

## Time to live the 'cool' life?

White goods are highly income-elastic given discretionary nature and large ticket size (Rs10-40k). AC penetration in India (11% CY21; close to 8% for cars) has suffered due to income effect and lower urbanization. Ref/WM penetration (38%/18% CY21) is also sub-par compared to other developing markets. Our cross-country study, with emphasis on China, goes beyond income growth to assess other factors (role of women, quality of electricity) that affect consumer choices. We build income-dependent penetration models for AC/ref/WM and posit that AC offers most sustainable growth runway (mid-teen vol. CAGR, FY21-36) due to rising income, urbanization and multiple units per household. Refrigerator/WM would dip below 10% volume CAGR post FY31, albeit with upside from premiumization. Amber is well-placed to capitalize on this trend. We remain cautious on Voltas owing to higher competition.

### Income-dependent penetration rates have country-specific variations

Income growth, highly correlated to urbanization rate, is the key explanatory variable for white goods penetration. Consumer electronics like TV/mobile phones have lower income-elasticity (i.e. consumers more likely to purchase for similar growth in income) compared to white goods such as ref/WM/AC. India is an outlier compared to other developing markets (South Africa/Brazi/Indonesia); it exhibits income elasticity for refrigerators/WMs. We posit this is due to lower urbanization and greater regional heterogeneity.

### China: Manufacturing flywheel led to income growth and penetration

Focus on manufacturing competitiveness (based on labour arbitrage) led to technology transfer and development of home-grown Chinese companies (Haier/Midea/Gree). Presence of large domestic market led to consumer-focused innovation catering to Chinese tastes. Flywheel effect led to income growth and manufacturing scale (development of vendor base/ supply chain) setting stage for export oriented policy as 'factory of the world'. Similar opportunity exists for India by coupling top-down investment (PLI schemes) with domestic innovation.

### Culture, role of women and access to electricity alter pecking order

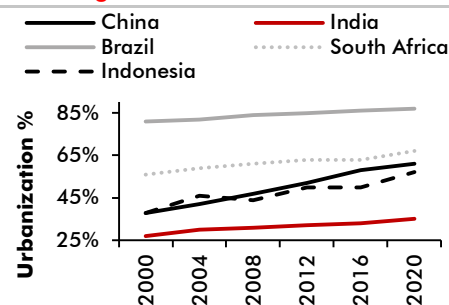
Consumer electronics (TV/mobiles) trump white goods (ref/WM/AC) in order of preference due to higher perceived utility (from infotainment value and shorter consumer-focused innovation cycle). Whilst AC is most susceptible to income effect (high upfront/recurring costs), pecking order between ref/WM is dependent on role of women (for WM), food preferences and 24x7 electricity (for ref). Whilst some factors are infra-dependent (electricity), consumer choice is an important consideration for local innovation and penetration.

### India: AC most attractive category; ref/WM are premiumization plays

Our estimates suggest 38%/18%/11% penetration for ref/WM/AC (CY21). Sustainable growth for AC (mid-teen CAGR over FY21-31E) is based on increasing slope of penetration S-curve (income effect assuming 5.5% GDP CAGR over next two decades). Additionally, scope of multiple units per household (at higher income-levels) suggests more robust long-term outlook for AC compared to ref/WM (single purchases). We expect ref/WM CAGR to dip sub-10% CAGR post FY31, albeit with upward revisions based on premiumization to frost-free refrigerators and automatic WMs.

**Note - We use abbreviations for durables as follows: television (TV), refrigerator (Ref), washing machine (WM) and air-conditioner (AC) throughout this report.**

### India lags in terms of urbanization



Source: Ambit Capital research, [globaldatalab.org](http://globaldatalab.org), [data.worldbank.org](http://data.worldbank.org)

### Pecking order for Indian consumer: TV > Ref > WM ~ AC

	Cost	Utility	Units per household	Pecking order
TV	●	●	●	●
Ref	●	●	●	●
WM	●	●	●	●
AC	●	●	●	●

Source: Ambit Capital research. Note: ● - Strong; ● - Relatively strong; ● - Average; ● - Relatively weak

### AC penetration in India has suffered so far due to income effect

Period ending	GDP per capita	Penetration		
		Ref	WM	AC
2006	18	16	4	1
2011	25	23	7	2
2016	36	29	15	10
2021	46	38	18	11

Source: Ambit Capital research, [NFHS\\_IHDS\\_Lokniti\\_data.worldbank.org](http://NFHS_IHDS_Lokniti_data.worldbank.org). Notes: <sup>1</sup>GDP per capita in Rs. '000s - at constant 1999 prices

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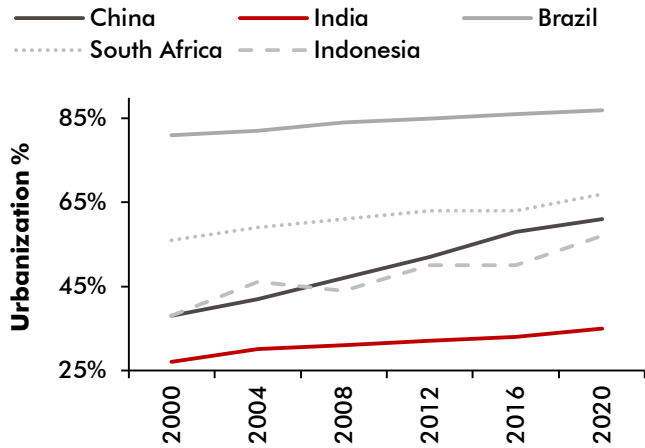
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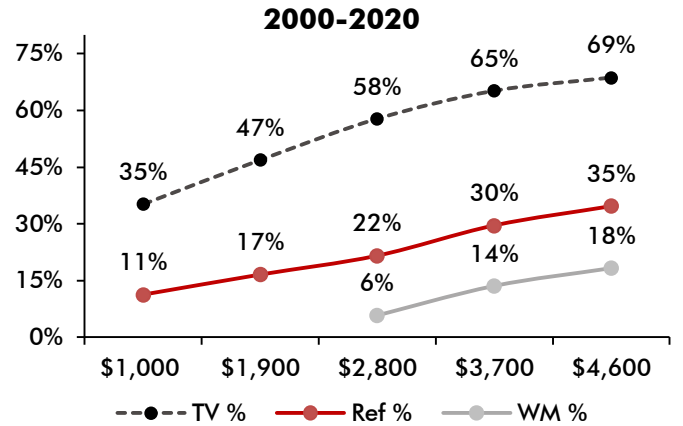
# The Narrative in charts

**Exhibit 1: India lags other developing countries in terms of urbanization...**



Source: Ambit Capital research, [globaldatalab.org](http://globaldatalab.org), [data.worldbank.org](http://data.worldbank.org)

**Exhibit 2: ...resulting in flatter penetration S-curves; in the pecking order, TV trumps other white goods (ref/WM)**



Source: : Ambit Capital research, [globaldatalab.org](http://globaldatalab.org), [data.worldbank.org](http://data.worldbank.org). X-axis is household income PPP basis current US\$; penetration rates are at overall level

**Exhibit 3: India is at least 15-20 years behind China in terms of white goods penetration...**

Year	Refrigerator		Washer		AC		TV	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
1990	42%	1%	78%	9%	NA	NA	70%	NA
1995	66%	5%	89%	17%	10%	NA	90%	70%
2000	80%	12%	91%	29%	25%	2%	110%	100%
2005	91%	20%	96%	33%	75%	10%	130%	130%
2010	97%	45%	97%	57%	105%	16%	135%	135%
2015	94%	83%	96%	79%	102%	39%	120%	130%
2020	103%	100%	97%	93%	150%	74%	122%	135%
2021 (India)	64%	25%	36%	9%	40%*	16%*	87%	58%

Source: Ambit Capital research, [ceicdata.com](http://ceicdata.com). Note: Figures show penetration rates. Data for India is taken from NFHS 5. \*AC penetration at urban/rural level for India is not available, table shows for AC/cooler combined penetration

**Exhibit 4: ...and India cannot replicate Chinese success without moving from low-income to middle-income status**

% of population	China			India			Change	
	2001	2011	2021	2001	2011	2021	China	India
Poor	41%	12%	0%	35%	20%	10%	-40%	-26%
Low income	57%	66%	46%	63%	77%	84%	-11%	21%
Middle income	3%	18%	35%	1%	3%	5%	33%	3%
Upper-middle income	0%	4%	17%	0%	1%	1%	17%	1%
High income	0%	1%	2%	0%	0%	0%	2%	0%

Source: Ambit Capital research, [Pew Research Center](http://Pew Research Center). Note: Daily income for different categories: poor <\$2, low income \$2-\$10, middle income \$10-20, upper middle \$20-50, high income >\$50. Figures expressed in 2011 PPP terms. Data for 2021 is assumed as per post-pandemic data using World Bank's PovcalNet database.

**Exhibit 5: Order of preference for household appliances in India - TV>ref>WM~AC**

Category	Consumer choice				Category attractiveness			Overall ranking	Comments
	Product price	Recurring costs	Dependence on power	Perceived utility	Replacement cycle	Multiple units per household	Availability of alternatives		
TV	●	●	●	●	●	●	●	●	Highest perceived utility; consumers keen to purchase despite significant cost as % of household income; with higher income scope for multiple purchases as well as premiumization
Ref	●	●	●	●	●	●	●	●	Second in pecking order; quality of electricity supply is a key variable
WM	●	●	●	●	●	●	●	●	Whilst WM relatively cheap, especially in entry category, it has much lower perceived utility due to alternatives (household help). Similar to Ref there is usually just one unit per household.
WC	●	●	●	●	●	●	●	●	Highly income elastic category with threshold due to significantly higher product and recurring costs; beyond larger income threshold multiple units per household presents significant long term opportunity.

Source: Ambit Capital research. Note: ● - Strong; ● - Relatively strong; ● - Average; ● - Relatively weak

# Cross-country comparison: role of income, urbanization and society

Lower urbanization and per-capita income in India imply lower penetration of white goods (38%/18%/11% for ref/WM/AC in CY21) compared to other developing markets. Whilst pecking order across electronics and other durables is largely similar (TV>ref>WM), income elasticity is highest in India. We deep-dive into Chinese success w.r.t. white goods manufacturing to understand both macro policy as well as consumer choice theory. Our analysis indicates penetration is an outcome of top-down approach as well as income flywheel effect that comes from labour participation in manufacturing. Developing global manufacturing competency in India would require i) technology transfer through FDI investment, ii) development of component ecosystem and supply chain and iii) country-specific innovation to cater to cultural preferences.

## Cross-country study reveals role of consumer choice

### Urbanization and income growth are key variables for penetration rates

As shown in exhibit 6, India lags significantly behind other developing markets in terms of urbanization – both in terms of absolute number as well as change over the last three decades. Some second order effects of urbanization are a) nuclearization of families (higher in urban vs rural areas) and b) quality of electricity supply (better in urban areas). We believe whilst the former improves scope for absolute stock of appliances in the long run, the latter promotes penetration. For example, consider that refrigerator is unlikely to be purchased if electricity supply is uneven – it’s no good for a household to be electrified if it does not receive continuous and predictable supply of electricity (>20 hours) to keep preserve food through refrigeration. We delve into these appliance specific offtake factors later in the note.

*India lags significantly behind other developing markets in terms of urbanization*

*In terms of change in urbanization and per capita GDP, it is interesting to note that China has achieved aggregate of India’s and Indonesia’s change over last 3 decades (exhibit 6)*

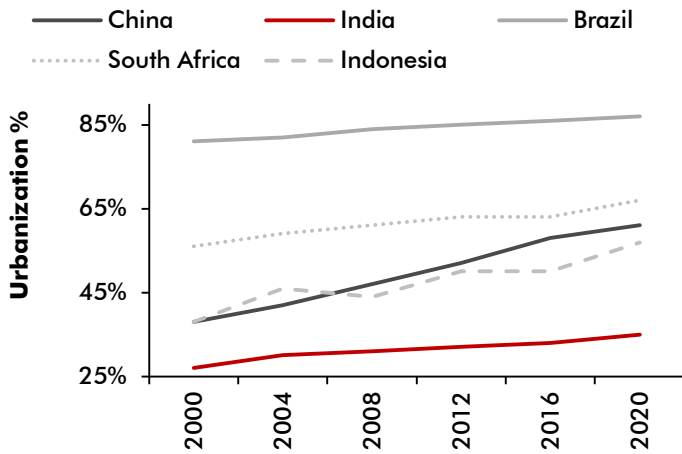
**Exhibit 6: Increase in disposable incomes is closely linked to urbanization**

	Urbanization %			GDP/capita (PPP - current US\$)		
	1990	2020	Change	1990	2020	Multiple
South Africa	52	67	15	7.1	13.4	1.9
World	43	56	13	5.6	17.2	3.1
Brazil	74	87	13	6.7	14.8	2.2
Korea, Rep.	74	81	8	8.4	45.2	5.4
<b>India</b>	<b>26</b>	<b>35</b>	<b>9</b>	<b>1.2</b>	<b>6.5</b>	<b>5.4</b>
Indonesia	31	57	26	3.1	12.1	3.9
China	26	61	35	1.0	17.2	17.5

Source: Ambit Capital research, World Bank

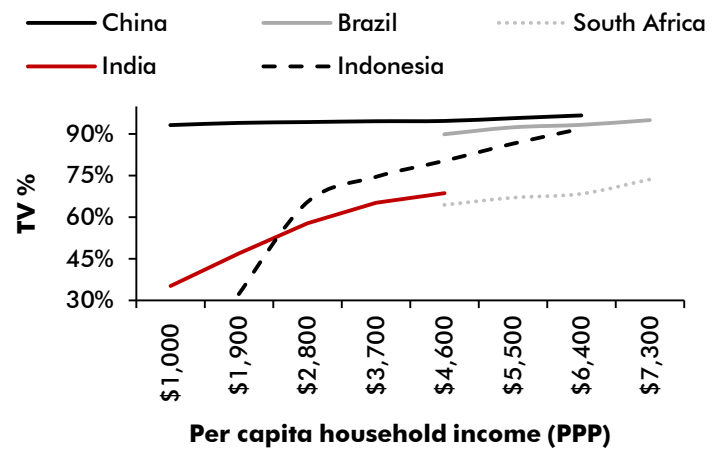
Additionally, since urban areas are primary centres for economic activity, average income levels are higher vs rural areas. Across all countries, urban areas have much higher rates of penetration of appliances. Causal effect of income on penetration rates is well documented and is borne out in all data. For forecasting of penetration in India, we use income (using per capita GDP as proxy) as key dependent variable.

