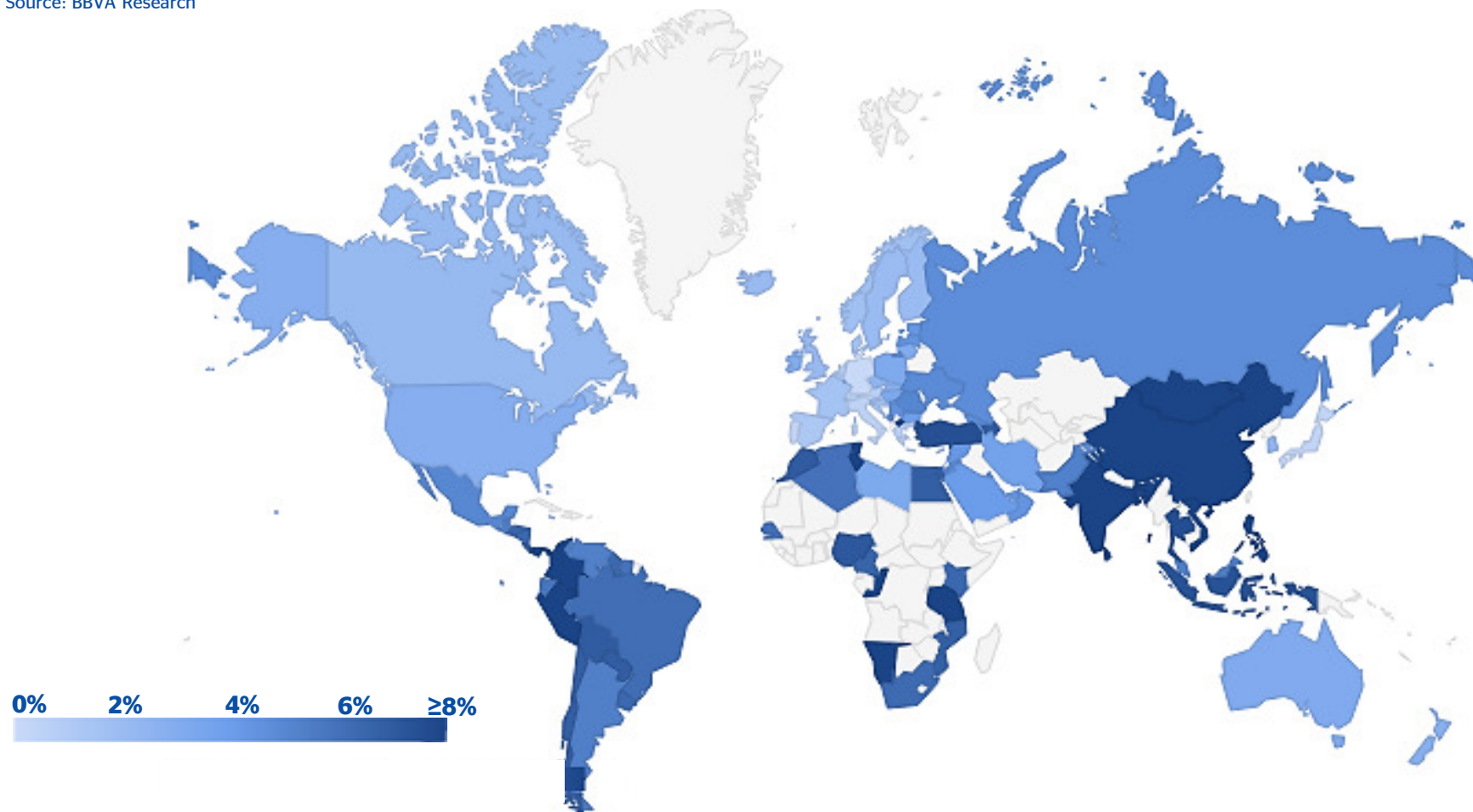


Expected annual increase in car fleet for the next decade concentrated in Asia and Latam

