INVESTOR DAY 2017

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The Future of P3 Transportation Infrastructure in the United States

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http://reason.org/transportation

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Overview

- Federal and state budgets under serious stress
- Large backlog of unmet needs
- Need to replace fuel tax as main funding source
- P3s an excellent fit for major projects
- Impact of autonomous vehicles
- Prospects for Trump infrastructure

Federal fiscal retrenchment

- Both CBO and GAO warn about the looming insolvency of the federal government.
- GAO's long-term simulations show "the federal government faces unsustainable growth in deficits and debt."
- CBO projects net interest costs will double by 2026 and double again by 2046.
- Hence, major reductions in federal infrastructure & other "discretionary" spending.

Can states pick up the slack?

- Ravitch/Volcker State Budget Crisis Task Force report (2014):
  - Medicaid expansion a major threat
  - Huge unfunded pension liabilities
  - Budget gimmicks disguise fiscal crisis.
- American Enterprise Institute estimates combined pension fund debt + unfunded liabilities = 35% of state GDP

Simpson-Bowles Commission

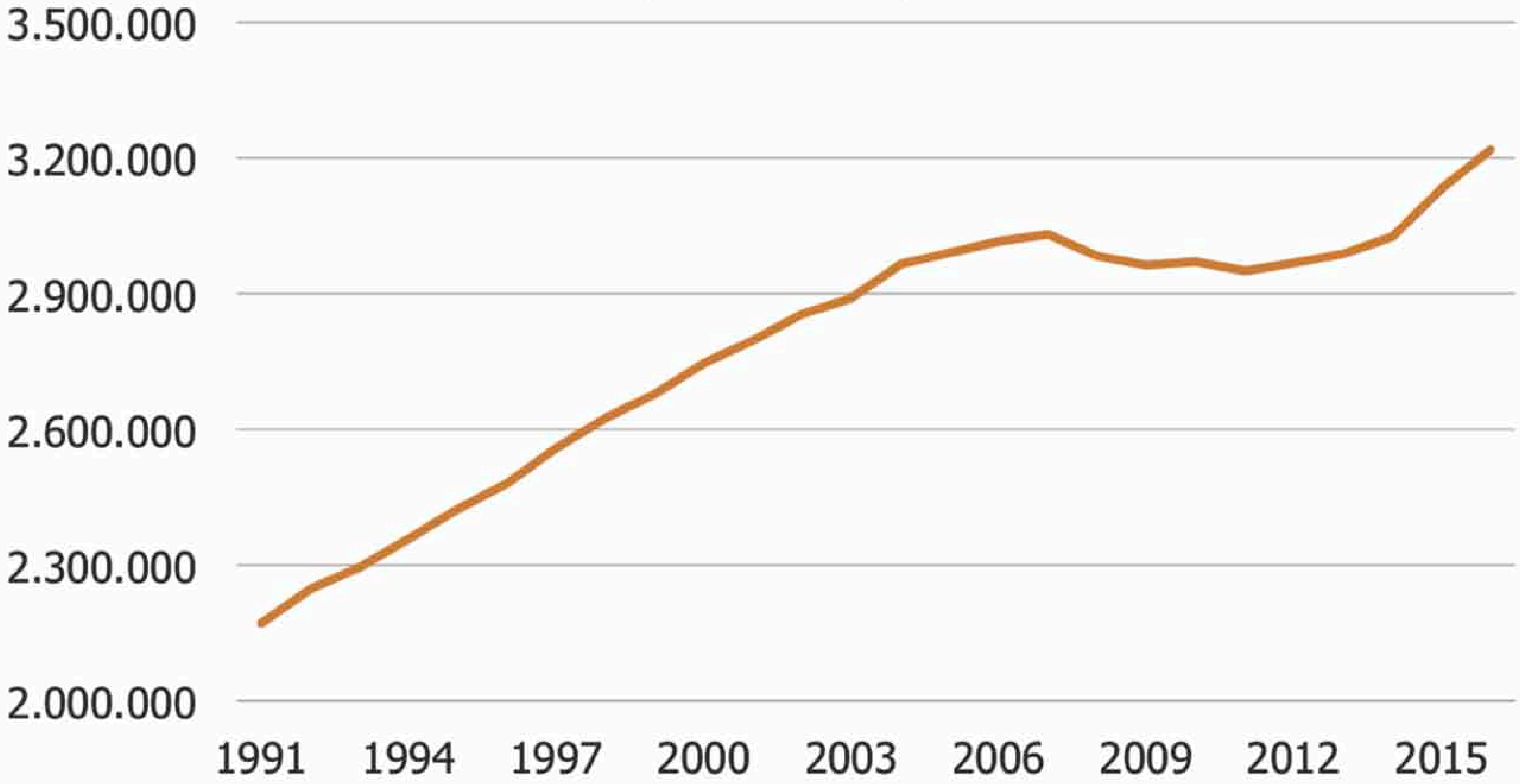
- Bipartisan 2010 commission to propose solutions to impending federal insolvency.
- Recommended protecting infrastructure investment, by making it 100% self-supporting from user taxes/ fees.
- President and Congress ignored its recommendations, enacted sequester.

Large unmet funding need

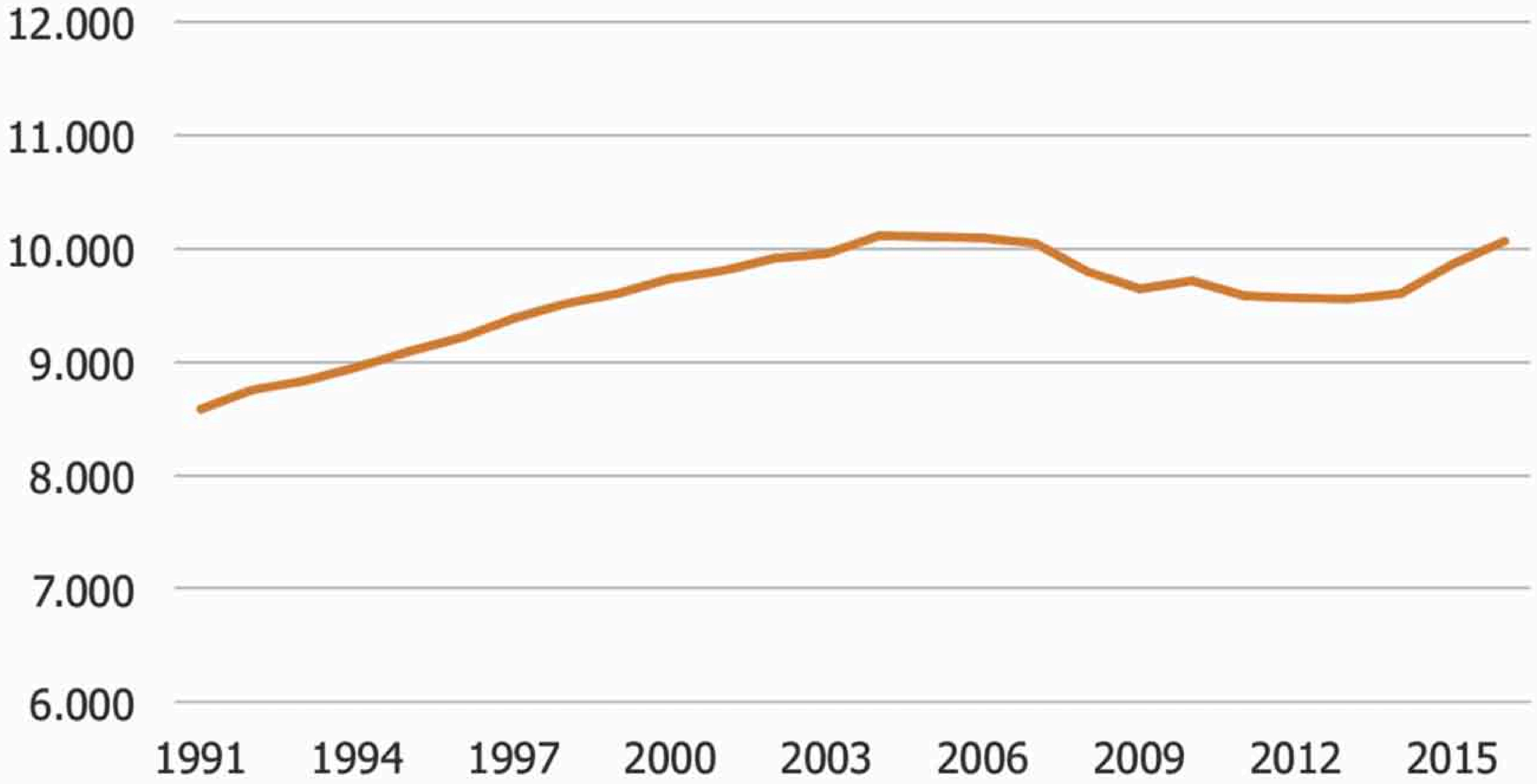
- US DOT estimates $43 billion annual highway & bridge investment shortfall.
- This is based on investments with positive benefit/ cost ratio.
- Largest needs are to rebuild and modernize urban and rural Interstate Highways.

