

Optimal Spectrum Allocation

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Easy Overview

- mobile nets are immensely productive
 - no other wireless application close
 - opportunity cost of liberal licenses ~ \$0
- spectrum for liberal licenses highly valuable
 - more competition
 - more capacity (with or without extra nets)
- consumer gains swamp auction revenues
 - restricting spectrum a welfare loser
 - delays, reserve prices, bidder credits, etc.



Take the U.S. Example

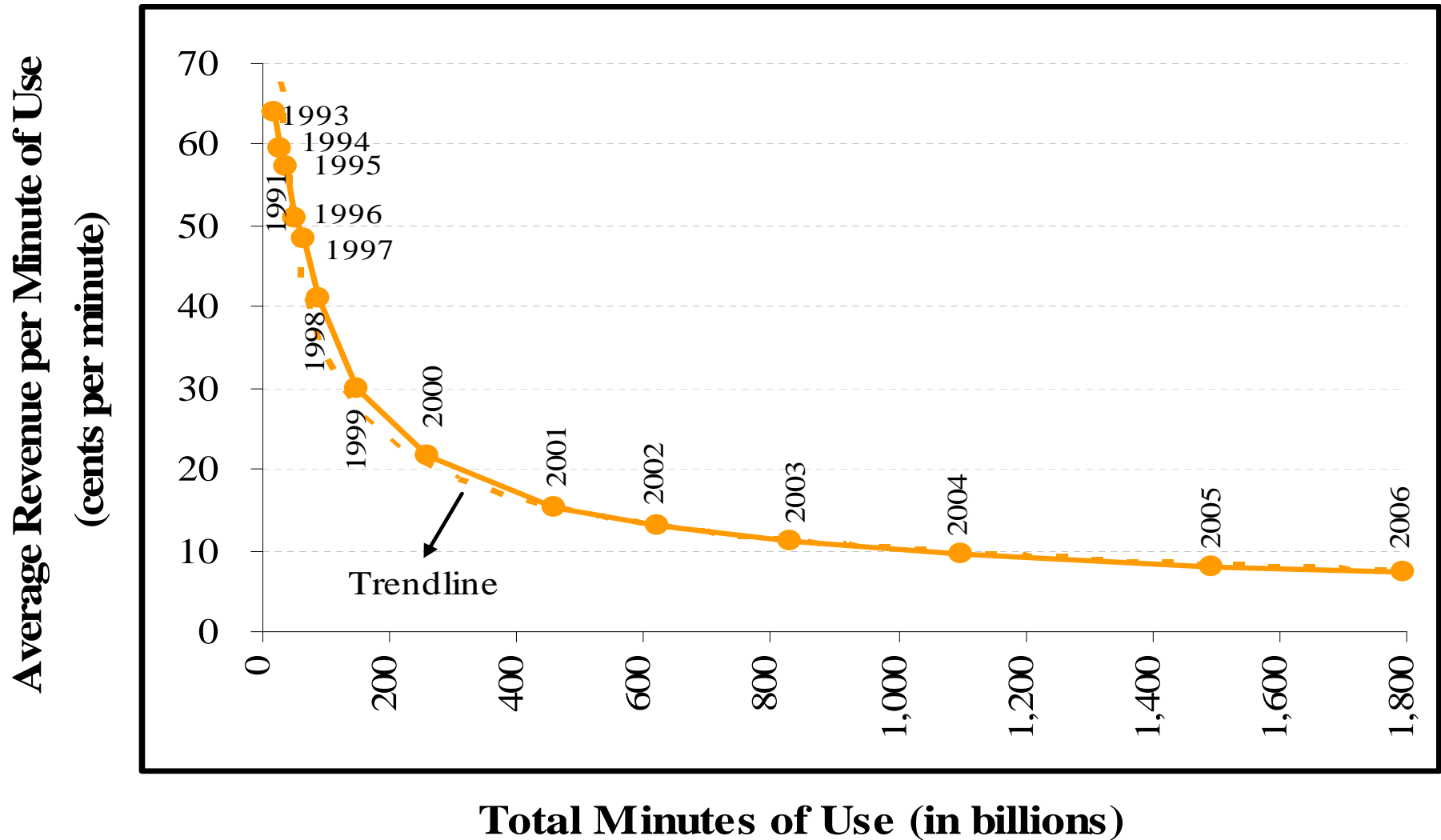
Total U.S.A. License Auction Revs

- authorized 1993, began July 1994
- 1994 – 2005: \$45.1 billion bid
- 1994 – 2005: only ~ \$20 billion paid
 - bidding credits → defaults (PCS C, F)
- Sept. 2006 (AWS): \$13.7 billion
- Mar. 2008 (700 MHz): \$19.4 billion
- ~ \$53 billion total, 1994-2008