**Exhibit 7: India lags other developing countries in terms of urbanization**



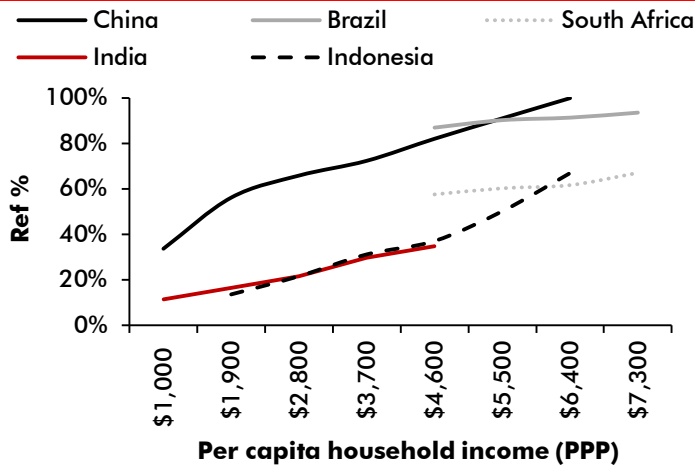
Source: Ambit Capital research, [globaldatalab.org](http://globaldatalab.org), [data.worldbank.org](http://data.worldbank.org)

**Exhibit 8: Sharper penetration curves for TV indicate role of perceived utility in consumer preferences**



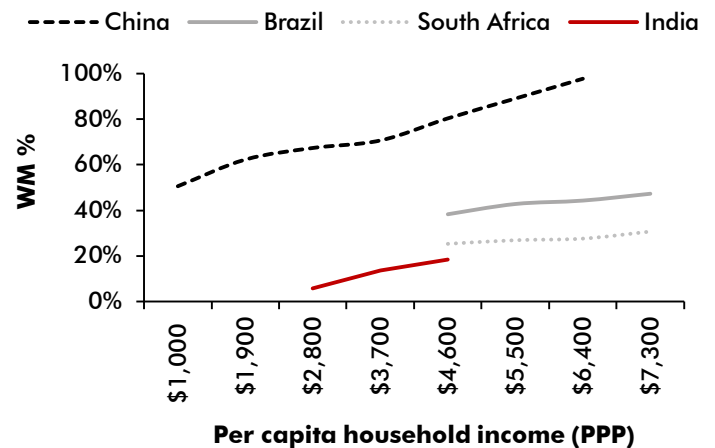
Source: Ambit Capital research, [globaldatalab.org](http://globaldatalab.org), [data.worldbank.org](http://data.worldbank.org). Note: This covers period 2000-2020. Household income is on PPP basis current US\$

**Exhibit 9: In terms of refrigerator penetration, India is closely tracking Indonesia**



Source: Ambit Capital research, [globaldatalab.org](http://globaldatalab.org), [data.worldbank.org](http://data.worldbank.org). Note: This covers period 2000-2020. Household income is on PPP basis current US\$

**Exhibit 10: Availability of cheap domestic help explains much lower WM penetration in India**



Source: Ambit Capital research, [globaldatalab.org](http://globaldatalab.org), [data.worldbank.org](http://data.worldbank.org). Note: This covers period 2000-2020. Household income is on PPP basis current US\$

Exhibits 8-10 show country-wide penetration rates for a few developing countries. Some common inferences that can be drawn from these are:

- As expected, penetration across categories increases with per capita household income. In order to diminish time-variant effects we have used income in PPP terms.
- S-shaped penetration curves are more sharply defined for some categories vs others. Although our note does not focus on forecasting penetration of consumer electronics (TV, mobile phones, etc.), we note how for similar income levels, penetration of TV is much higher than that of Ref. This explains role of consumer choice whereby perceived consumer utility plays a more important role than intrinsic utility of household appliances based on Maslow's hierarchy of needs. Similar trend is borne out in case of smartphones; e.g. in India smartphone penetration is already >40%, highest amongst all household appliance and consumer electronics categories after TV.
- Whilst income plays a key role in penetration, S-curves vary by country, implying other contributing factors, both macro specific (urbanization) as well as based on cultural preferences. Consider for example that penetration of WM in China is much higher than India at all levels of household income.

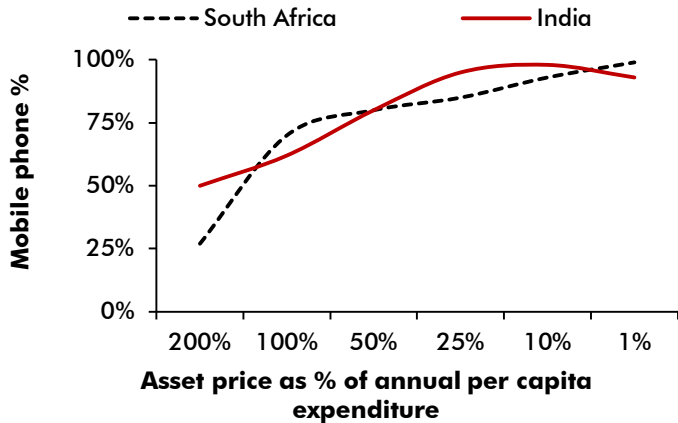
*For similar income levels, penetration of TV is much higher than that of refrigerators*

*Perceived consumer utility plays a more important role than intrinsic utility of household appliances*

*Penetration of WM in China is much higher than India at all levels of household income*

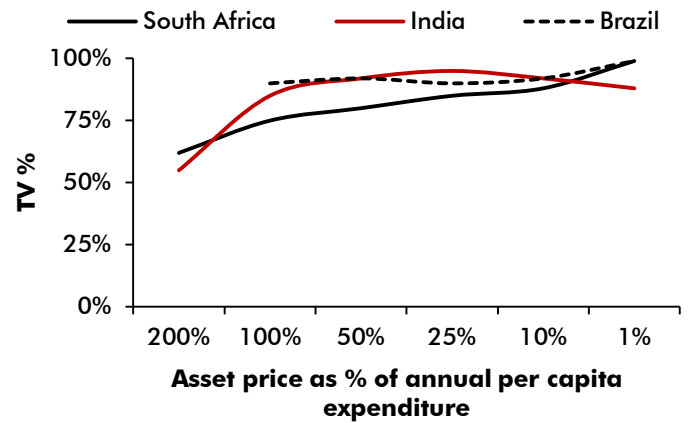
**India: outlier amongst developing countries w.r.t. to Ref/WM penetration**

**Exhibit 11: Mobile phone penetration is income inelastic...**



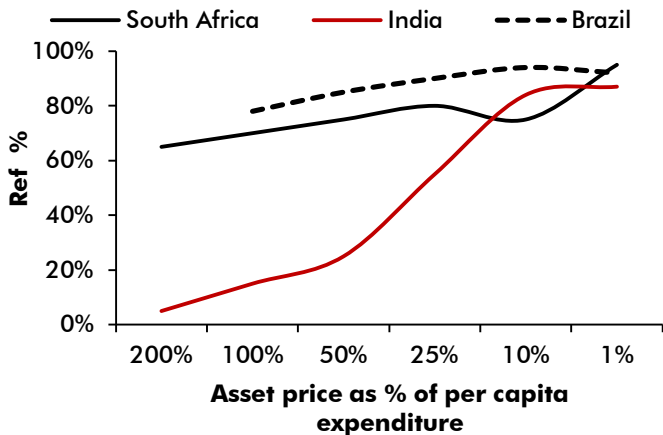
Source: Ambit Capital research, [Rao and Ummel \(2017\)](#) Note: Data from household surveys in period of 2008-11 in countries considered. Chart is representative only; actual values may differ. Prices in 2010 US\$ PPP basis.

**Exhibit 12: ...and similarly infotainment drives perceived utility and penetration of TV**



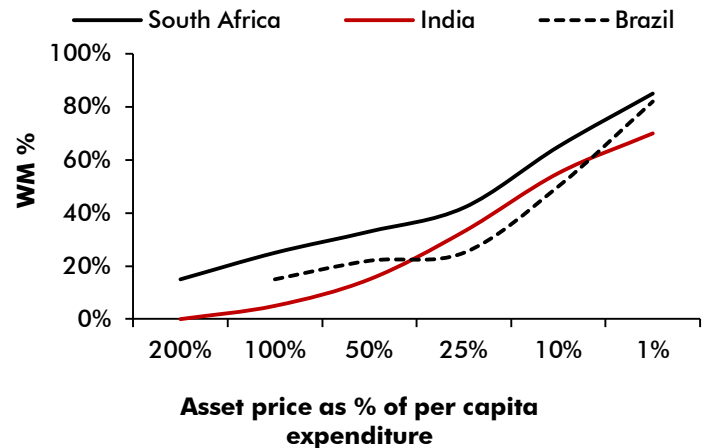
Source: Ambit Capital research, [Rao and Ummel \(2017\)](#) Note: Data from household surveys in period of 2008-11 in countries considered. Chart is representative only; actual values may differ. Prices in 2010 US\$ PPP basis.

**Exhibit 13: India stands out amongst developing markets and shows income elasticity w.r.t. to refrigerator penetration...**



Source: Ambit Capital research, [Rao and Ummel \(2017\)](#) Note: Data from household surveys in period of 2008-11 in countries considered. Chart is representative only; actual values may differ. Prices in 2010 US\$ PPP basis.

**Exhibit 14: ...whilst WM penetration is income elastic across all countries**



Source: Ambit Capital research, [Rao and Ummel \(2017\)](#) Note: Data from household surveys in period of 2008-11 in countries considered. Chart is representative only; actual values may differ. Prices in 2010 US\$ PPP basis.

Exhibits 11-14 reflect penetration (around year 2010) against asset price of % of household income in Brazil, South Africa and India - [Rao and Ummel \(2017\)](#). The following key messages can be gleaned from the paper:

- **Income elasticity across consumer durables:**
  - a. Penetration generally increases with income levels. However between countries penetration varies for same income levels implying country-specific factors matter.
  - b. Refrigerators are income inelastic in most countries, but India is an outlier in this regard (exhibit 13).
  - c. WM are income elastic compared to all other categories (exhibit 14).
  - d. As per authors, according to the logit model, for an increase in annual income of PPP (year 2010) US\$1000 per capita in India, the odds of owning a television increase by 52% and that of owning a refrigerator increase 30%, and that of owning a washing machine increase by about 18%.

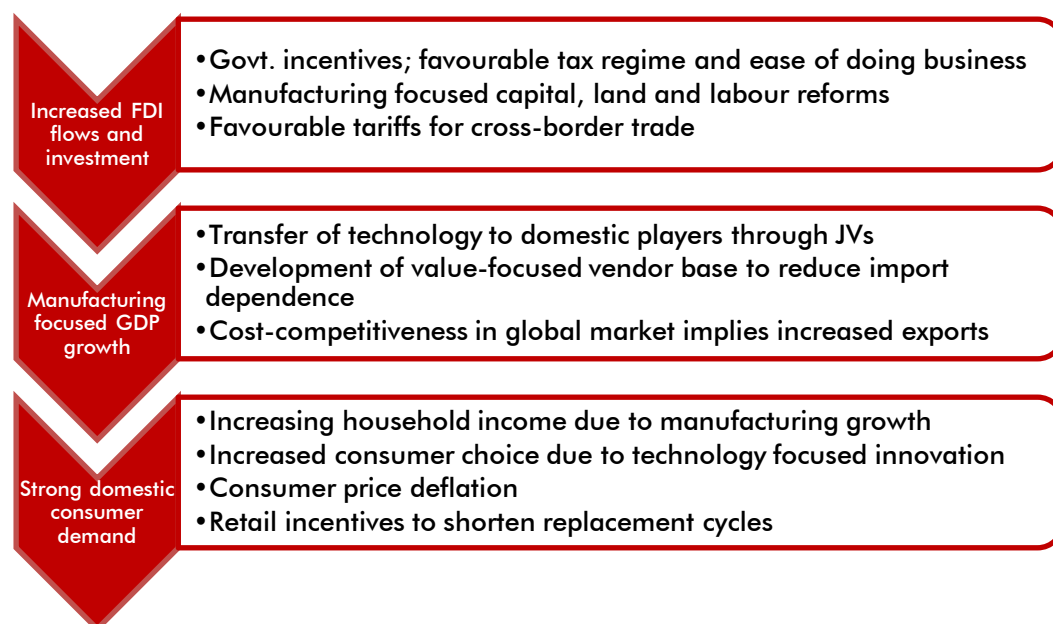
- **Order of preference between different durables:**
  - a. Many households are willing to pay prices for appliances that exceed their per capita annual expenditure. This is particularly true for TVs, followed by mobile phones.
  - b. In Brazil and South Africa, TV and refrigerators have similar penetration curves, but in India the order of preference is strictly with TV having much higher preference over refrigerators.
  - c. Penetration levels are lower for washing machines at all affordability levels in all three regions. Note that this is despite the fact that washing machines are cheaper than televisions in all cases, and by far in India.
- **Other factors that explain penetration:**
  - a. Effect of dwelling quality also explains differing penetrations. E.g. for TV, since it is not required to be used 24x7, constant electric supply is not mandatory. Thus the effect of reliable electricity supply is small.
  - b. In comparison, only at average availability higher than 18 hours per day does it make sense to have a ref, since anything less than that does not serve purpose of food preservation in hot weather.