VMT uptrend has resumed

(million miles)



VMT per capita also growing



What are America's two greatest highway investment needs?

- Rebuilding and widening the Interstate highway system nationwide, as it wears out. Cost: about $1 trillion.
- Reducing chronic freeway congestion. Direct cost to highway users: about $160 billion per year.

There is no serious federal program for either of these.

Tolling is a powerful tool for both:

- Can mobilize large sums of money up-front to finance major highway projects.
- Can reduce traffic congestion sustainably (if used as a variable price).

Two major funding priorities:

- Replace the obsolescing Interstate system with a 2nd-generation system, including dedicated truck lanes.
- Add networks of Express Toll Lanes in the 15 largest metro areas, for serious congestion relief.

Both could be toll-financed and procured as long-term P3 concessions.

A new model is needed for major highways

- Charge users per mile, not per gallon.
- Finance major projects, rather than using annual tax funding.
- Shift decision focus from lowest initial cost to lowest total (life-cycle) cost
- Solve the "deferred maintenance" problem.

From fuel taxes to per-mile charges

Why the fuel tax is "running out of gas":

- Assessed per gallon, not per mile driven.
- Fuel economy doubled since the 1970s.
- CAFE standards require new doubling by 2025 (to 54.5 mpg).
- Alternative fuel vehicles keep increasing.
- Most fuel taxes aren't inflation-indexed.
- It's very difficult politically to increase fuel taxes.

A "per mile charge" is another name for "toll."

From annual funding to financing

- If we switched to financing for all major projects:
  - We could build a lot more, sooner, working down the existing large backlog.
  - We could design projects to minimize total (life-cycle) costs, not initial cost.
  - We could guarantee ongoing maintenance, as required by the bond-buyers.

Revenue-based P3 concessions answer these needs

Per-mile charging and revenue-bond financing are a good fit for major projects, such as:

- Replacing worn-out or obsolete highways, interchanges, and bridges
- Adding express toll lanes to freeways
- Adding missing links to freeway systems
- Adding new expressways in growth areas

Advantages of P3 approach

- Ensures B>C in project selection
- Design innovations, thanks to outcome-based specifications
- Risk transfer shields taxpayers from cost overruns, late completion, revenue shortfalls
- Minimizes total (life-cycle) costs
- Equity cushion for early years' revenue shortfall
- Enforceable performance standards
- Guaranteed ongoing maintenance

Major opportunity: toll-financed Interstate reconstruction

- Interstates are America's most important highway infrastructure: 25% of miles traveled on just 2.5% of all lane-miles;
- Nearing the end of 50-year design life;
- Many corridors need widening;
- Many designs are obsolete, especially major interchanges;
- Most urban Interstates have peak-period congestion.

Toll-financed Interstate reconstruction & modernization

"Interstate 2.0" study:

- NPV of cost to reconstruct & widen: just under $1 trillion
- NPV of toll revenue: just under $1 trillion
- Modest CPI-linked toll rates: 30 states toll-feasible
- Somewhat higher toll rates: 15 states
- Not toll-feasible: 5 states

Ref: TRB Paper No. 14-0716, January 2014

Express Toll Lane networks to relieve congestion in 15 largest metro areas

- Largest 15 metros account for 50% of annual direct congestion cost of $160 billion.
- Individual ETL projects thus far:
  - 580 centerline miles
  - 1,065 lane-miles
- Networks now in long-range transportation plans of 14 metro areas
- Estimated cost: $300 billion
- Individual ETL projects in other metro areas

Express Toll Lanes Projects, 2016

Largest US highway P3 concessions (1)

Indiana Toll Road	$5.72B	66 yrs.	Toll	2015
Chicago Skyway	$2.84B	89 yrs.	Toll	2015
LBJ Express (TX)	$2.80B	52 yrs.	Toll	2010
I-4 Ultimate (FL)	$2.32B	40 yrs.	Toll-AP	2014
Midtown Tun. (VA)	$2.10B	58 yrs.	Toll	2012
NTE, 1&2 (TX)	$2.05B	52 yrs.	Toll	2009
Cap. Beltway (VA)	$1.99B	80 yrs.	Toll	2008
I-595 (FL)	$1.81B	35 yrs.	Toll-AP	2009
Goethals Br. (NY)	$1.50B	40 yrs.	Toll-AP	2013

Largest highway P3 concessions (2)

NTE 3 (TX)	$1.40B	52 yrs.	Toll	2013
SH130 (TX)	$1.36B	52 yrs.	Toll	2008
E. End (IN)	$1.18B	35 yrs.	Toll-AP	2013
PR-22 (PR)	$1.08B	40 yrs.	Toll	2011
I-95 Exp (VA)	$0.94B	73 yrs.	Toll	2012
Port Tun (FL)	$0.91B	35 yrs.	AP	2009
S.Bay Ex (CA)	$0.77B	35 yrs.	Toll	2003
I-77 Ex (NC)	$0.64B	50 yrs.	Toll	2015
TOTAL	**$31.41B**			

What impact will autonomous vehicles have on future highways?

- What level of automation do we mean?
- What time frames are realistic?
- What impact on urban VMT and roadways?
- What impact on inter-city VMT and highways?