Expected annual increase in World Car Fleet (2010-2020)

(% yearly growth)

Source: BBVA Research

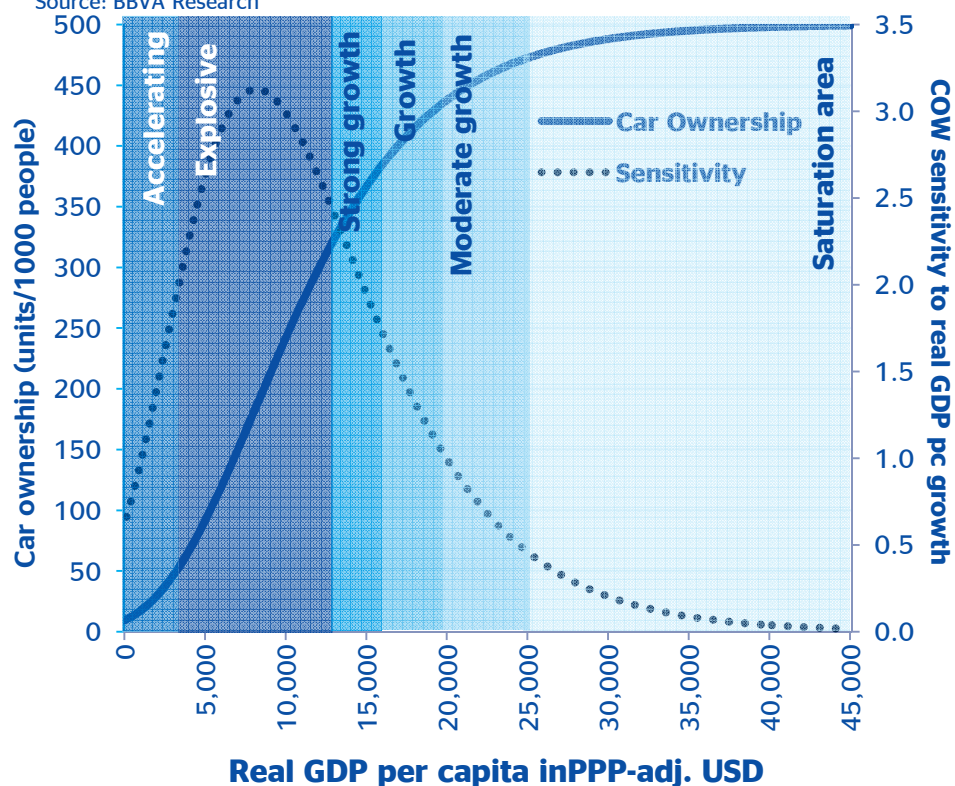


Different “Growth Areas” across the world

Car Ownership “Gomperzt” Curve

(Car Ownership and Sensitivity to GDP per Capita Growth as a function of GDP per capita levels)

Source: BBVA Research



Car Fleet Growth Areas

(Car Ownership and Sensitivity to GDP per Capita Growth as a function of GDP per capita levels)

Source: BBVA Research

Growth Area	Long-term income per capita (in real PPP-adjusted USD)		Sensitivity of car ownership to income per capita*	
	From...	..to	From...	..to
Accelerating Growth	1,100	4,600	1	2.5
Explosive Growth	4,600	12,500	2.5	3.1(max)
Strong Growth	12,500	15,800	1.75	2.5
Growth	15,800	19,900	1	1.75
Moderate Growth	19,900	24,400	0.5	1
Saturation	24,400	+	min»0	0.5

*Change of car ownership (units per 1,000 people) to a change of 100 USD in income per capita

Explosive and strong growth will be concentrated in Asia, Latam and Turkey

Car Fleet Growth Areas

(Car Ownership and Sensitivity to GDP per Capita Growth as a function of GDP per capita levels)