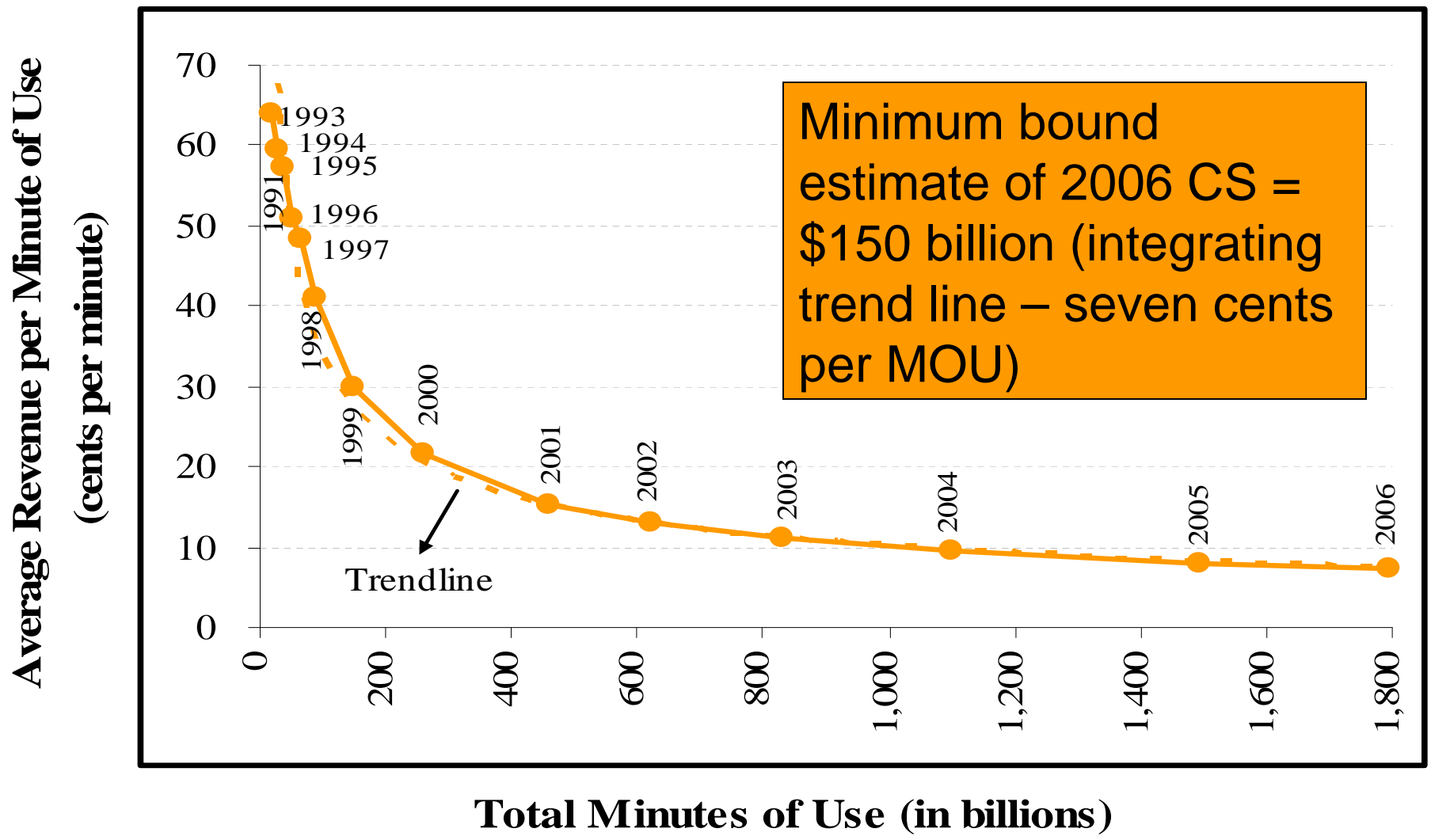
As of 2006, Value/MHz = \$150 mil.