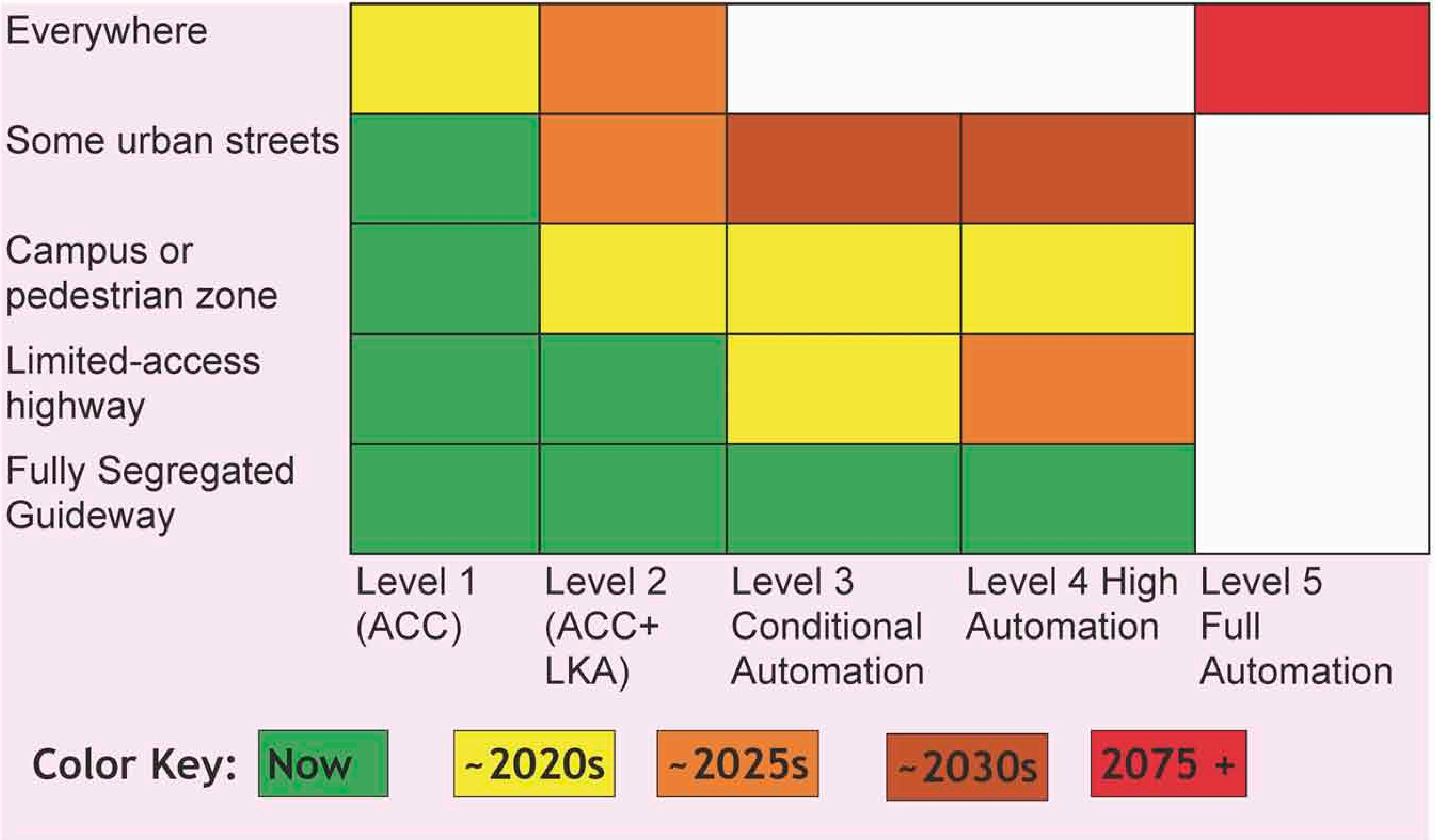
Example Systems at Each Automation Level

Source: Steve Shladover, UC Berkeley PATH

Level	Example Systems	Driver Roles
1	Adaptive Cruise Control OR Lane Keeping Assistance	Must drive <u>other</u> function and monitor driving environment
2	Adaptive Cruise Control AND Lane Keeping Assistance Traffic Jam Assist (Mercedes – and others)	Must monitor driving environment (system nags driver to try to ensure it)
3	Traffic Jam Pilot Automated parking	May read a book, text, or web surf, but be prepared to intervene when needed
4	Highway driving pilot Closed campus driverless shuttle Driverless valet parking in garage	May sleep, and system can revert to minimum risk condition if needed
5	Automated taxi (even for children) Car-share repositioning system	No driver needed

Estimates of Market Introductions

Source: Steve Shladover



Owned vs. shared AVs

- Some future scenarios show urban VMT reductions if most people shift from owned AVs to ride-sharing "mobility as a service."
- Sharing owned vehicles is different.
- Both require Level 5 automation, which is far- off for use everywhere.
- What fraction will share rides or vehicles is unknown —could range from 10% to 90%.
- Most researchers expect increased VMT if ownership prevails.

Shared-mobility market share

- Morgan Stanley estimates global increase from 5% today to 25% by 2030.
- Largest increase in developing countries, not US or Europe.
- In the US, "private car ownership is deeply woven into the American cultural fabric."
- US share projected at 7% by 2030, from 5% today.

Source: Morgan Stanley Research, "Shared Mobility on the Road to the Future," June 2016

KPMG study estimated [urban] VMT increases from non-drivers

Non-driver categories:

- Children and teenagers
- Elderly people
- Disabled people

- Projected increased personal miles of travel for each group, then converted that to VMT.
- Projected VMT in 2050 would be up to 5 trillion, compared with around 3.2 trillion now.

Source: KPMG, "The Clockspeed Dilemma: What Does It Mean for Automotive Innovation?" 2015

AV impacts on long-distance VMT

TWO CATEGEGORIES WITH VERY SIGNIFICANT CHARACTERISTICS

- Thru passenger travel
  - Business
  - Social
  - Recreational
  - Visit friends & relatives
- Thru freight travel
  - Agriculture/mining
  - Construction/manufac-turing
  - Wholesale/retail
  - Import/export

VMT IMPLICATIONS

- Major implications
- Lower Operating Costs = More Competitive = more VMT
- Reduced operator issues
- Expanded road-based market shifts business from Rail and Air as service range expands = more VMT

Summary on AVs and highways

- Level 4 automation unlikely before 2025.
- Replacing entire fleet would take 20 years from then (2045).
- Decades-long transition with mixed fleets, increased urban VMT, and increased congestion.
- What fraction will own AVs is unknown.
- Hence, long-term impact on transit and urban form is unclear.
- Long-term inter-city VMT will increase.

Trump Administration positive on P3s

- Campaign proposal: $1 trillion worth of revenue-financed P3 infrastructure.
- Recently, "mostly" private capital with "some" new federal money.
- Focus still more on reconstruction and replacement than all-new facilities.
- Not only transportation, but that gets the most emphasis.
- Another focus: streamlined approval process.

Appointees very P3-supportive

- White House
  - Gary Cohn, NEC
  - D.J. Gribbin, Asst. to President, Infrastructure
- US DOT
  - Elaine Chao, Secretary
  - Jeff Rosen and Derek Kan (#2 and #3)

Congress still a question mark

- P3 supporters mostly Republican.
- Some market-oriented Democrats support financing, private capital (e.g., Delaney).
- Rural state Senators and urban area House members want large new federal spending, leery of P3s.
- Compromise might emulate Australia's "asset recycling" approach.

Conclusions

- Traditional US highway model is broken.
- VMT has resumed upward trend, and AVs will increase it further.
- There’s a large backlog of highway and bridge investment needs.
- Financing and per-mile charging must replace per-gallon taxes.
- The P3 model addresses many shortcomings of the old model.
- Trump Administration support is positive for P3 model.

Questions?

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MODULE 3
CINTRA´S FUTURE

FUTURE GROWTH

CARLOS UGARTE

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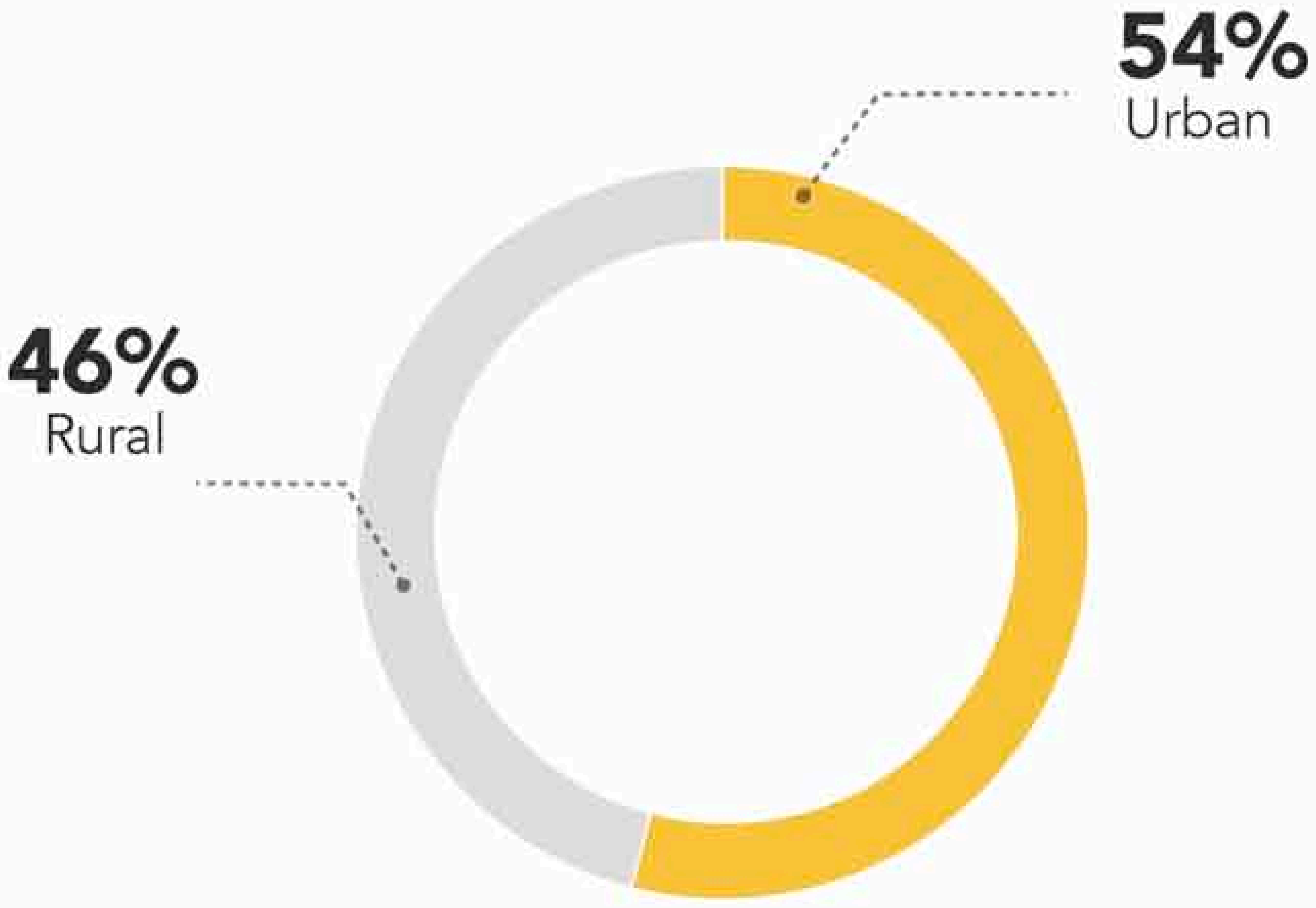
FUTURE GROWTH