Source: BBVA Research

<i>Growth Area</i>	Long-term income per capita (in real PPP-adjusted USD)		Sensitivity of car ownership to income per capita*		Countries and Groups
	From...	...to	From...	...to	
Accelerating Growth	1,100	4,600	1	2.5	Bangladesh, Pakistan, Nigeria, Vietnam, Philippines, India, Cameroon, Kenya
Explosive Growth	4,600	12,500	2.5	3.1 (max)	Indonesia, Egypt, Ukraine, Thailand, Colombia, China, S.Africa, Peru, Brazil, Paraguay, Bolivia, Ecuador
Strong Growth	12,500	15,800	1.75	2.5	Turkey, Mexico, Panama, Uruguay, Bulgaria, Romania
Growth	15,800	19,900	1	1.75	Malaysia, Chile, Russia, Argentina, Hungary, Croatia, Lithuania, Latvia
Moderate Growth	19,900	24,400	0.5	1	Poland, Portugal, Slovakia, Saudi Arabia, Greece, Estonia, Oman
Saturation	24,400	+	min»0	0.5	Korea, G7, Australia, Spain, Switzerland, Netherlands, Czech Republic, Slovenia, New Zealand

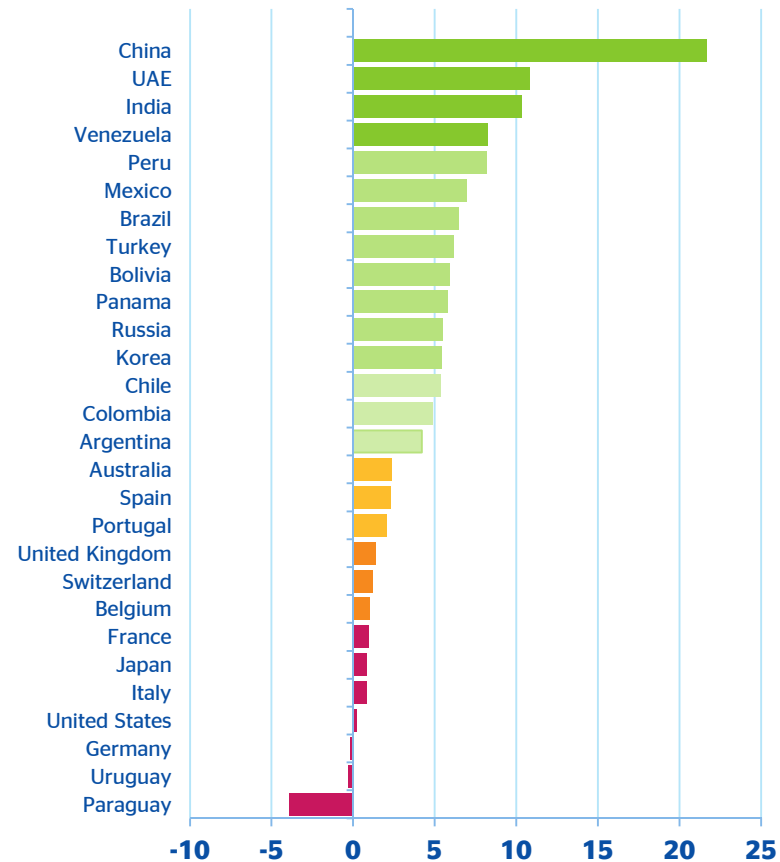
*Change of car ownership (units per 1,000 people) to a change of 100 USD in income per capita