*It seems that in all regions appliances attain full saturation when appliance costs are close to 1 % of per capita expenditure*

## China: Penetration due to manufacturing-led flywheel

In order to ascertain India’s growth path, comparison is often made with China, especially in manufacturing. China rose to world dominance (in economic terms) by becoming the ‘factory of the world’. In terms of factors of production, competitive advantage with respect to lower labour costs resulted in shifting global manufacturing to China. Whilst similar argument with respect to India holds true, there is a need to look beyond government-sponsored schemes such as PLI (that incentivize manufacturing). In this section, we attempt to understand how consumer durables industry grew in China as also note the idiosyncratic nature of the Chinese consumer that was at the heart of demand dynamics prior to export-oriented policies post the 90s. We hope the similarities and differences would help gain an understanding on how to better view India’s own consumer durable industry.

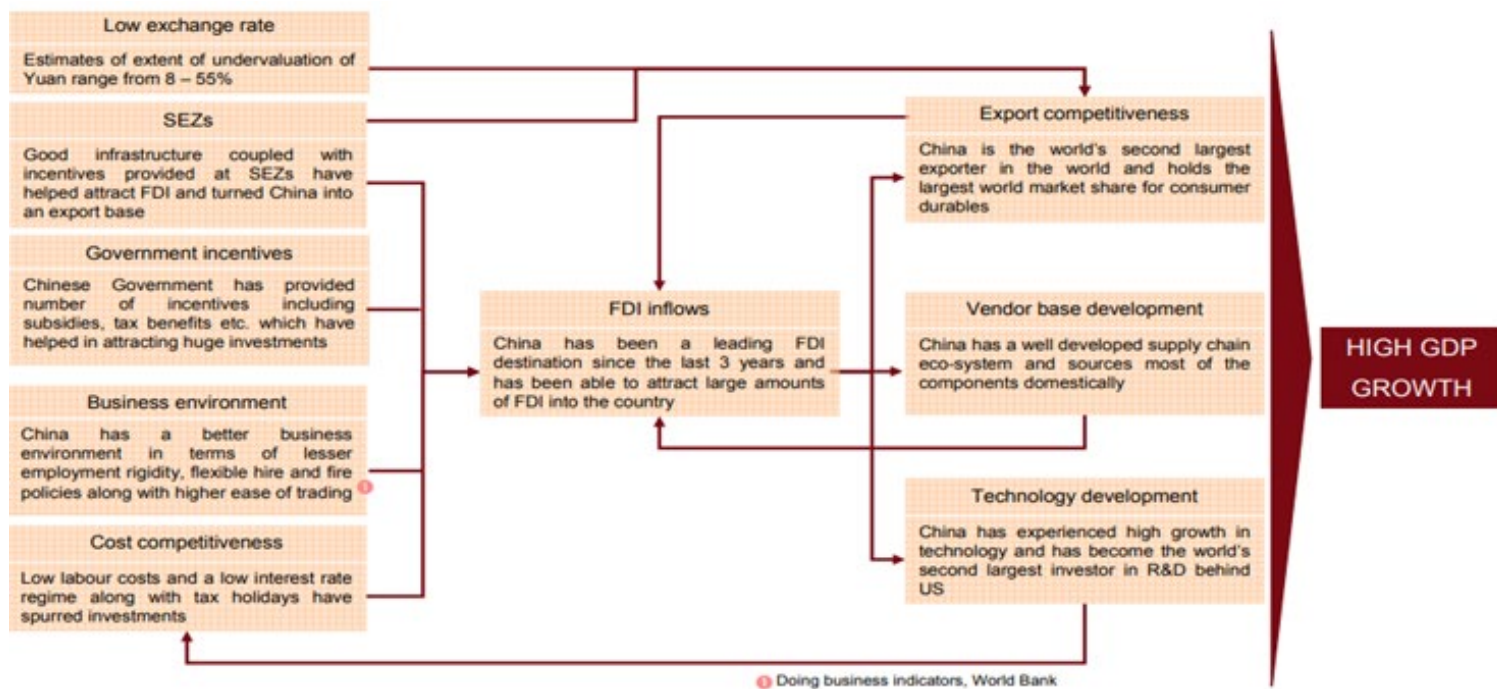
### Exhibit 15: Top-down approach to development of industry with focus on manufacturing led to Chinese growth over post 1980



Source: Ambit Capital research

## FDI fueled growth led to development of domestic manufacturing in China

### Exhibit 16: FDI flows and enabling business environment led to transfer of technology, development of vendor base and export competitiveness



Source: Ambit Capital research, [2009 FICCI India China Consumer Durable](#)

Whilst China grew at ~10% CAGR over last 30 years, India grew at ~6% CAGR. In the 1980s, countries were similar in size, but by 2016 China accounted for ~17% of world economy (against ~7% for India). GDP per capita (PPP – current US\$) in India became ~5x over 1990-2020 vs ~18x for China over same period.

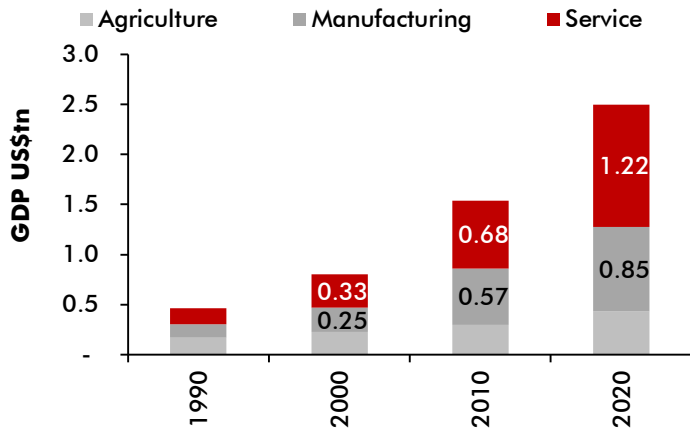
Reasons for Chinese outperformance in 1980s to late 1990s were: a) reform of state-owned enterprises (SOEs), (b) policy to permit the development of private enterprises and (c) policy of attracting foreign capital. In 2001, China entered the World Trade Organization, which helped the country become more outward looking to increase its exports and become the world's factory.

- **Investment in manufacturing led GDP growth:** During the 1980s and 1990s, China's investment as a percentage of GDP stood at 37% compared with India's 22%. China focused greatly on infrastructure to enable labour-intensive manufacturing. Whilst India made progress in some industries such as automotive, pharmaceuticals and IT, its manufacturing growth was not very broad-based. As of 2015, ~1/2 of Indian population worked in agriculture (vs ~1/3 for China) and 20% in manufacturing (vs 30% for China). This key difference in value adding labour output over a large period of time explains the difference in outcomes.
- **Foreign direct investment and technology transfer:** For over four decades, Chinese policies have been oriented to attract foreign capital. Chinese government focused on creation of special economic zones and reduced tariffs/ taxes. Along with capital, Chinese companies have gained technical know-how, much greater than in India. Their ability to look outwards and spur exports based on labour-cost advantage played greatly to their advantage and by 2015, China accounted for 13% of total exports vs ~2% for India.

*China focused on manufacturing focused GDP growth in early part of its rise to economic power*

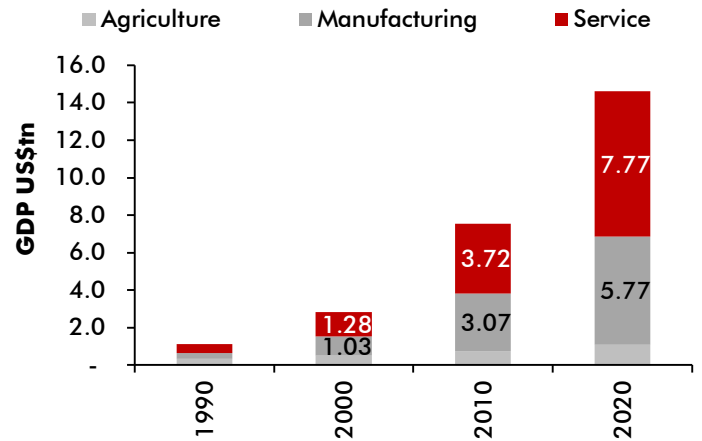
*Technology transfer in the long run plays a crucial role towards manufacturing competitiveness.*

**Exhibit 17: India's manufacturing growth has not been broad-based and agricultural dependence is higher...**



Source: Ambit Capital research, [data.worldbank.org](http://data.worldbank.org). Note: <sup>1</sup>Data is based on 2015 constant prices; <sup>2</sup>Manufacturing also includes construction

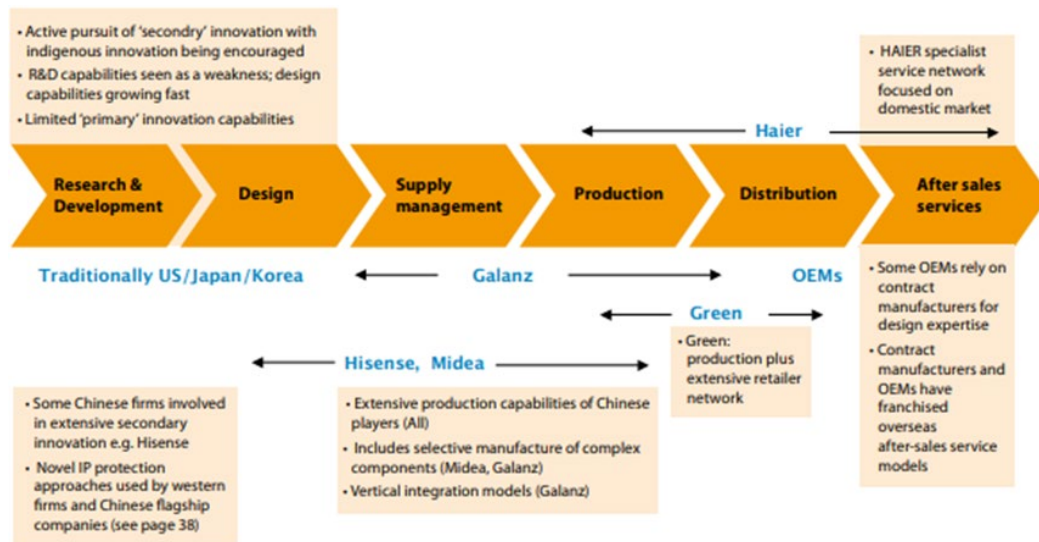
**Exhibit 18: ...than China that focused on domestic manufacturing until 90s and then looked outwards post that**



Source: Ambit Capital research, [data.worldbank.org](http://data.worldbank.org). Note: <sup>1</sup>Data is based on 2015 constant prices; <sup>2</sup>Manufacturing also includes construction

**Home-grown companies: domestic growth -> exports -> global brands**

**Exhibit 19: Whilst Chinese companies lacked in primary innovation, they focused on downstream activities to capture the mindset of domestic consumer**



Source: Ambit Capital research, 2008 IfM Report on 'Understanding China's manufacturing value chain'

**Tapping 'desi' before going global**

With market reforms in the early 1980s, the white goods industry in China was one of the first to be allowed to attract foreign capital. Administrative control was reduced and companies were given independence to develop. Starting from a very low base with massive under-penetration, domestic consumption grew very well in the 1980s (number of refrigerators produced increased 0.19 to 6.7mn units over 1983-89). In the 1980s, the predecessor company of Haier Group was a collective with workforce of less than 800 workers. By 2002, it had transformed into a behemoth with over 30k employees and a large market share in China and the world (30% of sales from exports). This transformation (Haier is a posterchild for the industry but other companies include Midea, Gree etc.) can be broken into two periods – domestic expansion (until early the 1990s) and international expansion (first through exports and then global brand building). Undoubtedly exposure to market forces contributed to entrepreneurial spirit that leveraged low labour costs in China to manufacture domestically and then for the world. Along with cost advantage, Chinese companies focused on innovation and technology

*Championing secondary innovation first to cater to domestic market before looking outward explains supply-side dominance of majors like Haier, Midea and Gree*



transfer in the first phase. Whilst primary innovation was slow to develop (exhibit 19), Chinese companies championed secondary innovation focused more on design elements to build appliances that catered to the needs/culture of the domestic market. This helped them also gain traction whilst inability of Western companies to innovate to local tastes implied that their market share never expanded to command leading positions. Also, with growth of Chinese white goods behemoths, vendor development occurred side by side which would also pave way for China's development as the world's factory in the second phase of growth. After the mid-1990s, with production outstripping domestic demand (penetration >80% in all categories in urban China), Chinese companies focused on exports. Seeing the potential to leverage lower labour costs, many Western brands tied up with Chinese manufacturers for production (ODM/OEM). Exhibit 20 shows how this led to explosion in exports across categories over 1995-2002.