1 INFRA NEED: WHY HIGH COMPLEXITY CONCESSIONS (HCCs)? WHY PRIVATE?

1. INFRA NEED: WHY HCCs? WHY PRIVATE?

INFRA TRENDS: MASSIVE DEMAND IN URBAN AREAS

WORLD POPULATION IN 2016: **7.4B PEOPLE**



The World Economic Forum estimates that the **current global investment** gap for infrastructure is **$1tr** per annum against an annual global investment demand of **$3.7tr**

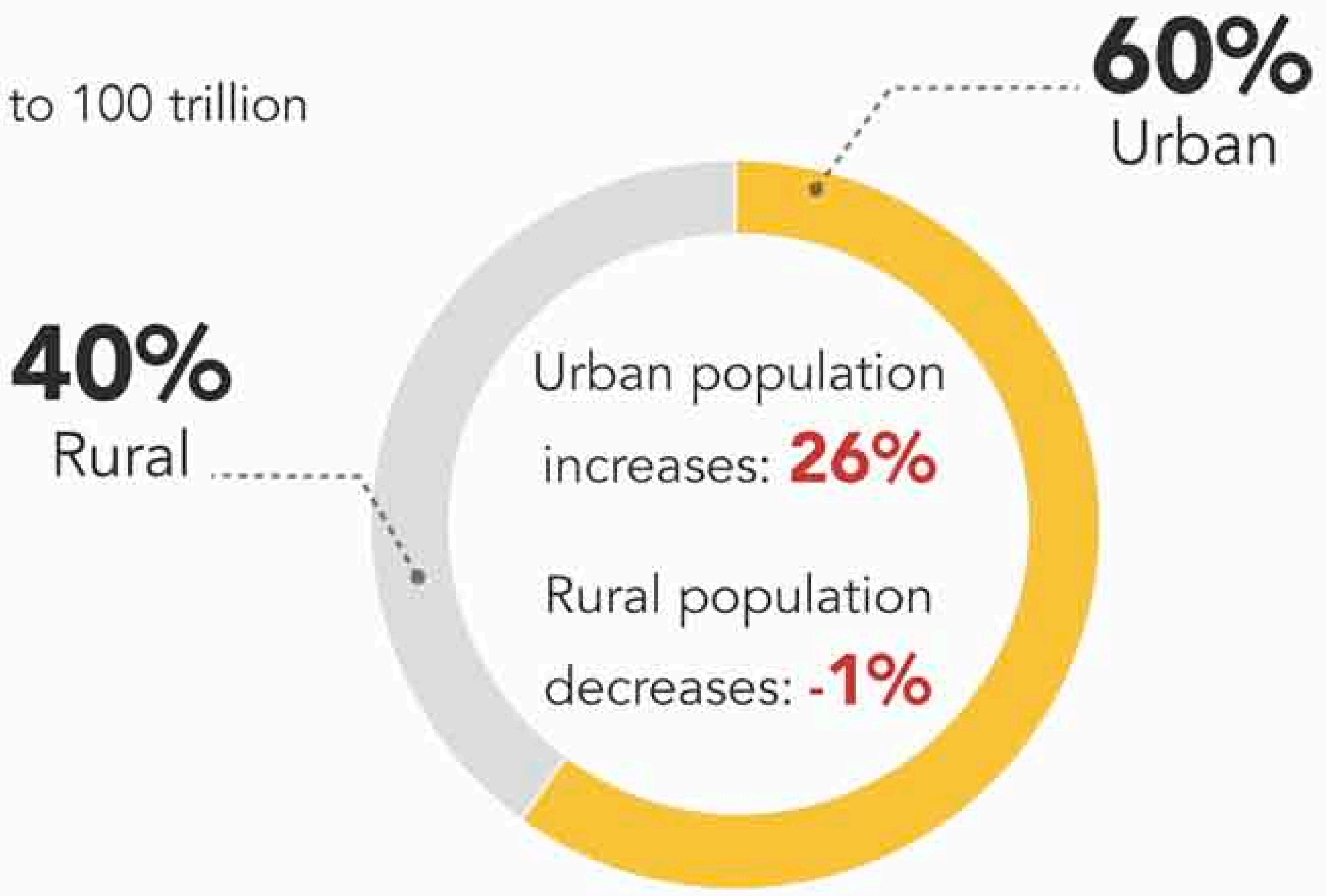
Sources: Cintra Infraestructures, S.E.

1. INFRA NEED: WHY HCCs? WHY PRIVATE?

INFRA TRENDS: MASSIVE DEMAND IN URBAN AREAS

- Global population expected to grow 1B by 2030 (World Economic Forum)
- Urban population will grow at a much higher rate than rural
- Number of vehicles will increase by **2x**. From **1B** in 2015 to **2B** in **2030**
- Number of kilometers traveled per capita per annum will double, from 50 trillion km p.a. to 100 trillion

WORLD POPULATION IN 2016 **2030**: 7.4 **8.4B PEOPLE**



Between now and 2030 the world population will grow a **14%** and the world is facing a vast **$14tr** shortfall in infrastructure

Sources: Cintra Infraestructures, S.E.