- U.S. mobile market allocated ~ 190 MHz
- Imputed national value between
 - \$28.5 billion - AWS (\$13.7B/90MHz in 2006)
 - \$71.0 billion – 700 MHz (\$19.4B/52 MHz in 2008)
- Consumer surplus easily exceeds \$150 billion *annually* (see 2006 data)

Mobile Price Per Minute, Minutes of Use: U.S.A. 1991-2006



Consumer Surplus an Order of Magnitude (or two) Above License Values



No 'Tragedy' with Private Spectrum Rights

- liberally licensed spectrum (i.e., cellular) hosts vast, productive economic activity
- technology upgrades, new apps
- intense spectrum sharing
 - millions of subscribers, hundreds of apps
 - voice and data network overlays
 - third party network overlays
 - Blackberry (RIM), OnStar, iPhone, Android
 - MVNOs (Virgin Mobile, Tracfone)
 - investment in WWANs dominates wireless

Policy Impediments

- Liberal licenses controversial
- Rent seeking
 - some incumbents threatened
 - some interests pressure for political allocations
 - more bandwidth (via auctions or other methods) can reduce revenues via supply expansion
- Academic argument for case-by-case licensed
 - smart radios asserted to obviate band ownership
 - unlicensed bands assertedly more efficient
 - as asserted, these assertions are wrong