Lower labour costs and operational efficiencies from scale (both assembly and vendor ecosystem) led to overall cost competitiveness.

**Exhibit 20: Chinese companies looked outside for growth post mid 90s (table shows annual exports)**

Year	Refrigerator	Washing machine	Microwave oven
1995	650	500	1,144
1996	720	560	1,496
1997	1,230	710	2,073
1998	1,280	530	3,244
1999	2,293	654	5,819
2000	3,546	1,008	8,368
2001	4,531	1,615	12,526
2002	6,103	2,267	20,345

Source: Ambit Capital research, 2005 book 'Labour in a Global World by Theo Nichols and Surhan Cam'. Note: table shows annual Chinese exports by category in '000 units

**Exhibit 21: By 2009, China had become the world's factory for household appliances**

Product category	Global share
Air conditioner	72%
Refrigerator	47%
TV	45%
Washing machine	35%
Smartphone	52%

Source: Ambit Capital research

Lower labour costs and operational efficiencies from scale (both assembly and vendor ecosystem) led to overall cost competitiveness. By 2009, China accounted for 72%/47%/45%/35%/52% global AC/Ref/TV/WM/smartphone production (exhibit 21). As Chinese companies matured, they shifted to OBM, with their own brand development and sales network in countries outside China. For differences in these manufacturing/design constructs, refer to our initiating coverage on [Amber Enterprises \(August 2020\)](#). As of FY21, Chinese companies have significant part of their revenue for sales outside China (Haier 51%, Midea 42%; Gree 15%) and have thus transformed themselves into global giants.

To develop global brands, companies need to excel in every phase of their development: OEM -> ODM -> OBM

**Flywheel effect led to income growth and strong rural consumer demand**

In addition to contribution to the Chinese economy as a whole, development of the white goods industry also provided basis for regional economic and social development. Moreover, since manufacturing is labour-intensive, growth of China's home appliance industry created a large number of jobs, especially for people from rural areas and less educated workers. Thus, growth of export-oriented companies also promoted reduction in poverty (Exhibit 22). Whilst China moved into the middle income category, India has been stuck in low income over the last two decades.

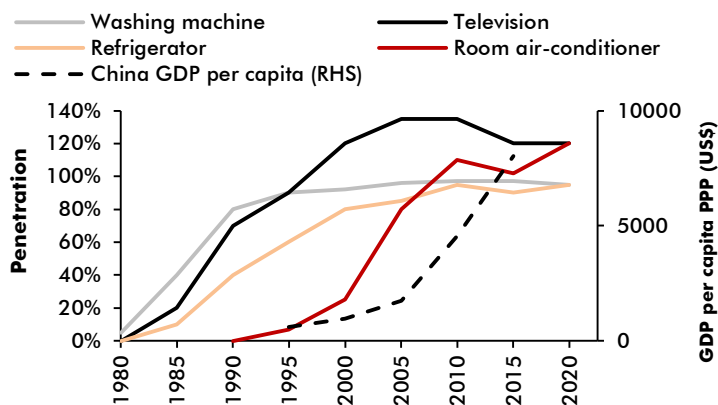
**Exhibit 22: Manufacturing-led GDP growth led to rising rural income and consumption in China; India stuck as a low-income economy for over two decades**

	China			India			Delta (2001-21)	
	2001	2011	2021	2001	2011	2021	China	India
Poor	41%	12%	0%	35%	20%	10%	-40%	-26%
Low income	57%	66%	46%	63%	77%	84%	-11%	21%
Middle income	3%	18%	35%	1%	3%	5%	33%	3%
Upper-middle income	0%	4%	17%	0%	1%	1%	17%	1%
High income	0%	1%	2%	0%	0%	0%	2%	0%

Source: Ambit Capital research, [Pew Research Center](#). Note: Daily income for different categories: poor <\$2, low income \$2-\$10, middle income \$10-20, upper middle \$20-50, high income >\$50. Figures expressed in 2011 PPP terms. Data for 2021 is assumed as per post-pandemic data using World Bank's PovcalNet database.

China is unparalleled in terms of pulling its citizens out of poverty and low-income: both in terms of scale and speed of change

**Exhibit 23: Whilst urban penetration in China grew into 80%+ levels across categories by year 2000...**



Source: Ambit Capital research, China Statistical yearbook. Note: bold lines indicate urban penetration of home appliances in China

**Exhibit 24: ...rural penetration has also saturated in China due to strong income growth over last 2 decades**

	Refrigerator		Washer		AC		TV	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
1985	10	NA	40	NA	NA	NA	20	NA
1990	42	1	78	9	NA	NA	70	NA
1995	66	5	89	17	10	NA	90	70
2000	80	12	91	29	25	2	110	100
2005	91	20	96	33	75	10	130	130
2010	97	45	97	57	105	16	135	135
2015	94	83	96	79	102	39	120	130
2020	103	100	97	93	150	74	122	135
<b>2021 (India)</b>	<b>64</b>	<b>25</b>	<b>36</b>	<b>9</b>	<b>40*</b>	<b>16*</b>	<b>87</b>	<b>58</b>

Source: Ambit Capital research, [ceicdata.com](http://ceicdata.com). Note: Figures show penetration rates. Data for India is taken from NFHS 5. \*AC penetration at urban/rural level for India is not available, table shows for AC/cooler combined penetration.

Rising rural incomes (from increased labour in manufacturing) led to increased rural penetration in China over the last two decades (exhibit 24). In addition to lower incomes, we posit that poor power network with unreliable electricity supply may also have led to slower penetration in rural areas in China. However, especially after 2005, support through government subsidy policies such as 'Old for new policy' and 'Home appliances to the countryside' spurred rural consumption; across categories penetration levels jumped from <20% levels to ~100% (except ACs).

**Chinese order of home appliance preference: TV>WM>ref**

In terms of preference, Chinese consumers are no different with respect to their propensity to purchase TV and other electronic items. However, with respect to refrigerators and WMs, food habits and role of women play a major role in inverting preferences compared to other countries.

- **TV and other electronics:** Across countries we see preference for TVs over other household appliances. More recently, with the adoption of smartphones and falling data rates, the penetration curve for smartphone is sharper than even TVs. Besides their utility for infotainment (which other home appliances don't provide), these electronic goods (TV/smartphone) also depict social status. With much sharper technological innovation, better features and increased usage, electronics also have much shorter replacement cycles. Thus perceived consumer utility of electronics (TV/mobiles) is much higher than other home appliances even if logically one would assume that a household is likely to purchase refrigerators first to preserve food and reduce wastage. Data from China, both urban and rural, corroborates this hypothesis
- **WM penetration is most sensitive to role of women in society:** Chinese homes indicate a peculiar trend – propensity to buy WM over refrigerators (exhibit 24). Unlike refrigerators, WM penetration is expected to show high income elasticity (as seen for other developing countries in exhibit 13/14). However, Chinese WM penetration across both rural and urban population has been faster than refrigerators. For example, rural WM penetration was already ~30% by 2000 (vs ~12% for refrigerators). [This study explains](#) the discrepancy through societal norms that are motivated by cleanliness and 'rites of passage' in a woman's life such that WM purchases in China are typically made at time of marriage as also childbirth. The absence of such cultural norms in other countries may explain the divergence in consumer choices.

*Chinese domestic white goods market has primarily grown through rural penetration over last two decades.*

*Similar to other countries, electronics (TV/ smartphone) has high perceived utility amongst Chinese consumers.*

*Role of women and dietary differences explain why WM has traditionally been preferred over Ref in China*

- **Refrigerators are lowest in pecking order:** [This article](#) notes how traditional Chinese society did not require refrigerators, even as they have been considered necessity in most Western cultures. Food processing and packaging in Chinese culture accommodated for general lack of refrigeration, and traditional foods could be kept for long periods at room temperature. Also traditionally, [dairy was not a big part of Chinese diet](#) and was considered as baby food until more recently. However habits have changed and with sufficient disposable income, almost all Chinese households have refrigerators now.

**Exhibit 25: Urban penetration of consumer goods in China and Japan in 2000 indicates differences in consumer choice at different stages of household income - \$1k in China vs \$13k in Japan per capita household income (PPP)**

(urban penetration)	China					Japan					Comments
	1999	2000	2001	2002	2003	1999	2000	2001	2002	2003	
Televisions	112	117	121	126	131	224	226	231	235	238	Televisions have high perceived utility; scope for multiple appliances per household
Refrigerators	78	80	82	87	89	121	122	121	125	126	Refrigerators have lower perceived utility compared to TVs albeit higher than other categories
Washing machines	91	91	92	93	94	108	109	110	110	110	Washing machines come third in consumer preference; albeit without need for multiple units per household
Air conditioners	24	31	36	51	62	201	208	217	230	245	At lower levels of income, ACs lag the most; at higher incomes though, their perceived value can lead to multiple units per household
Microwave ovens	12	18	22	31	37	98	99	101	102	102	Microwave ovens follow similarly as ACs albeit without the need for multiple units

Source: Ambit Capital research, GFK Marketing Consulting (Shanghai) Co. Ltd. Note: In year 2000, Chinese per capita household income (PPP) stood at \$1k vs \$13k for Japan.

In order to estimate how penetration may pan out over the next two decades, as also gauge cross-segment growth rates in China, we compare with Japan at the start of the millennium (exhibit 25). Whilst per-capita GDP increased ~12x since 2000 and penetration levels across categories have risen to ~100% for urban population in China (exhibit 23), at current prices [Chinese GDP per capita is still 1/3<sup>rd</sup> of Japan](#). It is amply clear that once a country moves to the high-income category, TVs and ACs hold high potential due to multiple units per household (>200% penetration). Additionally, [given the cooling challenge](#) and climate crisis that is likely to play out over the next few decades, top-down government policy is likely to favour replacement of older, polluting ACs with more-energy efficient and cleaner technology. In this context, AC offers potential to remain highest growth category amongst white goods in China.

*TV/ AC offer greater potential for sustainable growth at higher incomes due to multiple units per household.*

*Whilst replacement cycle for TV is lower due to consumer interest in better infotainment options, AC replacement would be championed by governments to move to cleaner and less energy intensive technologies.*

# India: Penetration analysis suggests AC has longest growth runway

We examine factors beyond income that affect penetration of various white goods in India. Due to its infotainment value, low running costs and fewer running hours in a day, TV is clearly the most important purchase, followed by refrigerator that is dependent on 24x7 electricity. Whilst AC is highly susceptible to income effect (being the costliest purchase), WM is also not a must-have due to availability of cheap household help and lower women labour participation. As per our estimates, household penetration for refrigerator/WM/AC stood at 38%/18%/11% in CY21. Using our income-based regression model covering training period of 1999-2021, we project growth for next 3 decades and find AC would be most attractive segment (mid-teen CAGR), whilst ref/WM growth would be sub-par at ~10% CAGR over FY21-31E.

## Less explored factors of consumer choice in India

Whilst overall macro factors like income growth plays a major role in improving penetration levels across categories, in the last section on China we also noted how penetration rates also vary due to sociocultural reasons. In this section we explain key demand drivers that affect consumer preferences in India. We examine some of these here in more detail for India

### Cost of ownership is a key variable; perceived utility more important for electronics

Penetration differences between appliances may be explained to a certain degree by differences in cost of ownership. However, as noted in previous sections, whilst some appliances are income elastic (refrigerators/WMs), others are income inelastic (TVs). Competition between TV and refrigerator as the first household appliance purchased depends not only on pricing but also electricity supply and perceived utility as discussed in other sections. In terms of pricing for entry segment of household appliances, WM < Ref < AC.

*Despite low product and running costs (for entry category), WM comes down the pecking order for Indian consumer => cost is not the most important variable for purchase.*

**Exhibit 26: Between 3-star and 5-star appliances the cost differential is 3-5k in terms of product price; savings in annual power are substantial for power hungry appliances like ACs/refrigerators with breakeven in 3-5 years**

	AC				Ref				WM			TV	
	Invertor split		Non-invertor split		Direct cool		Frost free		Semi-automatic	Front load	Top load	Colour TV	
	1 ton	3 ton	1 ton	3 ton	190 ltr	250 ltr	250 ltr	350 ltr	6.5 kg	8.5 kg	6.5kg	32 inch	
<b>Star rating</b>	3	5	3	5	3	5	3	5	NA	NA	NA	3	5
Avg. product price (Rs. k)	35	38	31	36	15	20	23	26	10	36	17	17	20
Annual power consumed (kWh)	700	600	800	1000	160	104	200	150	NA	NA	NA	55	45
Annual electricity cost (Rs. k.)	3.5	3	4	5	0.8	0.5	1	0.75	NA	NA	NA	0.28	0.22
Star migration annual saving (Rs. k)		0.5		0.5		0.3		0.25	NA	NA	NA		0.06

Source: Ambit Capital research, [BEE](#), E-comm websites. Note: 1. Annual power consumption for AC, Ref and TV was readily available from BEE labeling; values are indicative across category. 2. BEE rating for WM was not mandatory till Dec 2021; due to data unavailability we don't compute running costs for WM. Qualitatively, running costs from WM are very low since appliance is not power intensive like ref/AC and is used for limited time daily. 3. Electricity cost is calculated by multiplying annual power consumption with Rs5 per unit, although there would be significant variation between states.