3. KEY STRATEGIC PRIORITIES
HIGH COMPLEXITY PROJECTS

MASSIVE DEMAND FOR ROADS AND TRANSIT INFRA IN WESTERN URBAN AREAS

1. INFRA NEED: WHY HCCs? WHY PRIVATE?

HCCS & PRIVATE INVESTMENT WILL PLAY A DECISIVE ROLE

WHY HCCs?	Infra gap is bigger in urban areas, both in developing and developed countries Adding road capacity does not solve the problem in the medium/long term Traditional tolling (fixed toll rates escalated over time) is not an efficient solution Dynamic tolling is the efficient solution, and HCCs in the form of Managed Lanes are the only feasible solution for sprawled medium-sized cities (2-6M) like most US cities

WHY PRIVATE INVESTMENT IS INEVITABLE?	**HCC:** are complex from a revenue, construction and financial standpoint. For these reasons, there is high potential for efficiencies and the private sector is better poised to capture it. **Governments:** can't afford the debt and can't provide de required subsidy ("equity") **Private sector:** likes HCC risk, has the funds to invest, and is more efficient than public sector as it has the right incentives

1. INFRA NEED: WHY HCCs?, WHY PRIVATE?

PRIVATE INVESTMENT IN MANAGED LANES IS THE ONLY LONG TERM SOLUTION TO ADDRESS MOBILITY PROBLEMS IN HIGHLY CONGESTED WESTERN URBAN AREAS

2 CINTRA´S CORE MARKETS

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Cintra concentrates on a handful of markets and certain categories of projects

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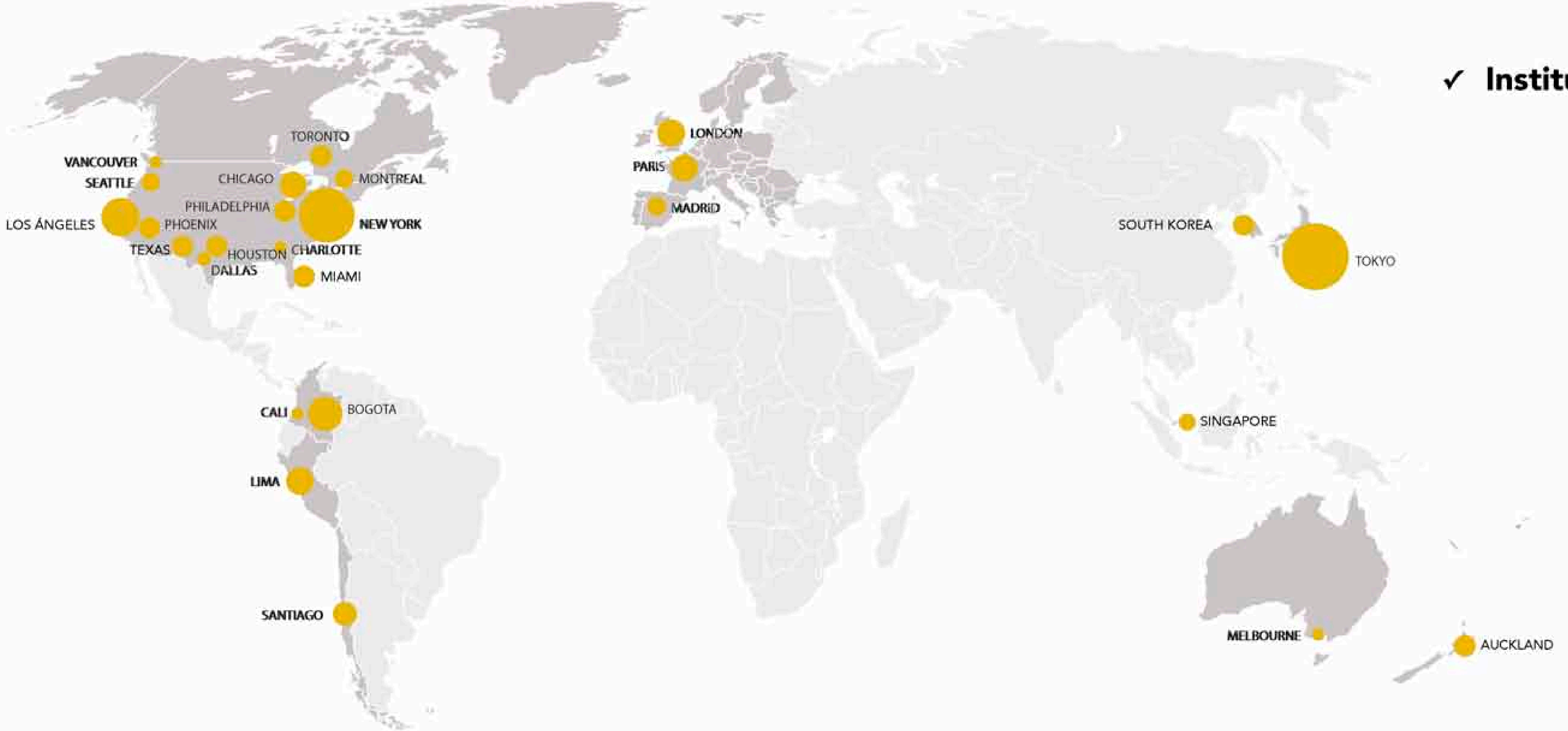
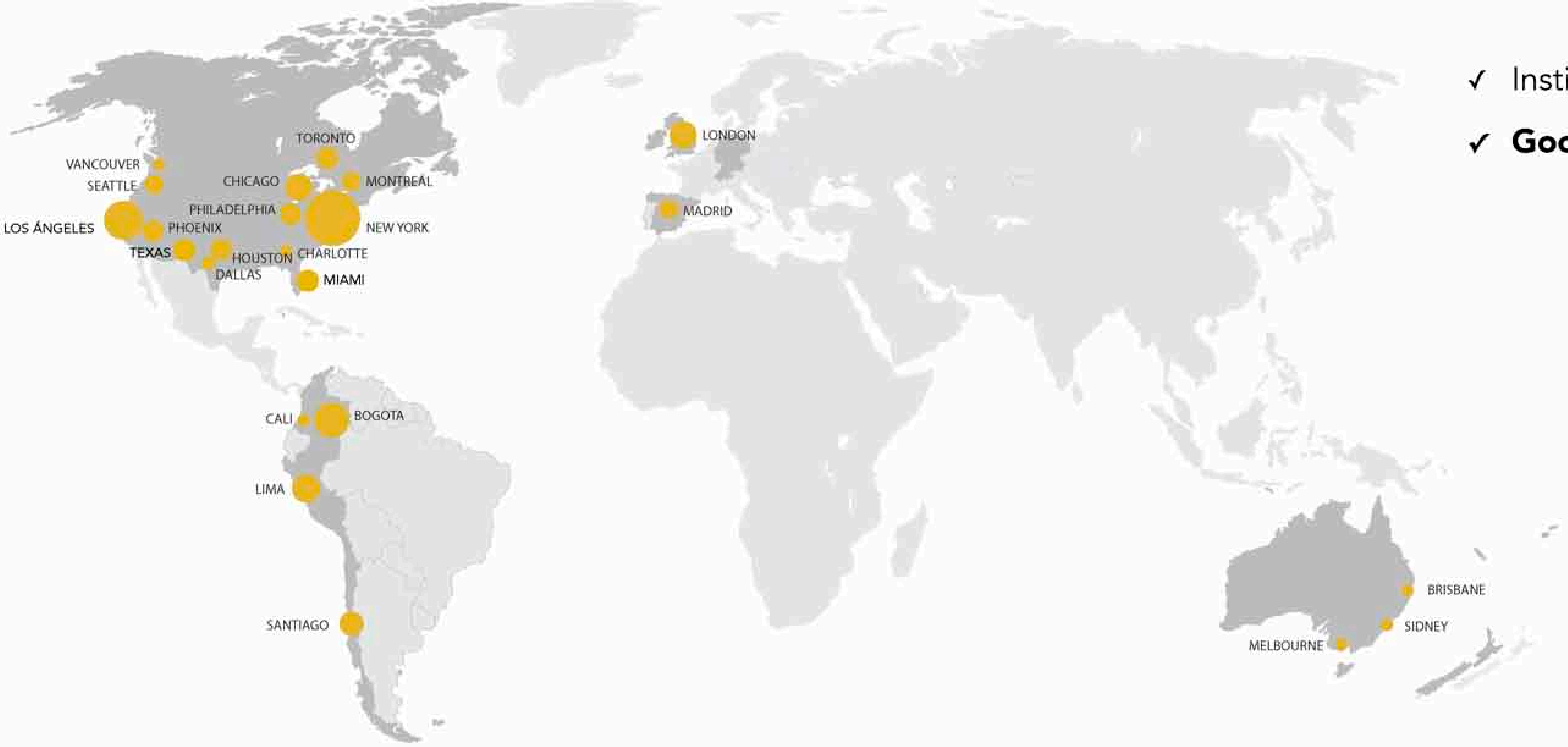


✓ **Institutional predictability**

2. CINTRA´S CORE MARKETS

Cintra concentrates on a handful of markets and certain categories of projects



- ✓ Institutional predictability
- ✓ **Good economic prospects**

2. OTHER MARKETS

Cintra concentrates on a handful of markets and certain category of projects

- ✓ Institutional predictability
- ✓ Good economic prospects
- ✓ **Essential projects**