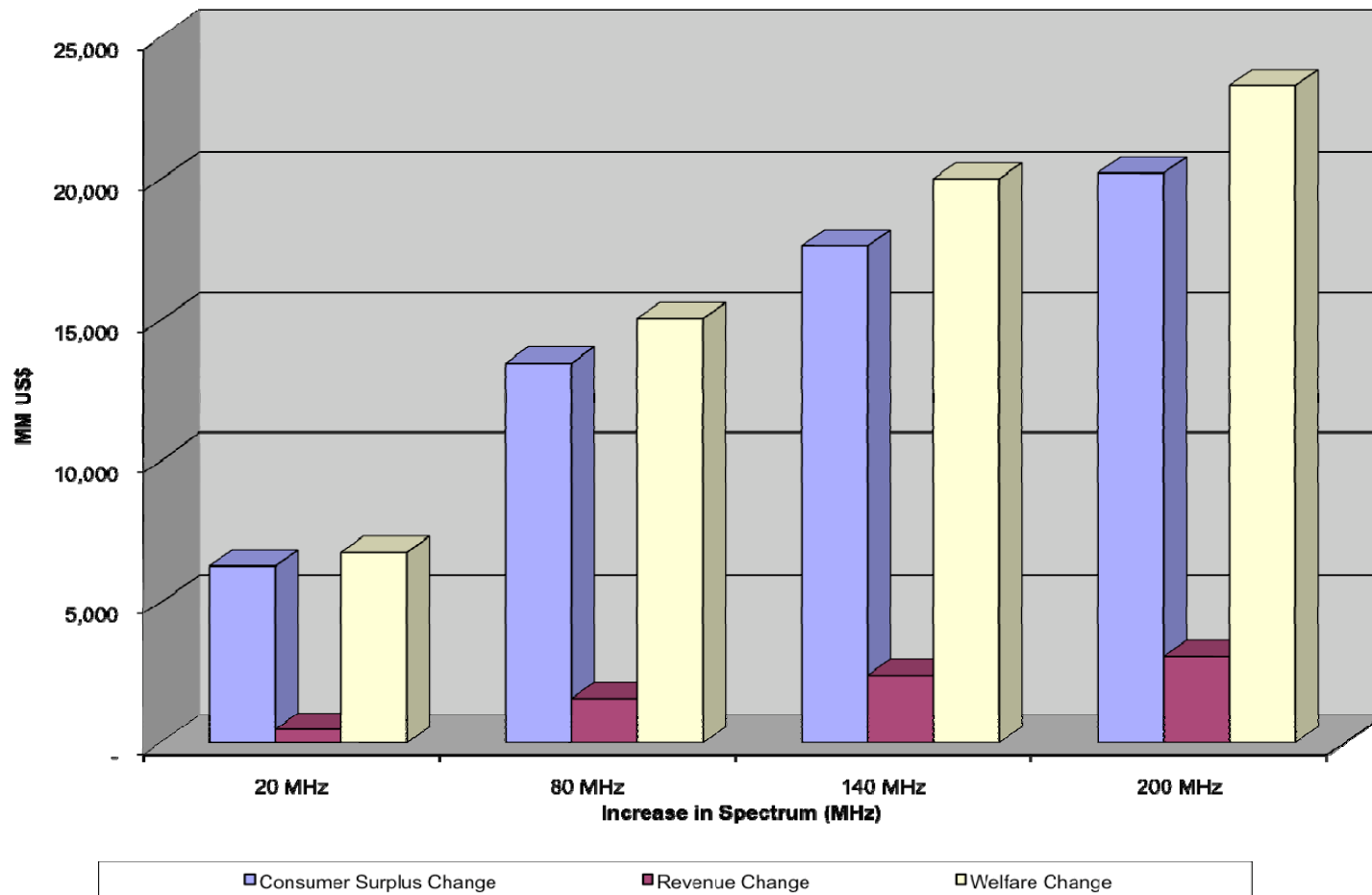
Social Value + Radio Spectrum

- Primary objective
 - distribute rights
 - increase wireless capacity, competition
- Ancillary objective
 - efficiently raise public funds
 - perhaps a 33% public finance bonus
 - raise \$1 billion, save society \$0.33 billion in tax-induced distortions