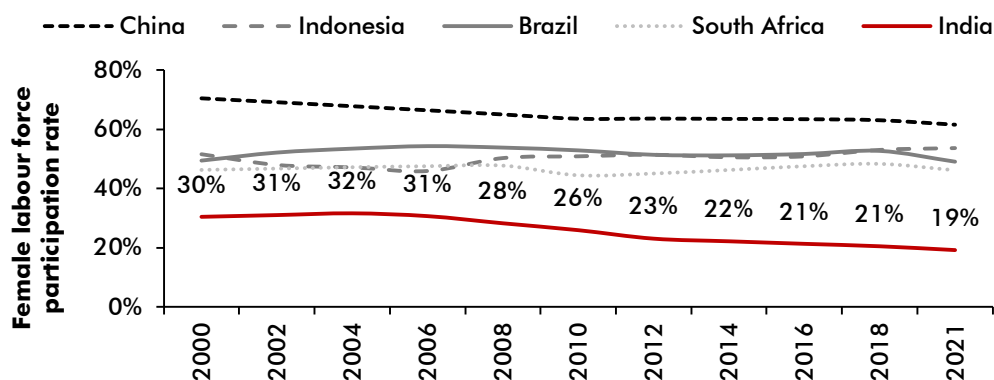
In addition to product cost, annual running costs may also be factored at the time of purchase. For example, running costs for an AC are substantial compared to WM/TV (exhibit 26). In terms of running cost, WM < Ref < AC. Thus AC suffers from both high purchase and running costs even in the value segment, implying highest susceptibility of overall penetration to income effect.

**Lower women’s labour participation rate is an unseen contributor w.r.t. refrigerators and WMs**

Appliance penetration needs to be seen in the context of substitutes. This is particularly true w.r.t. WM penetration. Availability of cheap domestic help in higher income households leads to lower refrigerator/WM penetration. In lower-income households, women of the house resort to performing household chores themselves. There is extensive literature (e.g. [Bose, Jain and Walker, 2020](#)) in the international context with respect to how change in societal norms and entry of women into the formal labour market led to penetration of household appliances, especially for WM. Authors also contend that household appliances are a fruit of liberation rather than the engines for it. With respect to domestic help, the authors also say that more expensive domestic help leads to higher propensity to purchase household appliances.

*Rate of change of Ref/WM penetration and premiumization in India would be contingent on how role of women (labour participation) changes over next two decades.*

**Exhibit 27: India has had lower women labour participation compared to other developing markets and this has worsened over the last decade**



Source: Ambit Capital research, [data.worldbank.org](http://data.worldbank.org)

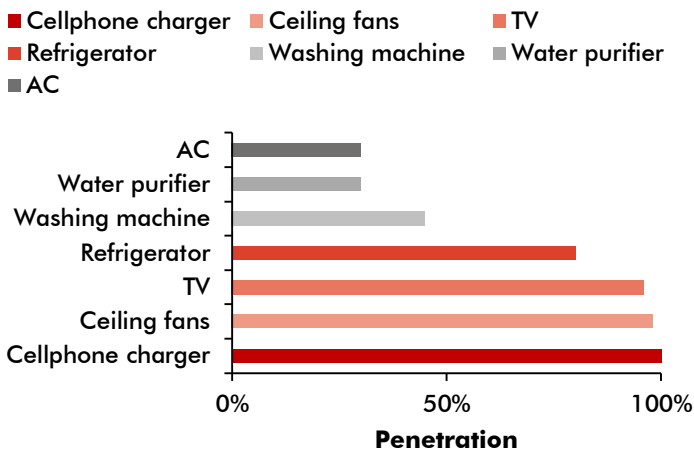
In the Indian context, [Dhanaraj, Mahambare and Munjal, 2020](#) contend that if the utility of a durable is skewed towards a particular gender, then it is likely that higher bargaining power of that gender within a household, higher is the probability of a household owning a particular durable (holding other variables such as income constant). India’s women labour force participation rate has continuously been declining from already low levels compared to other developing markets (exhibit 27). [Dhanaraj, Mahambare and Munjal, 2020](#) state that slow penetration rate of refrigerator ownership is largely an outcome of the failure of India’s social and economic policies. A rise in incomes per se does not necessarily lead to an increase in welfare unless the government plays a supportive role, in this case by improving the energy and education policies. More recent studies have indicated that whilst women’s education is improving, this is not translating into their employment due to poor societal norms and medium education leaving women to tend to child care and housework. ([link1](#), [link2](#)). Thus societal attitude towards women contributing to household income is an often overlooked parameter with respect to penetration of household appliances. With respect to the positive contribution towards women’s lives and economic growth, some ([link1](#), [link2](#)) have even hailed this innovation to have had as a bigger impact on human history than internet.

**Quality of electricity supply is another unseen explanatory variable**

Exhibit 29 shows the number of hours of operation for different appliances in a sample of 1200 households from three cities – Pune, Talegaon Dabhade and Ahmednagar. Exhibits 30-33 show how users perceive power supply in their regions and how erratic supply informs their choices for voltage stabilizers (e.g. in Ahmednagar in order to prevent failure of their appliances). This analysis gives an interesting representation of how quantity and quality of electricity supply affects consumer choices affects decisions to purchase household appliances. Due to high hours of operation, any household that receives <18 hours of electricity is unlikely to purchase refrigerators as the utility of appliance is lost altogether ([Dhanaraj, Mahambare and Munjal, 2020](#)). This is of less importance to TV purchase since the number of hours of operation is far fewer, and maybe one reason for higher TV penetration compared to refrigerators (exhibit 24).

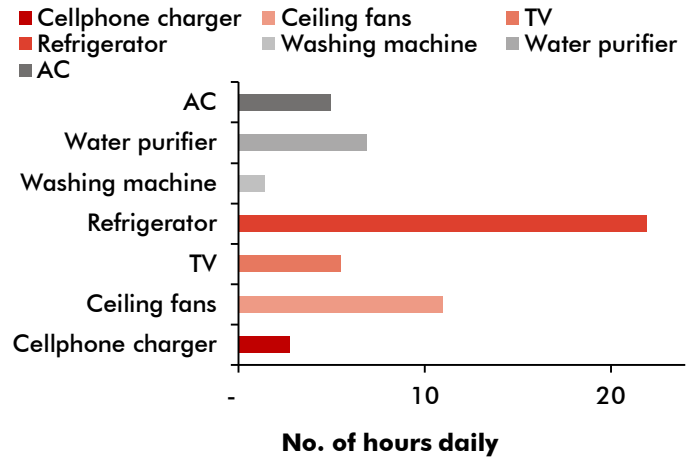
*Quality of electricity is key variable especially for Ref, given highest daily usage*

**Exhibit 28: Refrigerators and WMs find lower utility in the Indian household**



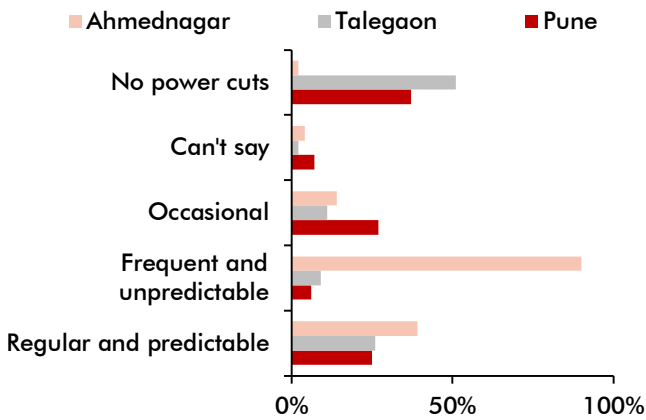
Source: Ambit Capital research, [2020 Report on 'Energy Consumption Patterns in Indian Households – insights from Pune, Talegaon Dabhade and Ahmednagar](#)

**Exhibit 29: Refrigerators have the highest usage daily amongst all appliances**



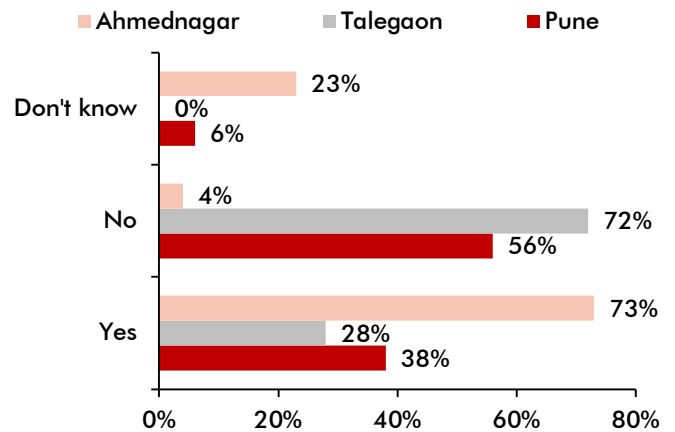
Source: Ambit Capital research, [2020 Report on 'Energy Consumption Patterns in Indian Households – insights from Pune, Talegaon Dabhade and Ahmednagar](#)

**Exhibit 30: Nature of outages as perceived by surveyed households**



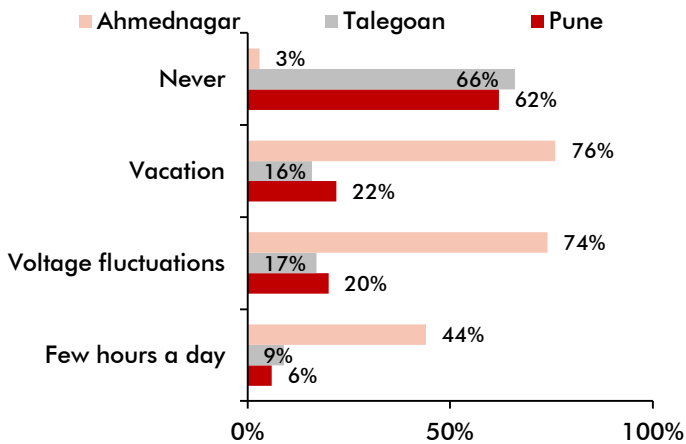
Source: Ambit Capital research, [2020 Report on 'Energy Consumption Patterns in Indian Households – insights from Pune, Talegaon Dabhade and Ahmednagar](#)

**Exhibit 31: Voltage fluctuations as perceived by surveyed households**



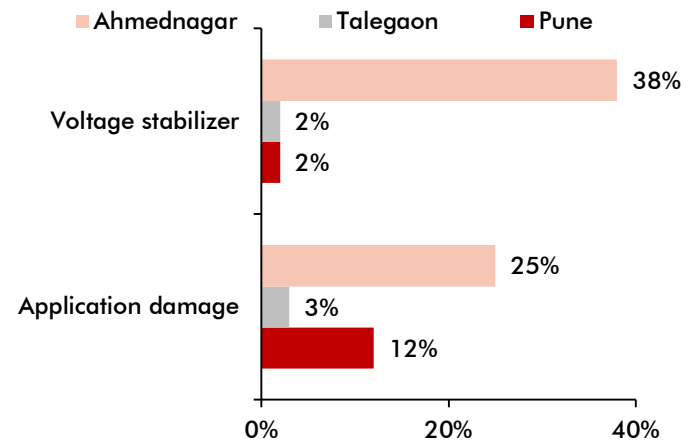
Source: Ambit Capital research, [2020 Report on 'Energy Consumption Patterns in Indian Households – insights from Pune, Talegaon Dabhade and Ahmednagar](#)

**Exhibit 32: In tier 2/3 cities, fear of poor electricity affecting appliances is a major concern**



Source: Ambit Capital research, [2020 Report on 'Energy Consumption Patterns in Indian Households – insights from Pune, Talegaon Dabhade and Ahmednagar](#). Note: The chart indicates responses to question of why electricity is turned off during the day

**Exhibit 33: Effects of poor electricity supply lead to appliance damage and users resorting to stabilizers**



Source: Ambit Capital research, [2020 Report on 'Energy Consumption Patterns in Indian Households – insights from Pune, Talegaon Dabhade and Ahmednagar](#)

**Exhibit 34: Order of preference for household appliances in India: TV>refrigerator>WM~AC**

Category	Consumer choice				Category attractiveness			Overall ranking	Comments
	Product price	Recurring costs	Dependence on power	Perceived utility	Replacement cycle	Multiple units per household	Availability of alternatives		
TV									Highest perceived utility; consumers keen to purchase despite significant cost as % of household income; with higher income there is significant scope for multiple purchases as well as premiumization
Ref									Second in pecking order; quality of electricity supply is a key variable
WM									Whilst WM are relatively cheap, especially in entry category they have much lower perceived utility due to availability of alternatives (household help). Additionally similar to refrigerators there is usually just one unit per household.
WC									Highly income elastic category with threshold due to significantly higher product cost and recurring costs; beyond larger income threshold multiple units per household presents significant long term opportunity for industry.