CORE MARKETS: USA, AUSTRALIA, CANADA & UK

2. OTHER MARKETS

Cintra concentrates on a handful of markets and certain category of projects

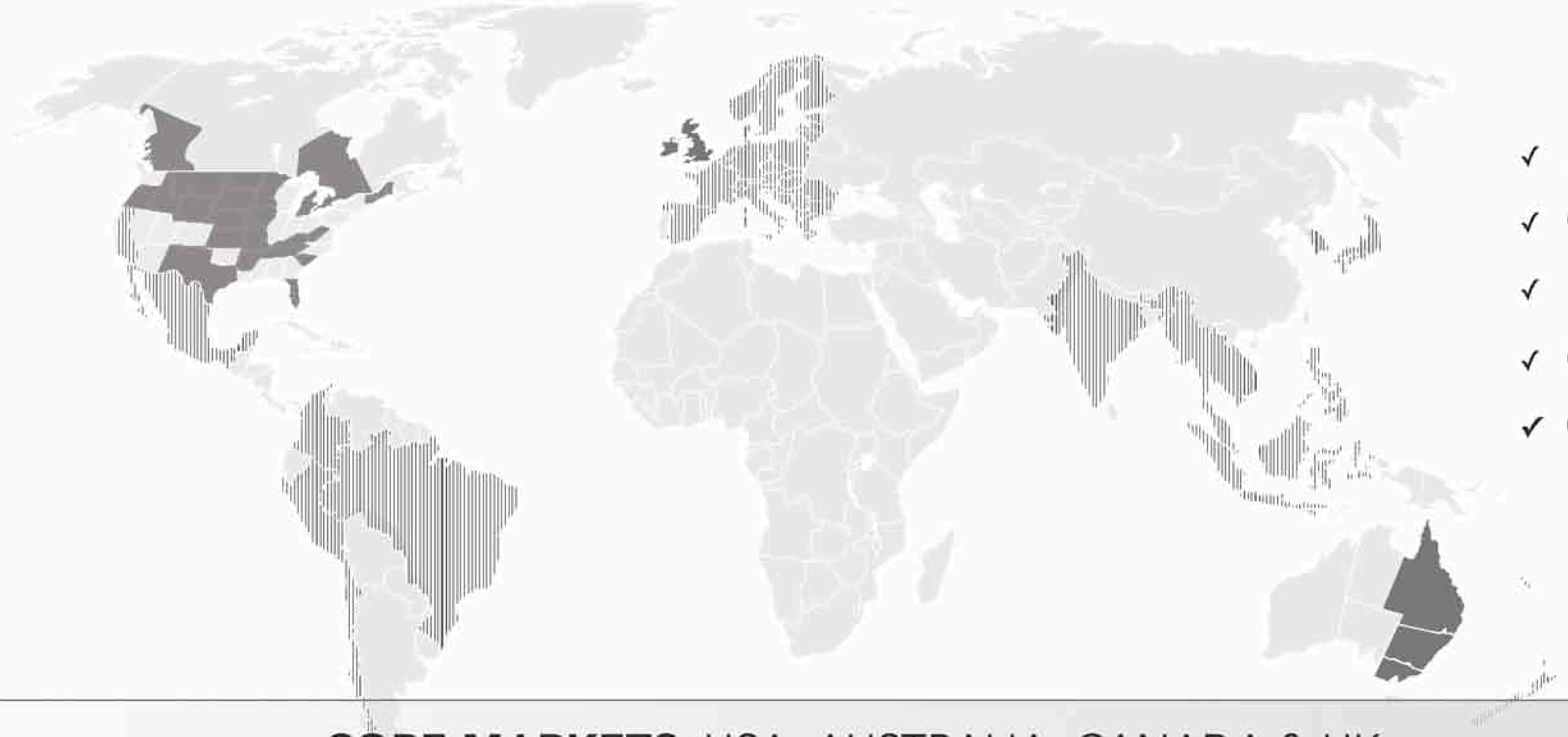
- ✓ Institutional predictability
- ✓ Good economic prospects
- ✓ Essential projects
- ✓ **Other countries of interest**

CORE MARKETS: USA, AUSTRALIA, CANADA & UK

OTHER COUNTRIES OF INTEREST: PERU, COLOMBIA, CHILE, SPAIN & GERMANY

2. OTHER MARKETS

Cintra concentrates on a handful of markets and certain category of projects



- ✓ Institutional predictability
- ✓ Good economic prospects
- ✓ Essential projects
- ✓ Other countries of interest
- ✓ **Other countries we follow**

CORE MARKETS: USA, AUSTRALIA, CANADA & UK

OTHER COUNTRIES OF INTEREST: PERU, COLOMBIA, CHILE, SPAIN & GERMANY

OTHER COUNTRIES WE FOLLOW: REST OF EUROPE, BRAZIL, MEXICO, INDIA & SOUTHEAST ASIA

3 KEY STRATEGIC PRIORITIES

3.1 HIGH COMPLEXITY CONCESSIONS (HCCs)

3. KEY STRATEGIC PRIORITIES
HIGH COMPLEXITY CONCESSIONS (HCCs)

HIGH COMPLEXITY (MANAGED LANES or 407 ETR)

WHY?

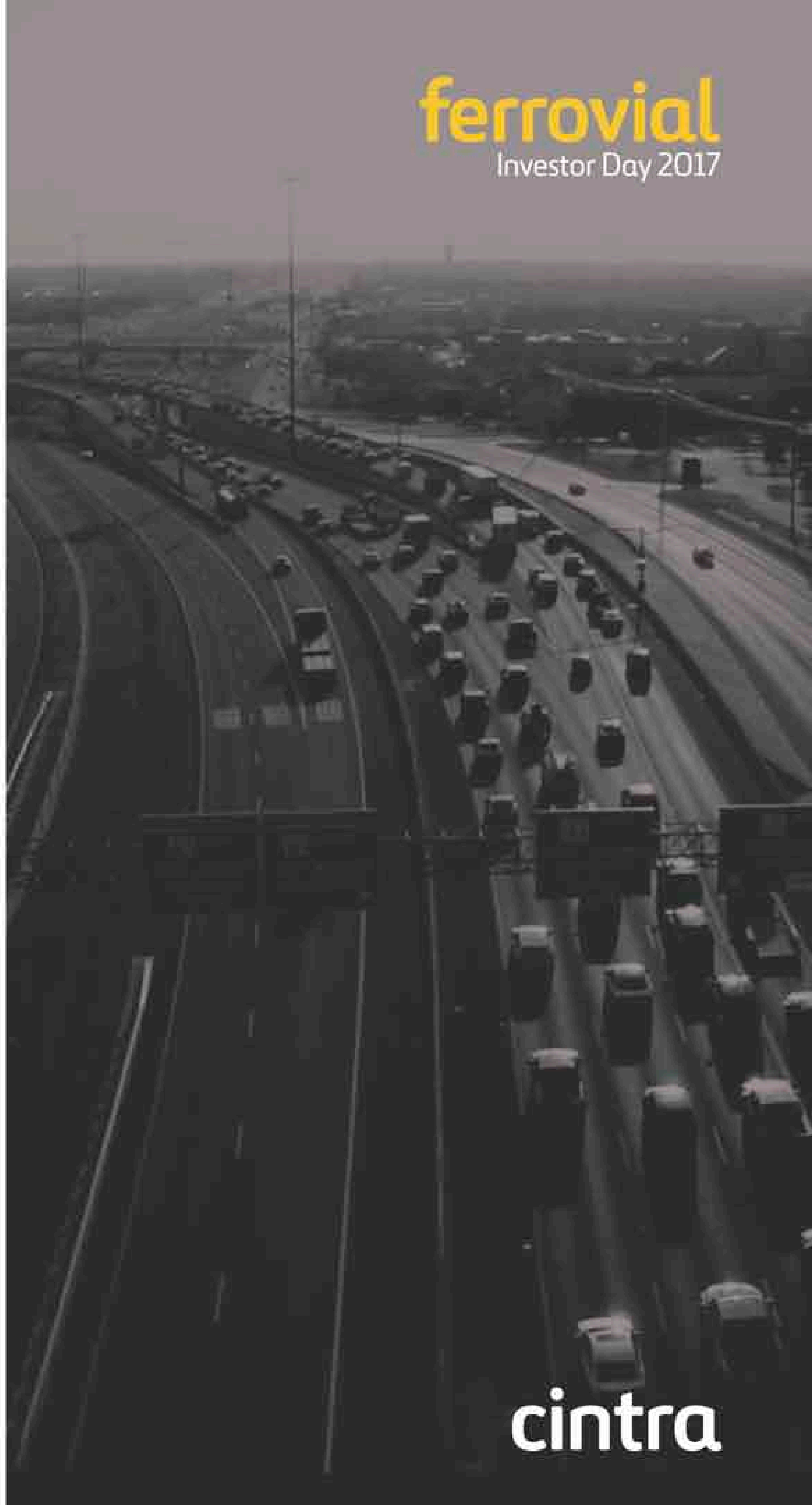
BEST SOURCE OF **VALUE CREATION**

Value arises from offering consumers the **right service at the right price therefore capturing consumers willingness to pay**