Growth markets will lie in the Emerging Markets area

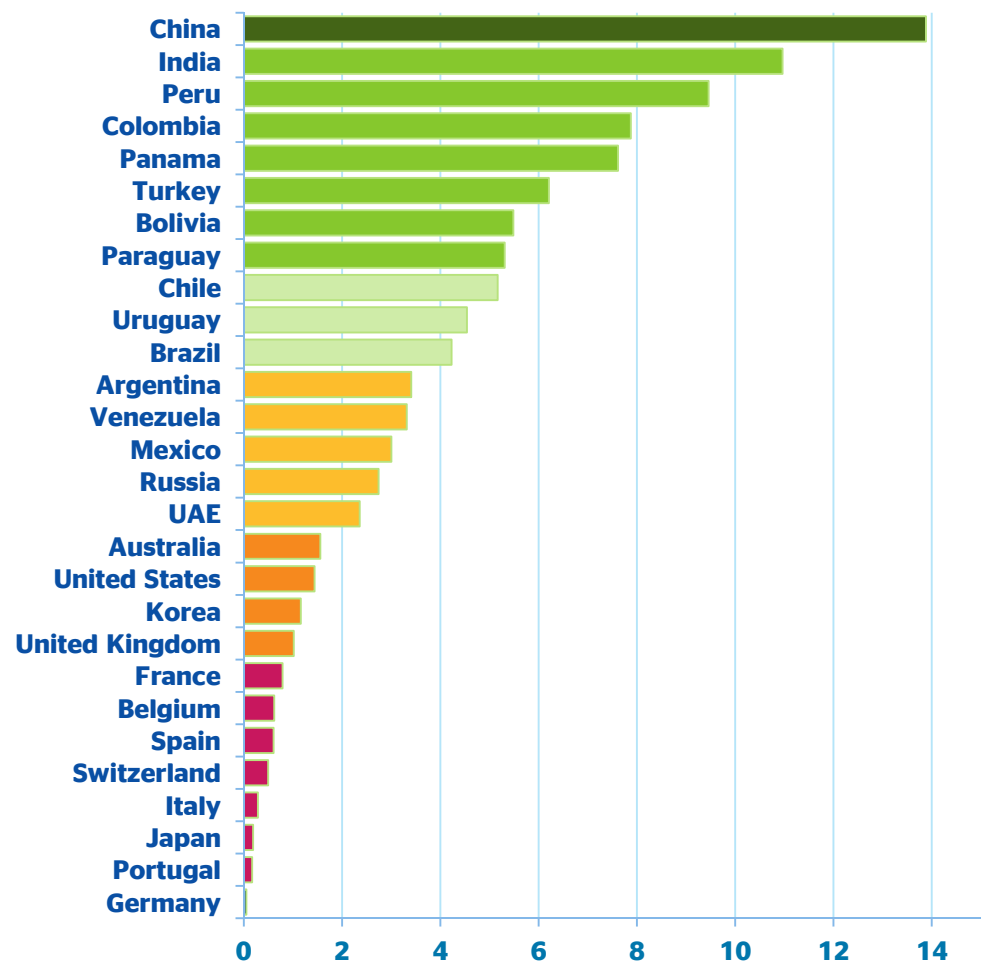
Expected increase in Car Fleet (2000-10)

(% yearly growth)
Source: BBVA Research



Expected increase in Car Fleet (2010-20)

(% yearly growth)
Source: BBVA Research





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Literature on car ownership

- ❑ **Dargay, Gately and Sommer (2007):** They use a similar **saturation** model. Panel of 45 countries. They assume **a different sensitivity of every country** to GDP per capita.
- ❑ **Chamon, Mauro, and Okawa (2008):** They assume there is **no saturation rate**. They concentrate on estimating a “take off” income threshold at which car demand starts to grow exponentially.
- ❑ **Medlock, K. B., and Soligo, R. (2002):** Panel of 28 countries. **The model includes the user cost of capital and assume and find different saturation levels for each country.**



Enhancements of BBVA Car Model

- **We include the level of financial development and an infrastructure quality indicator** as determinants of each country saturation level.
- **We associate the saturation level to a long-term or «structural» level of income instead of the observed GDP per capita.**
- **We allow short term deviations of income per capita from its «structural» level to account for short-term variations in car ownership,** instead of relying on the lagged value of the dependent variable to model short-term dynamics.