Source: Ambit Capital research. Note: - Strong; - Relatively strong; - Average; - Relatively weak

**Order of preference for Indian consumer: TV > refrigerator > WM ~ AC**

Both from consumer choice perspective as well as category attractiveness, TV scores much higher than other categories (exhibit 34). Whilst our note is not focused on TV growth per se, we include it in our commentary to give a sense on how wallet share is divided first to consumer electronics rather than refrigerators/WMs/ACs. Food preservation is a key need for households, however, uninterrupted power supply is a consideration for cooling without any alternative. Thus refrigerators come second in the pecking order. In the presence of alternatives (cheap household help) as also cultural difference in role of women (who are expected to perform household chores in low income households), washing machine is not accorded similar importance as in China. Thus despite their relative cost effectiveness, penetration has been low. This may change in the future, especially if India focusses on increasing female workforce participation. We give ACs a similar ranking as WMs since it is an income elastic category that is likely to see significant volume growth on the back of increasing income. Thus, despite the lowest penetration amongst all categories and income effect that restricts its usage to mostly urban areas now, scope for multiple units per household (possibly higher than TV in the long run) gives it a more durable growth runway in India.

*Qualitatively product importance can be assessed from floor/wall space accorded to different categories in a retail showroom. Consumer electronics such as TV/mobiles attract more eyeballs than other household durables.*

## State-wise analysis of home appliance penetration

**Data sources:** We use [NFHS](#), [SECC](#), [IHDS](#) and [Lokniti/CSDS](#) datasets to compile penetration of various white goods at 5-yr intervals over the last two decades. Exhibit 35 shows all India level penetration. For details on year-wise data sources for different categories and other variables check exhibit 45.

### Exhibit 35: With increasing per capita GDP, penetration of white goods has increased albeit at different rates

Period ending	Population(mn)	GDP per capita	Penetration		
			Ref	WM	AC
2006	1,123	18	16	4	1
2011	1,209	25	23	7	2
2016	1,270	36	29	15	10
2021	1,335	46	38	18	11

Source: Ambit Capital research, [NFHS](#), [IHDS](#), [Lokniti](#), [data.worldbank.org](#), RBI. Notes: <sup>1</sup>GDP per capita in Rs. '000s - at constant 1999 prices; <sup>2</sup>Penetration rates in % terms; <sup>3</sup>Data for only 17 states is considered, but represents 92% of total Indian population.

### State-wise cross-category penetration levels

**Assumptions/limitations of our study:** In order to reduce time-invariant effects we debase GDP per capita to constant 1999 prices. State-level data for ACs is not available from NFHS/NSS since they club ACs with coolers in their surveys. Specifically for ACs we rely on IHDS (for 2006/11) and Lokniti surveys (for 2016/21, imputed values are calculated state-level election surveys taken during period 2014). Exhibit 36 shows state-wise penetration of refrigerator/WM as of 2021 (NFHS 5). As seen across the board, states with higher GDP report higher penetration. However, there are sufficient variations also based on rate of urbanization. We assume that state-level factors sufficiently cover these variations, although there could be scope for further improvements with respect to explanatory variables. Some media articles ([link1](#), [link2](#)) discuss interesting variations based on these studies. Also, as discussed in previous sections, the role of women (using labour participation as proxy) could be better captured as also quality of electricity supply. We use only overall electricity penetration instead. There is also scope for more micro income-cohort level analysis, but for our purpose we only focus on state-level aggregates.

*State-wise heterogeneity in terms of income, societal preferences and climate indicate scope for micro-market (tier 2/3 & rural focused) strategies rather than pan-India sales and branding*

### Exhibit 36: As of 2021, state-wise penetration of refrigerator/WM indicates significant scope especially in rural areas

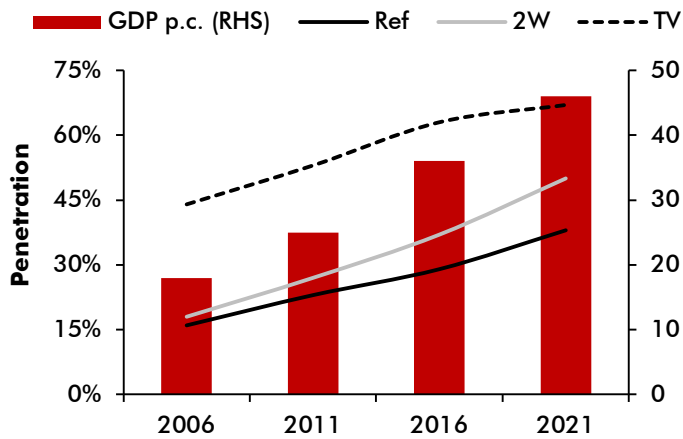
State	Per capita GDP (Rs. '000s)	Population (mn)		Ref penetration			WM penetration			AC/cooler penetration		
		Urban	Rural	Urban	Rural	Overall	Urban	Rural	Overall	Urban	Rural	Overall
Bihar	14.7	13	102	34	6	9	18	2	4	21	3	6
Uttar Pradesh	21.5	49	172	60	19	28	44	11	18	53	16	25
Jharkhand	25.4	9	28	40	6	14	27	2	8	25	2	8
Madhya Pradesh	33.7	22	58	53	13	24	28	3	10	66	26	37
Odisha	36.1	8	39	55	18	24	26	4	7	35	10	14
West Bengal	37	32	69	52	12	25	14	1	5	13	1	5
Rajasthan	37.7	19	57	73	35	45	42	10	18	79	46	54
Punjab	50.8	11	19	87	87	87	75	61	66	75	67	70
Andhra Pradesh	55	31	62	65	37	46	30	6	14	36	12	20
Himachal Pradesh	62.2	1	7	77	66	67	68	40	43	23	11	12
Maharashtra	66	56	68	67	30	47	33	4	17	44	25	34
Tamil Nadu	69.7	39	41	67	42	54	40	11	25	20	5	12
Gujarat	69.9	28	38	73	38	52	25	3	13	32	7	18
Kerala	72.5	18	19	81	71	76	46	32	39	18	10	14
Karnataka	72.9	26	41	55	20	33	34	6	17	18	5	10
Haryana	80.9	10	18	78	69	73	69	57	61	71	57	62
Delhi	122.9	18	0	77	83	77	65	75	65	74	81	74
<b>Total</b>	<b>45.6</b>	<b>390</b>	<b>838</b>	<b>64</b>	<b>25</b>	<b>38</b>	<b>36</b>	<b>9</b>	<b>18</b>	<b>40</b>	<b>16</b>	<b>24</b>

Source: Ambit Capital research, [NFHS](#) RBI. Notes: <sup>1</sup>GDP per capita in Rs. '000s - at constant 1999 prices; <sup>2</sup>Penetration rates in % terms; <sup>3</sup>Data for only 17 states is considered, but represents 92% of total Indian population.



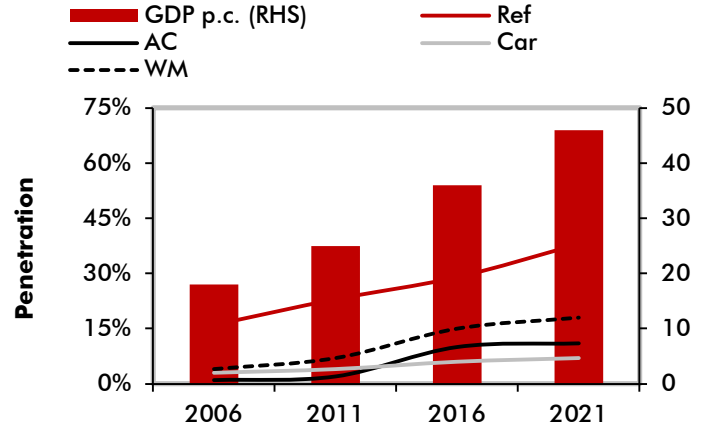
Looking at the preference pyramid with respect to other household items

**Exhibit 37: Whilst TVs and two-wheelers have higher order of preference compared to refrigerators...**



Source: Ambit Capital research, [NFHS](#) Note: Data for 2011 is interpolated from 2006 and 2016 data. 2W represents scooters/bikes. GDP p.c. stands for GDP per capita measured in Rs. '000s – constant 1999 prices.

**Exhibit 38: ...WMs, ACs and cars are more discretionary in nature**



Source: Ambit Capital research, [NFHS](#), [Lokniti](#), [IHDS](#) Note: Data for 2011 is interpolated from 2006 and 2016 data. GDP p.c. stands for GDP per capita measured in Rs. '000s – constant 1999 prices.

TV penetration is tied to perceived utility from infotainment, as discussed in a previous section. As seen in exhibit 37, two-wheeler penetration has also been higher than that of refrigerators. We believe this is because two-wheelers serve the purpose of transportation, especially in rural areas with poor public transportation (and poor roads spur demand for motorcycles with higher ground clearance). For self-employed people particularly, it may serve the purpose also of being an engine of business activity. WMs, ACs and cars fall lower in needs and are highly discretionary in nature (exhibit 38).

*Other durables compete with white goods in consumption basket some with much higher preference (such as 2W)*

**Income dependent regression models**

**Regression modeling:** We use beta regression for modeling since it is suitable to model penetration data (values from 0 to 100%). Additionally, for AC penetration, we consider cooling-degree days (since cooler places are less likely to require ACs). We also posit that AC penetration is unlikely to occur unless households already own WMs (due to income effect; since WM cost is comparatively much lower than AC) and thus take WM penetration as another explanatory variable for AC penetration. Exhibit 46 shows data availability for both dependent/independent variables across our period of study. We cover only 17 states. Other states have poor data availability and lead to unclear results with respect to our regression analysis. Nevertheless, since the states in our study cater to >92% of India’s population, we believe our sample is between 0-1 (in terms of penetration rate). Per capita income is the most important representative of India as a whole.

*We built income dependent regression models to forecast penetration of white goods over next 3 decades.*

**Regression results and robustness:** Exhibits 47-49 show regression results with degree of significance. With the exception of AC penetration (since it has far fewer data points), we regress penetrations over data till 2016 and calculate training RMSE. Similarly we calculate testing RMSE (using actual values and forecasted penetration for 2021). High R<sup>2</sup> values for all three regressions along with low RMSE values indicates the robustness of our models (exhibit 39).

**Exhibit 39: Our regression results are quite robust as per R<sup>2</sup> and RMSE errors**

Category	Adj. R <sup>2</sup>	Training RMSE	Testing RMSE
Ref	0.95	0.04	0.08
WM	0.91	0.06	0.11
AC	0.88	0.03	NA

Source: Ambit Capital research. Note: For AC, due to fewer data points, it was not possible to calculate testing RMSE.

# Crystal gazing for the next three decades

## Note on assumptions and sanity checks

Using forecast penetration for the next three decades, we then calculate 5-year volumes and volume CAGR for five-year periods. Some assumptions considered here as follows:

- **GDP growth:** Taken as 5.5% CAGR and similar for all states.
- **Population growth:** 1% CAGR; since we cover only 17 states (92% population coverage), we adjust final population by multiple of 1.09 to calculate total population
- **Avg. number of persons per household:** Taken as 4.2 for 2021, and linearly reduced to 2.7 by 2051.
- **Electricity penetration:** Increased linearly by 1% every year, with max value of 100%.
- **Cooling degree days (CDD):** Held constant as per 2021 values.
- **Replacement cycle for appliances:** We assume constant replacement cycle for all three categories at ~10 years.

Due to lack of state specific estimates, we assume constant and similar growth rates. Variations from our forecasts are likely due to significant state-wise heterogeneity.

**Exhibit 40: Our estimates based on regression modelling are similar to NFHS/Lokniti studies; AC penetration is overstated due to poorer modeling from data insufficiency**

	NFHS		Lokniti		Our estimates	
	2016	2021	2014	2019	2016	2021
Ref	33%	38%	24%	42%	29%	39%
WM	17%	18%	NA	21%	15%	22%
AC	NA	NA	6%	8%	6%	12%

Source: Ambit Capital research, [NFHS](#), [Lokniti](#)

Exhibit 40 compares our estimates for penetration in 2016/21 against reported values from NFHS/Lokniti national election surveys. Whilst refrigerator/WM penetration is in line broadly, our AC penetration estimate for 2021 is on the higher side. As noted earlier, due to fewer data points in our sample (taken primarily from IHDS and imputed values of Lokniti survey), there is scope for improper modeling. However, since overall model fit with respect to income-dependent regression modeling (exhibit 39) is sufficient, we believe our model is suited for forecasting. Exhibits 50-52 show how penetration curves vary across states for the next three decades.

Our estimates for AC penetration are likely overstated. Data insufficiency as also poor data quality affects our regression result.