THERE IS A PIPELINE

MANAGED LANES ARE THE **FUTURE**:

ML are the **efficient** solution for mobility problems in congested western urban cities



3. KEY STRATEGIC PRIORITIES
HIGH COMPLEXITY CONCESSIONS (HCCs)

WHY?	Cintra has **unrivaled competitive advantages** when competing for this asset class

PRIVATE MANAGED LANES PROJECTS IN US

Sources: Cintra Infraestructures, S.E.

3. KEY STRATEGIC PRIORITIES
HIGH COMPLEXITY PROJECTS

OUR MAIN PRIORITY IS MANAGED LANES

* Prices adjusted by inflation

3.2 LOW-MEDIUM COMPLEXITY AVAILABILITY PROJECTS

3.2 OTHER CINTRA PRIORITIES
LOW-MEDIUM COMPLEXITY AVAILABILITY PROJECTS

LOW-MEDIUM COMPLEXITY AVAILABILITY PROJECTS

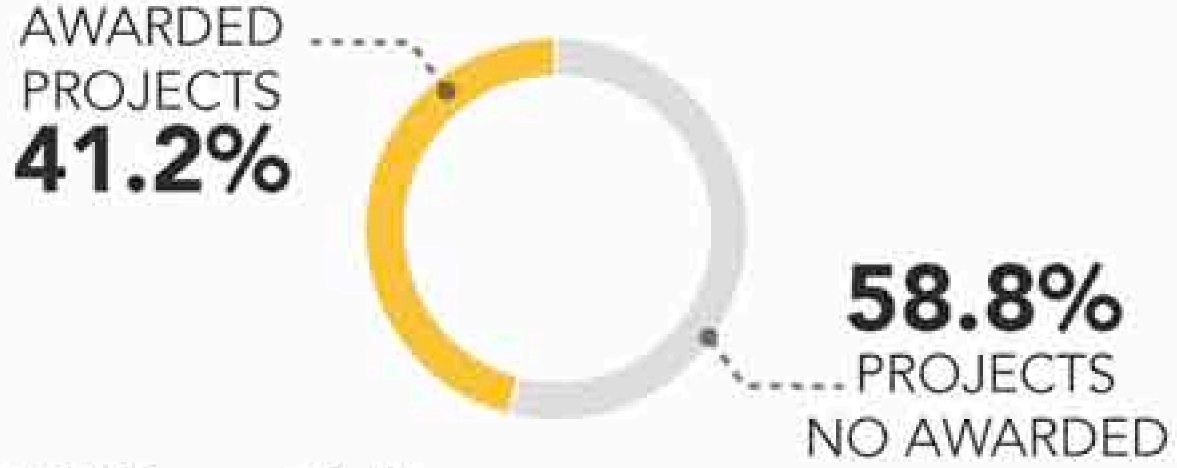
WHAT TYPE?

- Big equity tickets
- Construction complexity
- Operational complexity
- Not only roads but also other infra that requires Cintra's bidding & operating skills

WHY?

- Steady and **abundant pipeline**
- The integrated business model with Ferrovial Agroman provides us with **competitive advantages:**
  - Increases with the size and complexity of the opportunity

Hit Ratio: **World Financial Crisis to Date**
2009-2016



- This asset class **creates value** both "standalone" and as a complement to our HCC portfolio
  - Standalone: market returns (or even above market returns)
  - Complementary to our HCC portfolio:
    - Positions Cintra / Ferrovial in the market with: grantors, subcontractors, partners, etc.
    - Keeps the team "tuned"
      - Creates growth opportunities that allow to retain and attract talent
      - Prepares the team for managing high complexity projects (HCCs)

Sources: Cintra Infraestructures, S.E.

3. 2 OTHER CINTRA PRIORITIES

LOW-MEDIUM COMPLEXITY AVAILABILITY PROJECTS

THE BEST TEAM IN THE WORLD CAN'T WIN ONLY ON ITS WILL, THEY NEED TRAINING, HARD WORK AND TO BE TUNED

4 PIPELINE

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4. PIPELINE
SHORT TO MEDIUM TERM **3-5 YEARS**

- Enough pipeline in our target markets (our "small world") of complex revenue projects
  HCC and low-medium complex availability projects

TOTAL INVESTMENT VALUE	**€103B**
TOTAL EQUITY REQUIREMENTS (CINTRA)	**€9B**

6	**13**	**38**
TOTAL MANAGED LANES PROJECTS	TOTAL REVENUE RISK PROJECTS*	TOTAL AVAILABILITY PROJECTS

* NOT INCLUDING MANAGED LANES

Sources: Cintra Infraestructures, S.E.

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4. PIPELINE

SHORT TO MEDIUM TERM **3-5 YEARS**

Managed Lanes	6
Toll	1
Rail	9
Availability	13

€56B
€8B equity

Toll	4
Rail	3
Availability	3

€24B
€265M equity

Toll	1
Rail	1
Availability	5

€10B
€200M equity

Toll	7
Rail	3
Availavity	1

€13B
€580M equity

Sources: Cintra Infraestructures, S.E.

4. PIPELINE

SHORT TO MEDIUM TERM **3-5 YEARS**

MANAGED LANES PIPELINE:

THE QUESTION IS NOT IF... IT'S WHEN THIS WILL HAPPEN

OUR CHALLENGE AS LEADERS, IS HOW TO ACCELERATE ITS DEVELOPMENT

5 WHY CINTRA WILL CAPTURE A SIGNIFICANT PORTION OF THE PIPELINE

5. WHY CINTRA WILL CAPTURE A SIGNIFICANT PORTION OF THE PIPELINE

Competitive advantages

- Capable of extracting value from HCC portfolio
- Implementation of economies of scale

Ferrovial Group vertical integration

- Coordinated bidding approach with Ferrovial Agroman
- Transaction costs minimization and risk mitigation through alignment of interest