Model specification

The model is estimated by maximum likelihood using a non-linear estimator with robust standard errors. The equation that we finally estimate is the following:

$$\begin{aligned}
 \ln CAROW_{it} &= \ln \{ (\alpha + \beta_1 (\overline{GDPPC}_{it}^{5yMA} - \overline{GDPPC}_{it}^{15yMA}) \\
 &+ \beta_2 (DENS)_{it}^{>US} + \beta_3 (DENS)_{it}^{<US} + \beta_4 (URB)_{it}^{>US} \\
 &+ \beta_4 (URB)_{it}^{<US} + \beta_6 (\overline{ROADSQ})_i + \beta_7 \overline{PCRED}_{it}^{5yMA}) \\
 &* \exp[\gamma * \exp(\beta_8 (\overline{GDPPC}_{it}^{15yMA}))] + \beta_9 (GDPPC_{it} - \overline{GDPPC}_{it}^{15yMA}) \\
 &+ \beta_{10} (GDPPC_{it} - \overline{GDPPC}_{it}^{15yMA})^{GDP < 0} \}
 \end{aligned}$$

CAROW = Car Ownership, GDPPC = Real GDP per capita in PPP-adj. USD, DENS = Population Density, URB = Urbanization Ratio, ROADSQ = Quality of Road Infrastructure, PCRED = Private Credit Ratio

Estimated regression

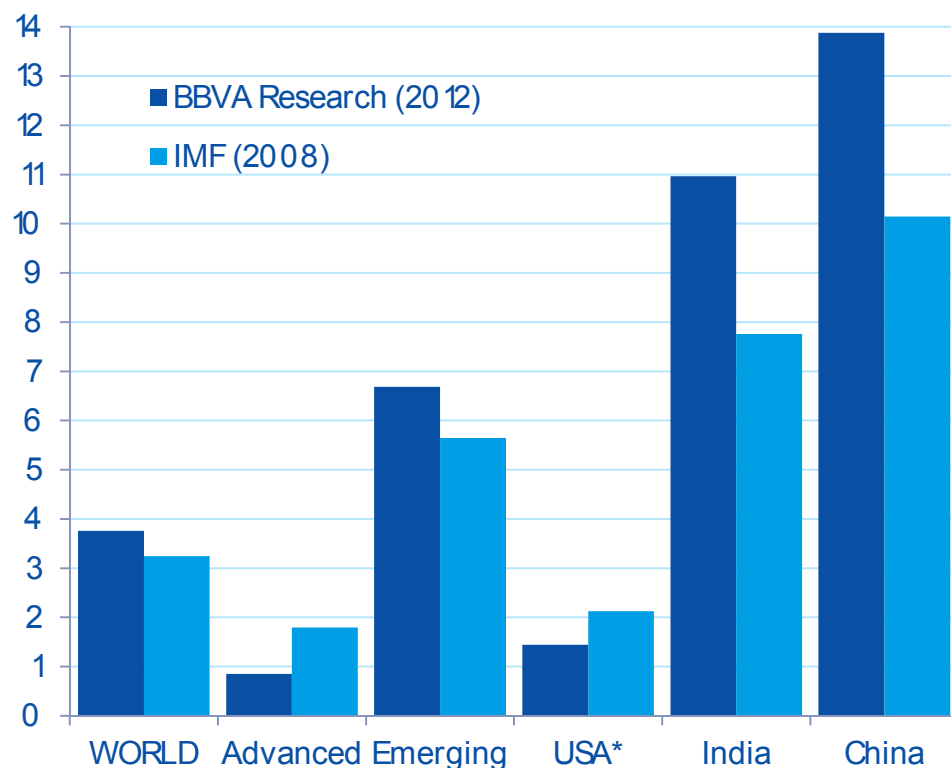
Variable			Coefficient
Saturation Level determinants	Long-term per capita income	α (max. constant Saturation Level)	499.9***
		γ (Gompertz curve shape)	-3.95***
		β (real GDPpc PPP-adj. 15y MA)	-0.00017***
	Other structural determinants	Real GDPpc PPP-adj. deviation 5yMA-15yMA	0.007***
		Population density (above US)	-0.18***
		Population density (below US)	-0.19
		Urbanization rate (above US)	2.259***
		Urbanization rate (below US)	-1.06*
		Roads quality Indicator	90.86***
		Credit to private sector	1.152***
Short-Term determinants		Real GDPpc PPP-adj. dev. Obs.-5yMA	0.009***
		Real GDPpc PPP-adj. dev. obs.-5yMA (in recessions)	-0.01***
Adjusted R ²			0,991
Number of Observations			2.001
Number of Countries			92