**Exhibit 41: AC presents the highest growth category in volume terms for the next two decades**

Period ending	GDP per capita	Penetration			5-yr vol. sold (mn)			5-yr vol. CAGR		
		Ref	WM	AC	Ref	WM	AC	Ref	WM	AC
2021	46	39	22	12	82	48	24	8.7	7.8	14.9
2026	60	49	32	24	113	79	53	6.6	10.5	17.2
2031	78	61	46	41	154	126	96	6.4	9.8	12.6
2036	102	71	62	60	200	185	138	5.4	8.0	7.5
2041	133	81	75	75	250	245	165	4.6	5.8	3.6
2046	174	88	85	85	305	304	191	4.1	4.4	3.0
2051	227	93	92	92	366	368	218	3.7	3.9	2.7

Source: Ambit Capital research, [NFHS](#), [data.worldbank.org](#), RBI. Notes: <sup>1</sup>GDP per capita in Rs. '000s - at constant 1999 prices; <sup>2</sup>Penetration rates in % terms; <sup>3</sup>Data for only 17 states is considered, but represents 92% of total Indian population.

We believe AC is likely to grow fastest with mid-teen volume growth whilst ref/WM growth is likely to taper sub 10% post CY31.

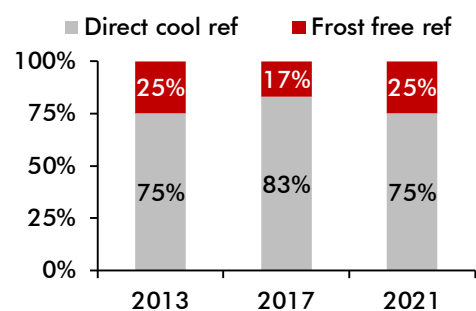
**Notes to our estimates for regression modelling**

- Since our estimates are based on regression modelling over 5-year periods with training set over 1999-2016, actual values may differ from those estimated. For example, our penetration estimates for 2021 look exaggerated, especially for AC penetration (most sources estimate <10%).
- Our model is income-dependent primarily and not adjusted for income effects/sales-impact from Covid-19 pandemic over 2020-21. Thus our volume and growth estimates for the 5-year period ending CY21 are overestimated.
- Our model works with only household penetration with assumption of one unit per household. Whilst this is true for refrigerators/WMs, generally there would be multiple ACs per high-income household at higher income levels. Thus, whilst our analysis estimates aggressive AC penetration over FY21-36, our estimates for volume CAGR may require upward revision post FY31 as households already owning ACs may resort to additional purchases.
- More than actual values, regression results and estimates are useful for broad level analysis and growth ranges between categories. Our estimates for industry/company growth in our stock-specific valuation models are not strictly as per values shown in above table.

**AC would be the most lucrative segment; premiumization across categories**

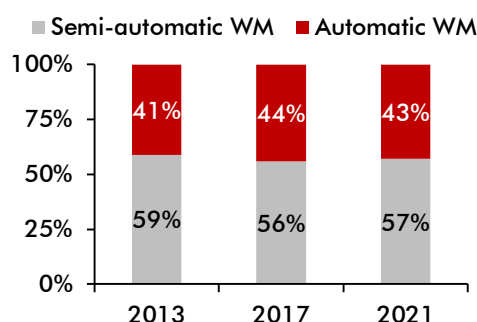
Given lower AC penetration so far, it stands to reason that AC would grow fastest over refrigerator/WM (exhibit 41). Similarly, we expect WMs to grow faster than refrigerators. It is also interesting to note that post CY36, WM/AC penetration is likely to mirror each other. This is of particular interest from a branding perspective as the ability to cross-sell increases with cross-category presence. In the Indian context, some companies that were primarily into AC manufacturing have already made the transition to a more broad-based product portfolio (Lloyd, Voltas Beko).

**Exhibit 42: Share is tipped towards direct cool refrigerators...**



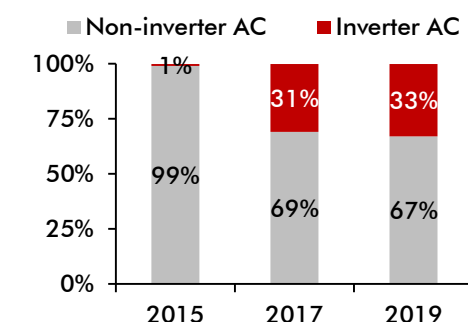
Source: Ambit Capital research

**Exhibit 43: ...semi-automatic WMs...**



Source: Ambit Capital research

**Exhibit 44: ...and non-inverter ACs in the value conscious Indian market**



Source: Ambit Capital research

Additionally we expect value CAGR across categories to be higher than volume CAGR on account of premiumization. As seen in exhibits 42-44, India is a price-conscious market with a larger share of value products. We expect the share of more premium products to increase, adding 200-300 bps to overall growth.

# Appendix

## Regression analysis

**Exhibit 45: Data sources for variables used in regression analysis**

	1999	2006	2011	2016	2021
Ref penetration	NFHS 2	NFHS 3	SECC 2011	NFHS 4	NFHS 5
WM penetration	NA	NFHS 3	SECC 2011	NFHS 4	NFHS 5
AC penetration	NA	IHDS 1	IHDS 2	Lokniti	Lokniti
Electricity penetration	NA	SECC			
Per capita GDP	NA	RBI			
Cooling degree days	NA	Degreedays.net			

Source: Ambit Capital research

**Exhibit 46: Data availability across parameters for penetration regression analysis**

Period ending	State	GDP per capita	Penetration				
			Ref	WM	AC	Elec.	CDD
1999	17	17	16	0	0	17	16
2006	17	17	17	16	9	17	17
2011	17	17	17	17	17	17	17
2016	17	17	17	17	14	17	17
2021	17	17	17	17	14	17	17

Source: Ambit Capital research, [NFHS](#), [IHDS](#), [Lokniti](#), RBI Note: Elec. stands for electricity penetration; CDD stands for cooling degree days

**Exhibit 47: Regression analysis for ref penetration**

factor	Estimate	Std. Error	Lower 95%	Upper 95%	P-value
(Intercept)	-2.298	0.195	-2.68	-1.916	<0.001
per_capita_nsdp	0.021	0.002	0.017	0.024	<0.001
factor(state)Bihar	0.119	0.171	-0.215	0.454	0.485
factor(state)Delhi	0.822	0.117	0.592	1.052	<0.001
factor(state)Gujarat	0.369	0.107	0.16	0.579	0.001
factor(state)Haryana	0.607	0.106	0.399	0.815	<0.001
factor(state)Himachal Pradesh	0.651	0.105	0.445	0.857	<0.001
factor(state)Jharkhand	0.262	0.138	-0.009	0.533	0.058
factor(state)Karnataka	-0.045	0.113	-0.266	0.177	0.692
factor(state)Kerala	0.785	0.105	0.578	0.991	<0.001
factor(state)Madhya Pradesh	0.201	0.118	-0.03	0.431	0.089
factor(state)Maharashtra	0.23	0.109	0.015	0.444	0.036
factor(state)Odisha	0.154	0.133	-0.106	0.414	0.247
factor(state)Punjab	1.276	0.105	1.07	1.482	<0.001
factor(state)Rajasthan	0.39	0.114	0.167	0.612	0.001
factor(state)Tamil Nadu	0.1	0.11	-0.117	0.316	0.367
factor(state)Uttar Pradesh	0.599	0.135	0.334	0.865	<0.001
factor(state)West Bengal	0.263	0.123	0.022	0.504	0.033
electricity_penetration	0.76	0.215	0.338	1.182	<0.001
phi	91.7255				
<b>Pseudo R-squared</b>	<b>0.951</b>				

Source: Ambit Capital research, [NFHS](#), [IHDS](#), [Lokniti](#), [data.worldbank.org](#). Notes: Regression equation as follows:  $ref\_penetration \sim per\_capita\_nsdp + factor(state) + electricity\_penetration$

**Exhibit 48: Regression analysis for WM penetration**

factor	Estimate	Std. Error	Lower 95%	Upper 95%	P-value
(Intercept)	-3.451	0.465	-4.362	-2.539	<0.001
per_capita_nsdp	0.022	0.003	0.016	0.029	<0.001
factor(state)Bihar	0.677	0.346	-0.002	1.355	0.051
factor(state)Delhi	1.089	0.238	0.623	1.555	<0.001
factor(state)Gujarat	-0.065	0.23	-0.516	0.385	0.776
factor(state)Haryana	0.816	0.208	0.409	1.223	<0.001
factor(state)Himachal Pradesh	0.477	0.21	0.065	0.888	0.023
factor(state)Jharkhand	0.681	0.273	0.146	1.217	0.013
factor(state)Karnataka	0.068	0.225	-0.373	0.508	0.763
factor(state)Kerala	0.669	0.207	0.262	1.075	0.001
factor(state)Madhya Pradesh	0.481	0.238	0.015	0.948	0.043
factor(state)Maharashtra	-0.198	0.258	-0.704	0.308	0.443
factor(state)Odisha	0.503	0.263	-0.012	1.018	0.056
factor(state)Punjab	1.014	0.201	0.62	1.408	<0.001
factor(state)Rajasthan	0.861	0.222	0.426	1.296	<0.001
factor(state)Tamil Nadu	0.312	0.217	-0.113	0.736	0.15
factor(state)Uttar Pradesh	1.037	0.282	0.485	1.589	<0.001
factor(state)West Bengal	0.201	0.255	-0.3	0.702	0.431
electricity_penetration	1.167	0.484	0.218	2.116	0.016
phi	44.0675				
<b>Pseudo R-squared</b>	<b>0.905</b>				

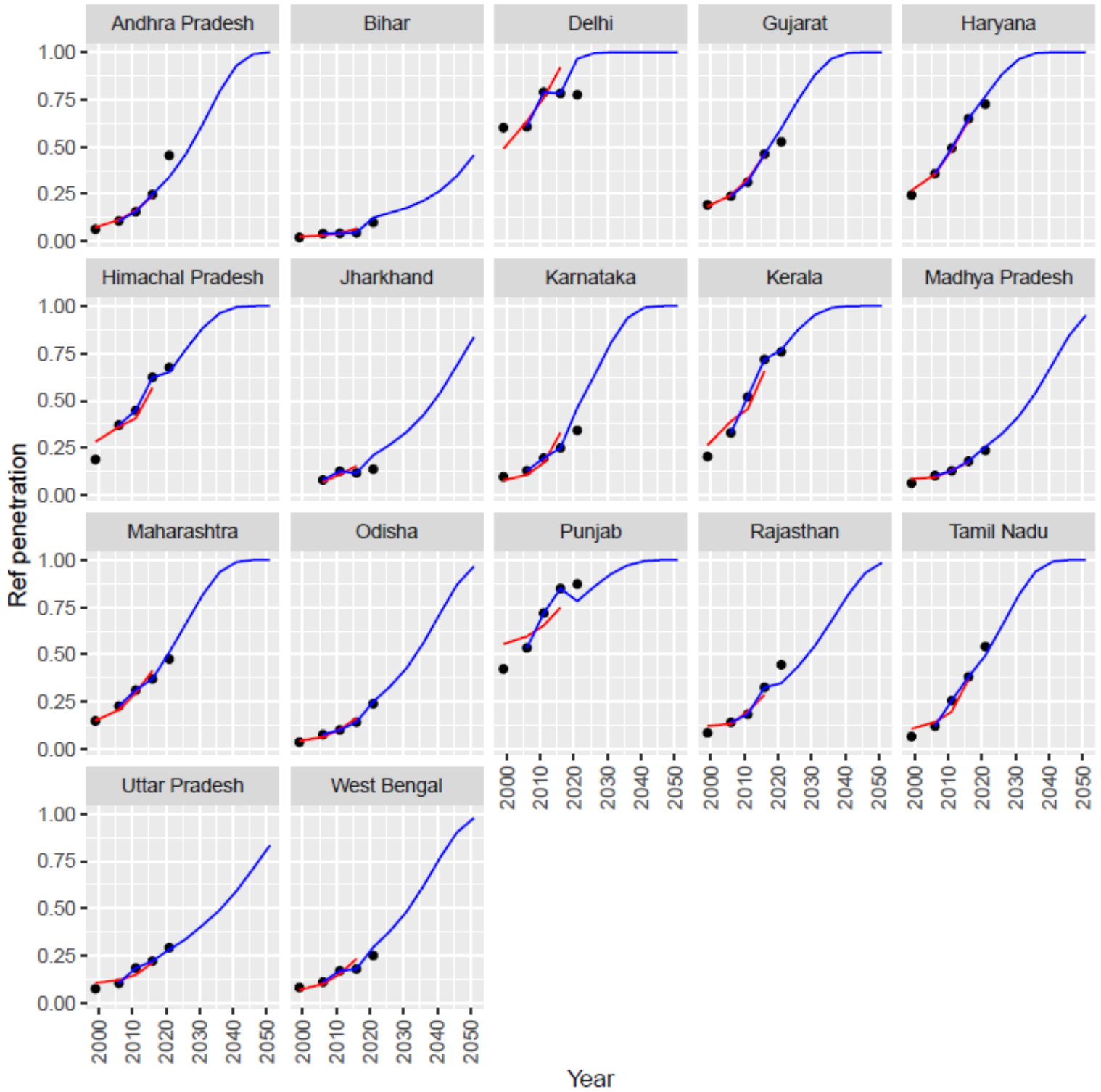
Source: Ambit Capital research, [NFHS](#), [IHDS](#), [Lokniti](#), [data.worldbank.org](#). Notes: Regression equation as follows:  $wm\_penetration \sim per\_capita\_nsdp + factor(state) + electricity\_penetration$