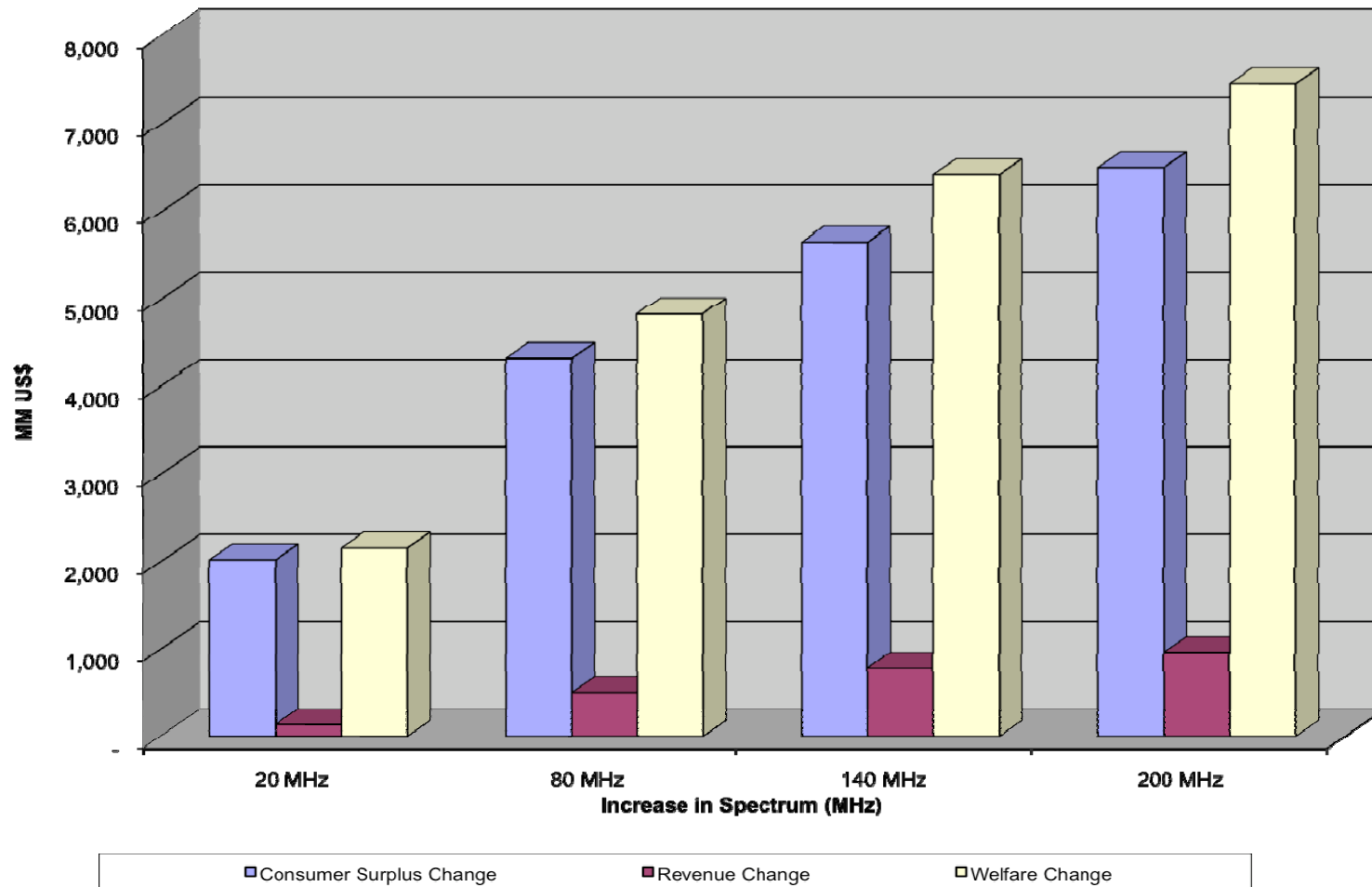
Caveat

- don't let ancillary trump primary
- benefits of more spectrum extremely large
- public finance dividend small potatoes

Hazlett-Munoz Estimates: extra MHz for Mexican Market



Hazlett-Munoz Estimates: extra MHz for Argentine Market





General Outcome

- across Latin America
- UK – delays in 3G
- USA – delays in 2G (PCS C)

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- UK – 140 MHz for 3G w/ \$35B license sale
- USA – delays in 2G (PCS C)
- Greece, Belgium 2001 3G
 - reserve prices blocked extra 35 MHz

U.S.A. '3G' Delays

- Good news: 1988 liberalization removes license restrictions (1G = 2G = 3G)
- Bad news: no new spectrum beyond PCS allocation (1989-1994)
- 2001: Bush Admin delayed new auctions
 - 'win win' situation
 - incumbents and govt. revenue authority
 - excluded U.S. consumers, American Economy

Lack of Spectrum Delayed 3G

- 6 U.S. national carriers in 2001-04
- Verizon invested in EV DO network
- Others spectrum constrained, frozen
- Cingular bought A&T (2004)
- Sprint bought Nextel (2005)
- Six goes to four
- T Mobile left without sufficient bandwidth