*** indicates significance at a 1% confidence level, ** at a 5% level and * at a 10% level

BBVA Research forecasts (2012) compared with previous IMF work (2008)

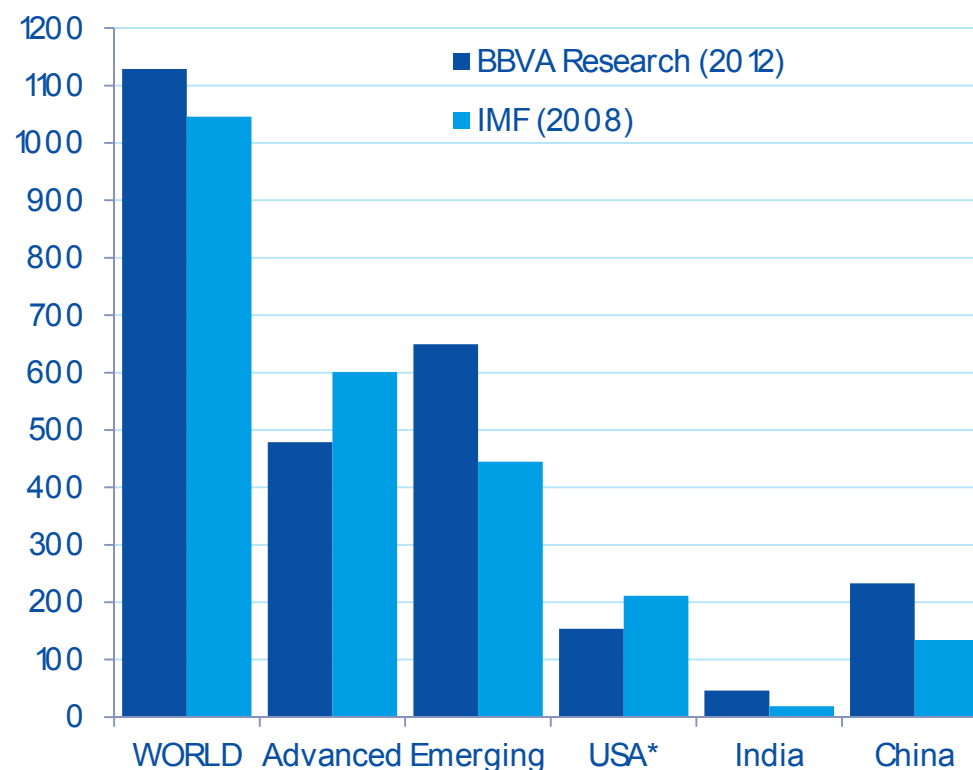
Growth of Car fleet (2010-2020)

(average % yoy)
Source: BBVA Research



Car fleet of largest markets in 2020

(Million cars)
Source: BBVA Research



*BBVA Research uses only passenger cars and not light trucks

Variables definition and source

Variable	Definition	Source
Car ownership	Passenger cars per 1,000 people	World Bank and UN
GDP per capita	Real GDP per capita in PPP-adjusted USD 2005 constant terms)	IMF and BBVA Research
Population density	Population per km ² of area	United Nations
Urbanization	Percentage of urban population	United Nations
Road density 1	Road kilometers per km ² of area	World Bank
Road density 2	Road kilometers per capita	World Bank
Private credit	Private credit to non-financial institutions to GDP ratio	World Bank, Haver and BBVA Research



Cross-country emerging markets analysis unit

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