**Exhibit 49: Regression analysis for AC penetration**

factor	Estimate	Std. Error	Lower 95%	Upper 95%	P-value
(Intercept)	-6.515	0.832	-8.146	-4.884	<0.001
per_capita_nsdp	0.023	0.002	0.019	0.027	<0.001
factor(state)Bihar	1.276	0.329	0.631	1.92	<0.001
factor(state)Delhi	-0.215	0.319	-0.84	0.411	0.501
factor(state)Gujarat	0.079	0.216	-0.345	0.502	0.716
factor(state)Haryana	0.193	0.323	-0.439	0.826	0.549
factor(state)Himachal Pradesh	0.814	0.434	-0.036	1.664	0.061
factor(state)Jharkhand	1.555	0.336	0.897	2.214	<0.001
factor(state)Karnataka	0.502	0.363	-0.209	1.213	0.166
factor(state)Kerala	0.059	0.232	-0.396	0.514	0.799
factor(state)Madhya Pradesh	0.902	0.263	0.387	1.417	0.001
factor(state)Maharashtra	-0.072	0.224	-0.511	0.367	0.747
factor(state)Odisha	0.912	0.356	0.214	1.609	0.01
factor(state)Punjab	1.066	0.316	0.448	1.685	0.001
factor(state)Rajasthan	0.66	0.251	0.167	1.152	0.009
factor(state)Tamil Nadu	0.503	0.211	0.091	0.916	0.017
factor(state)Uttar Pradesh	1.324	0.277	0.781	1.868	<0.001
factor(state)West Bengal	0.751	0.232	0.297	1.205	0.001
wm_penetration	0.877	0.308	0.273	1.482	0.004
cdd	0.001	0	0	0.001	<0.001
electricity_penetration	1.303	0.413	0.494	2.113	0.002
phi	110.941				
<b>Pseudo R-squared</b>	<b>0.883</b>				

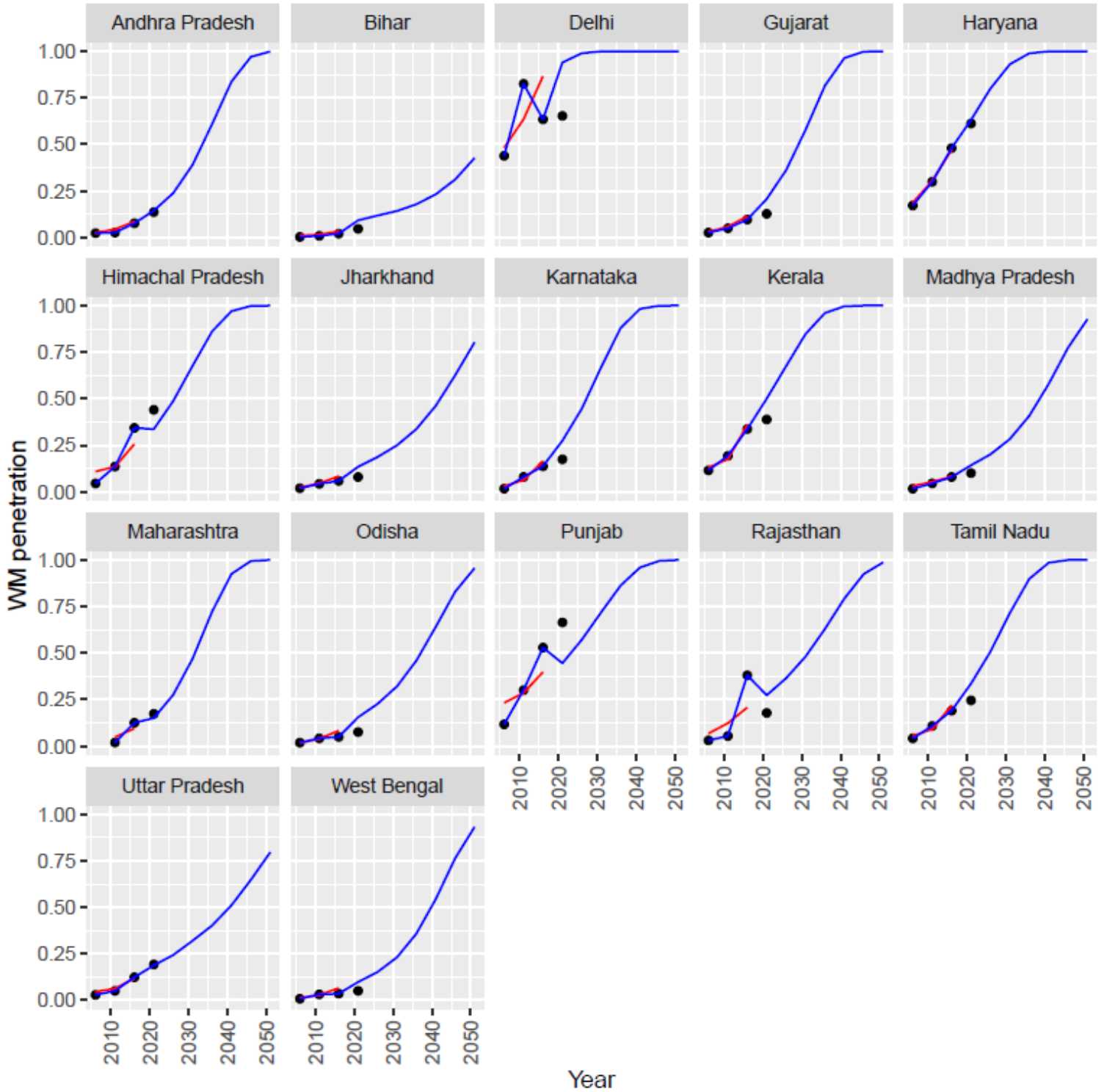
Source: Ambit Capital research, [NFHS](#), [IHDS](#), [Lokniti](#), [data.worldbank.org](#). Regression equation as follows:  $ac\_penetration \sim per\_capita\_nsdp + factor(state) + wm\_penetration + cdd + electricity\_penetration$

**Exhibit 50: Estimated state-wise ref penetration for the next three decades**



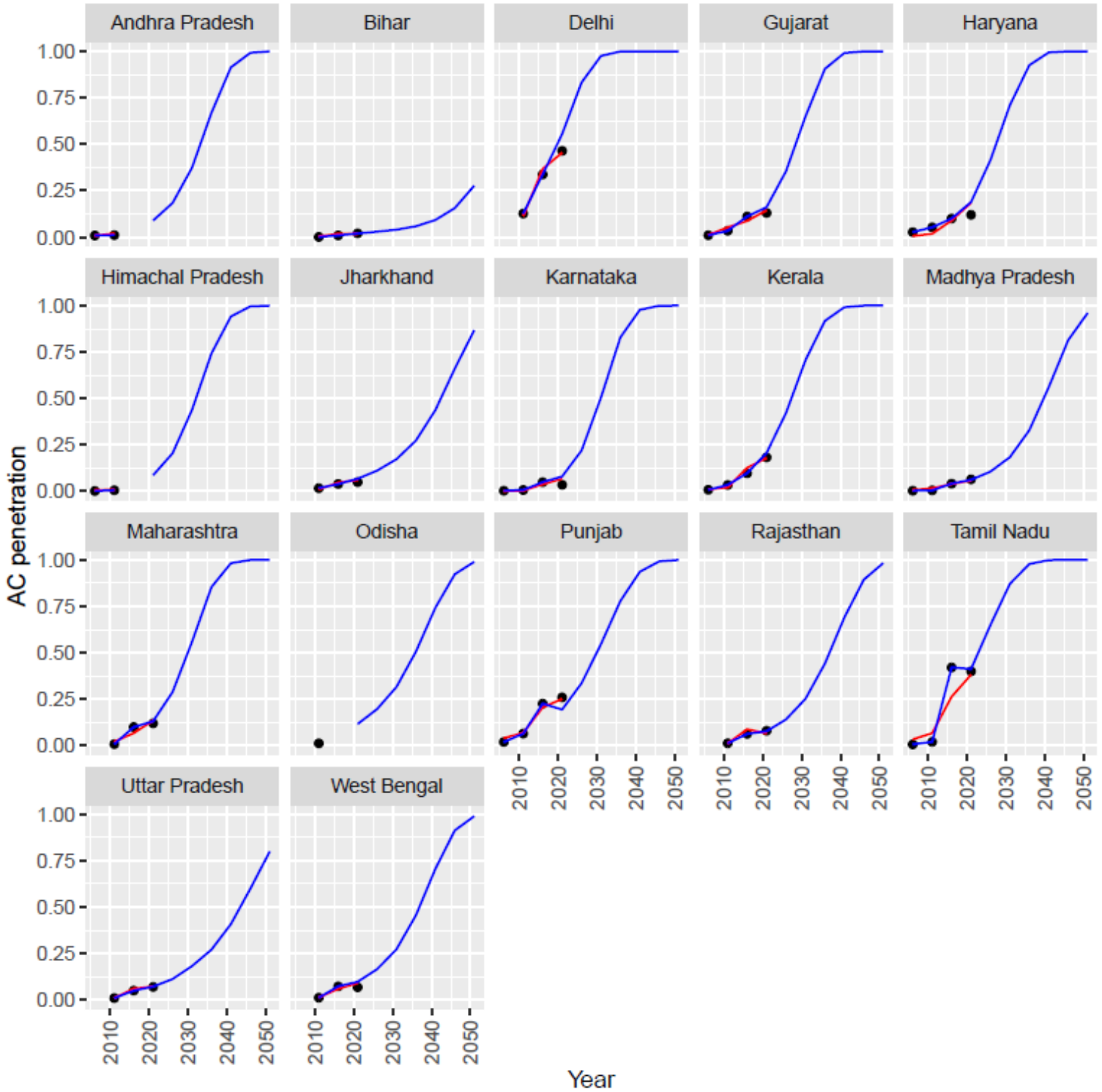
Source: Ambit Capital research. Note: Black dots indicate actual penetration up to 2021; red line indicates fitted values using past data till 2016; blue line indicates forecasted data

**Exhibit 51: Estimated state-wise WM penetration for the next three decades**



Source: Ambit Capital research. Note: Black dots indicate actual penetration up to 2021; red line indicates fitted values using past data till 2016; blue line indicates forecasted data

**Exhibit 52: Estimated state-wise AC penetration for the next three decades**



Source: Ambit Capital research. Note: Black dots indicate actual penetration up to 2021; red line indicates fitted values using past data till 2016; blue line indicates forecasted data



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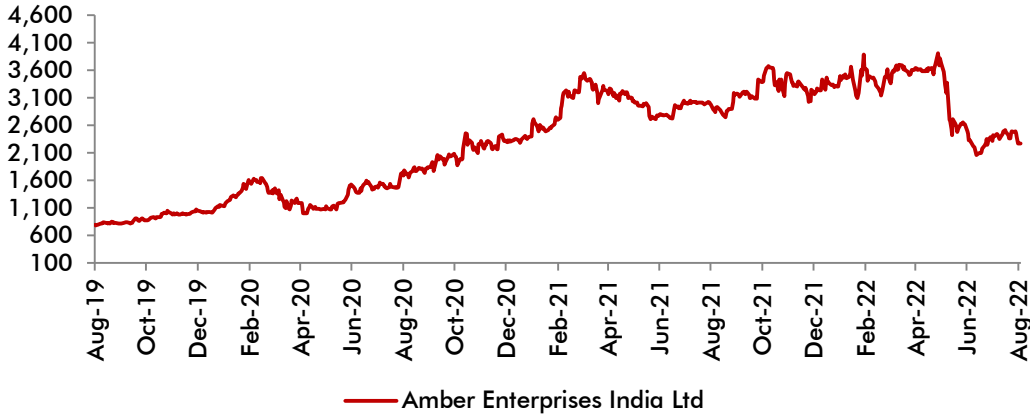
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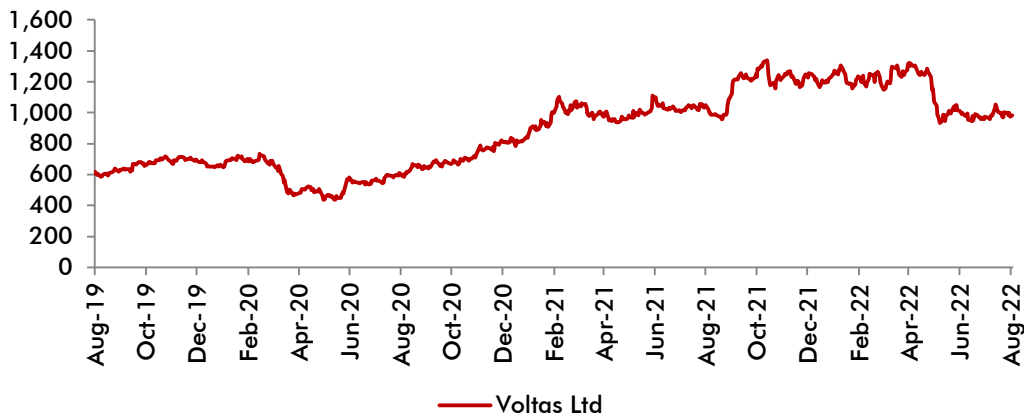
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Source: Bloomberg, Ambit Capital research

**Voltas Ltd (VOLT IN, SELL)**



Source: Bloomberg, Ambit Capital research

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