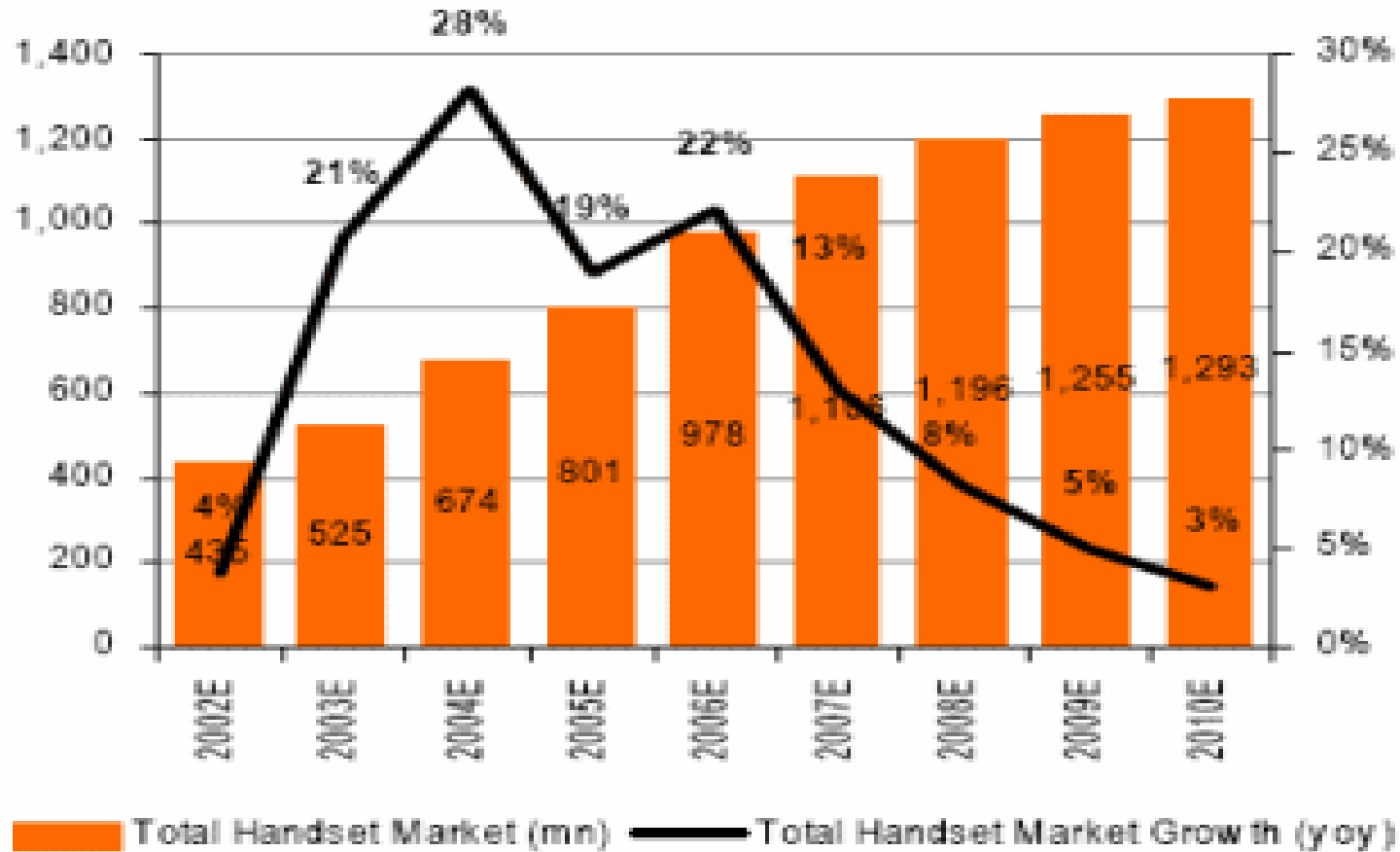
Wireless Broadband Networks

- Wireless broadband: from 0 to 35 million USA subscribers (June 2004 – June 2007)
- Lack of spectrum 'remedied' by mergers
 - 190 MHz much below EU average
- T-Mobile left out until AWS (90 MHz) 9.06
 - T-M largest winner - \$4.2B, immediately announced \$2.7B 3G network build-out
 - Google phone (Android) just debuted... on T-Mobile 3G network
 - Google paradox?

Asymmetric Triumphalism

- Wireless generally “disruptive”
 - Smart technologies in licensed and unlicensed
- Exclusive spectrum rights host intense ‘non-exclusive’ wireless use
 - Coordinated by delegating mgt. to market competitor, as opposed to regulation of radios
- Mobile networks far more deployed
 - 4 billion+ subscribers
 - 2005 global data, WWAN v. WLAN
 - \$200 bil. vs. \$3 bil
 - excludes service revenues

Merrill Lynch Global Handset Estimates



Date: Feb. 5, 2007 (<http://www.cellular-news.com/story/21779.php>)

Under Utilized ISM (unlic.) Bands?

Start Freq (MHZ)	Stop Freq (MHZ)	Bandwidth (MHz)	Allocation	Average Occupancy
2500	2686	186	ITFS, MMDS	0.1043
2390	2500	110	U-PCS, ISM (Unlicensed)	0.1449
2300	2360	60	Amateur, WCS, DARS	0.2038
470	512	42	TV 14-20	0.2107
902	928	26	Unlicensed	0.2287
928	960	32	Paging, SMS, Fixed, BX Aux, and FMS	0.2401
1850	1990	140	PCS, Asyn, Iso	0.3376
806	902	96	Cell phone and SMR	0.4632

Source: McHenry & McCloskey (2004, p. 95)

Unlicensed regime – state allocation – is inefficient

- state determines sharing rules
- decides case by case → regulatory hold up
- 'unlicensed' apps do not need unlicensed bands
 - private property offers extreme flexibility

Liberalization

- Liberal License regime
- More spectrum
- Competition policy backstop
- Overlay rights to reallocate encumbered bands
 - Grandfather existing rights holders
 - Supply adjudicatory institutions – or not
- Via auction or other assignment
- Transparent purchase → public “commons”



THANK YOU.