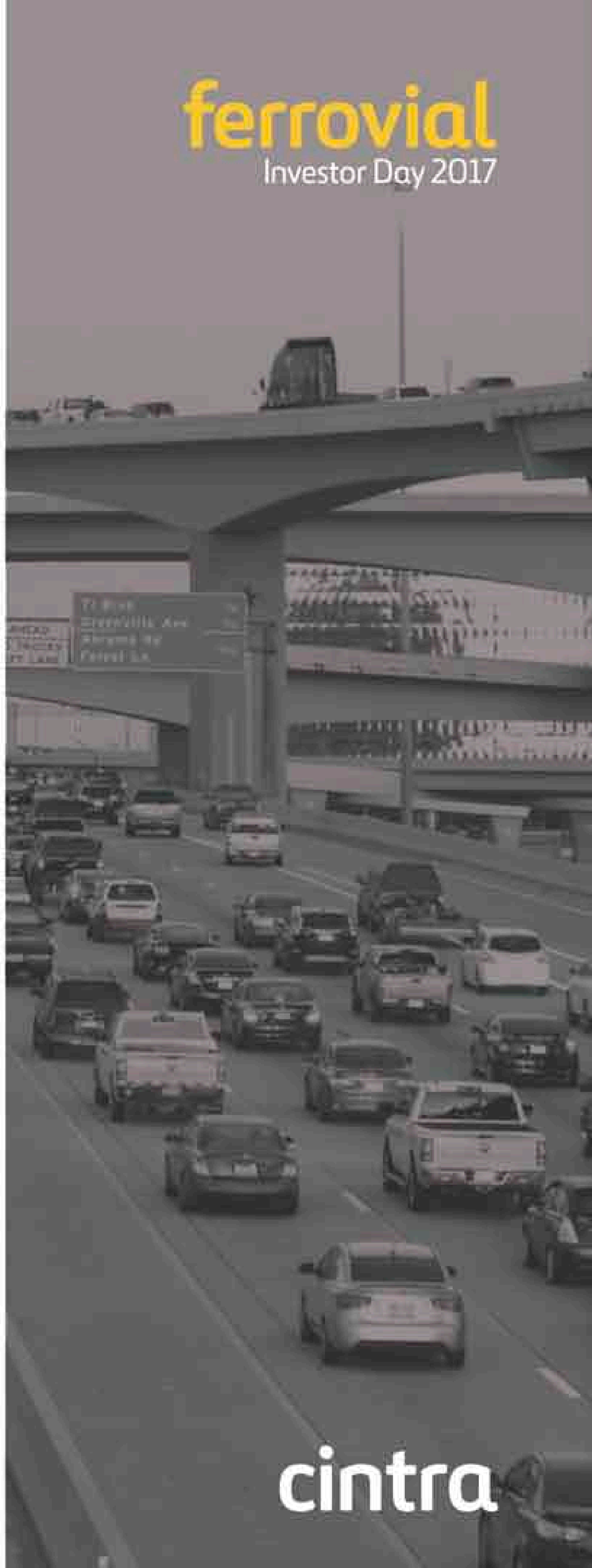
Credibility in the **market**

- Better market conditions from partners and lenders, due to trust in Cintra's expertise and consistent investment approach

Experienced & specialized In-house bidding team, with a proven track-record

- Pioneer: markets, asset classes and pricing methodologies
- Long term experience & expertise in analyzing the whole range of project types and contracts
- All required bidding inputs produced by in-house teams (legal, technical, financial structuring, and financial analysis)
- Bidding teams leverage the evolving knowledge from the operation of 6 owned HCCs

WE HAVE IN-HOUSE WHAT IT TAKES, WE HAVE DONE IT BEFORE,
AND OUR COMPETITORS, INSTEAD, HAVE ADVISORS



6 HOW WILL CINTRA STAY “AHEAD OF THE CURVE”?

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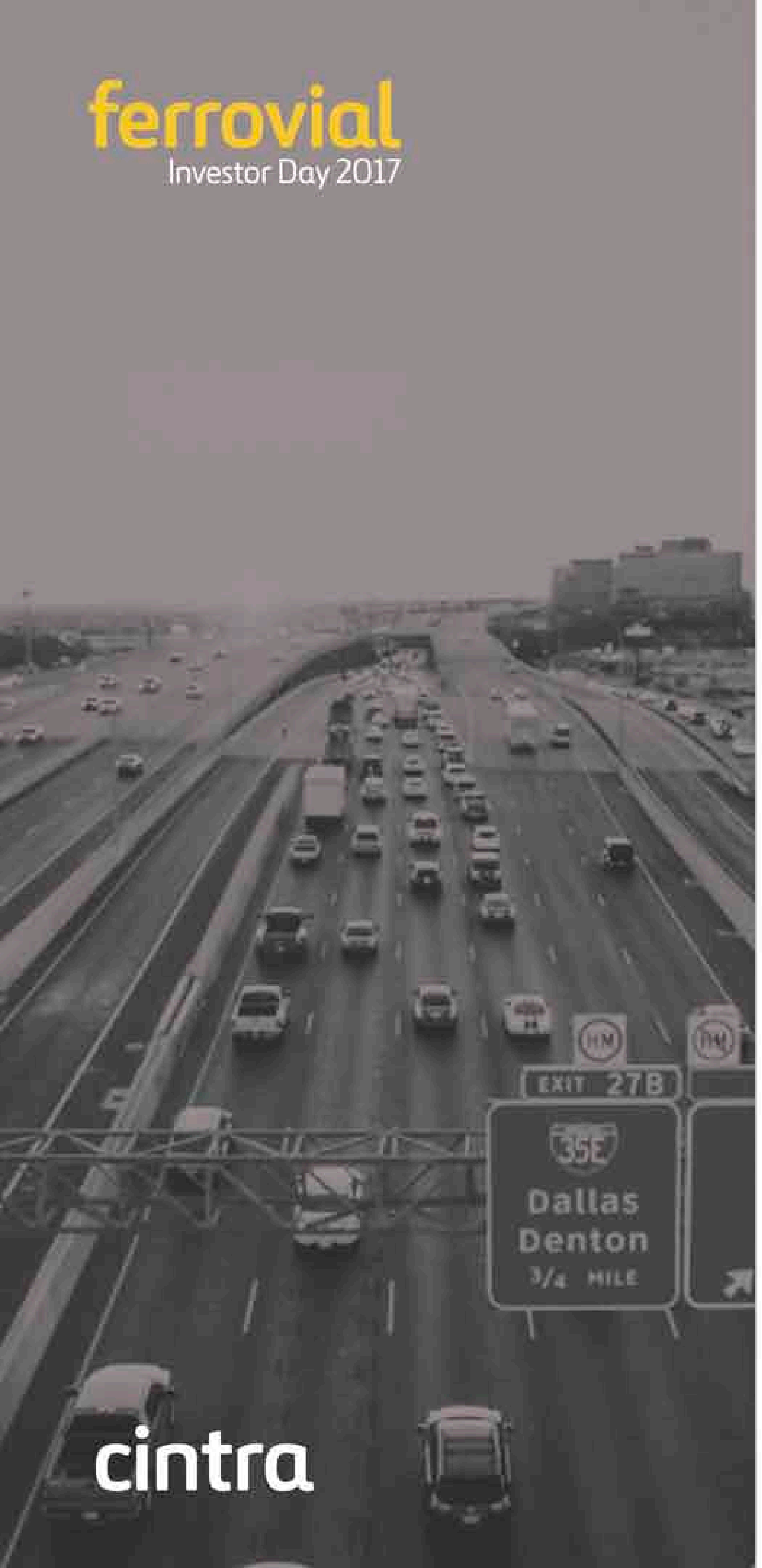

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6. HOW WILL CINTRA STAY "AHEAD OF THE CURVE"?

THROUGH PROACTIVE BUSINESS DEVELOPMENT

1 - Positioning Cintra as a "local player" to maximize our competitiveness

2 - Proposing innovative and value-added solutions to the client, both at planning and bidding phases, to make projects feasible and more attractive to the private sector and the authority

3 - Early scanning of potential opportunities and working with the public authorities to create new projects.

4 - Proposing ideas to accelerate the procurement process

THROUGH THE DEVELOPMENT OF NEW COMPETITIVE ADVANTAGES

BIG DATA: SOURCE OF NEW COMPETITIVE ADVANTAGES

NICOLÁS RUBIO - RICARDO SÁNCHEZ

BIG DATA AS THE SOURCE OF NEW COMPETITIVE ADVANTAGES

OVER TIME, COMPETITIVE ADVANTAGES BECOME WIDESPREAD KNOWLEDGE

HOW ARE WE REMAINING AHEAD OF THE CURVE?

- **Big Data Analytics**:
  - New technologies are opening an amazing array of possibilities to better understand network traffic conditions and users' travel behavior > new competitive advantages to:
    - Improve accuracy of traffic and revenue forecasts
    - Optimize revenue in existing projects

- **Main challenges** of using Big Data
  - **Formulate the right business questions**
    - Searching for business-useful knowledge rather than "interesting information"
  - **Collect the right data:** mix of proprietary and external sources
  - **Adequate set of skills** to conduct analysis and extract value out of the Data

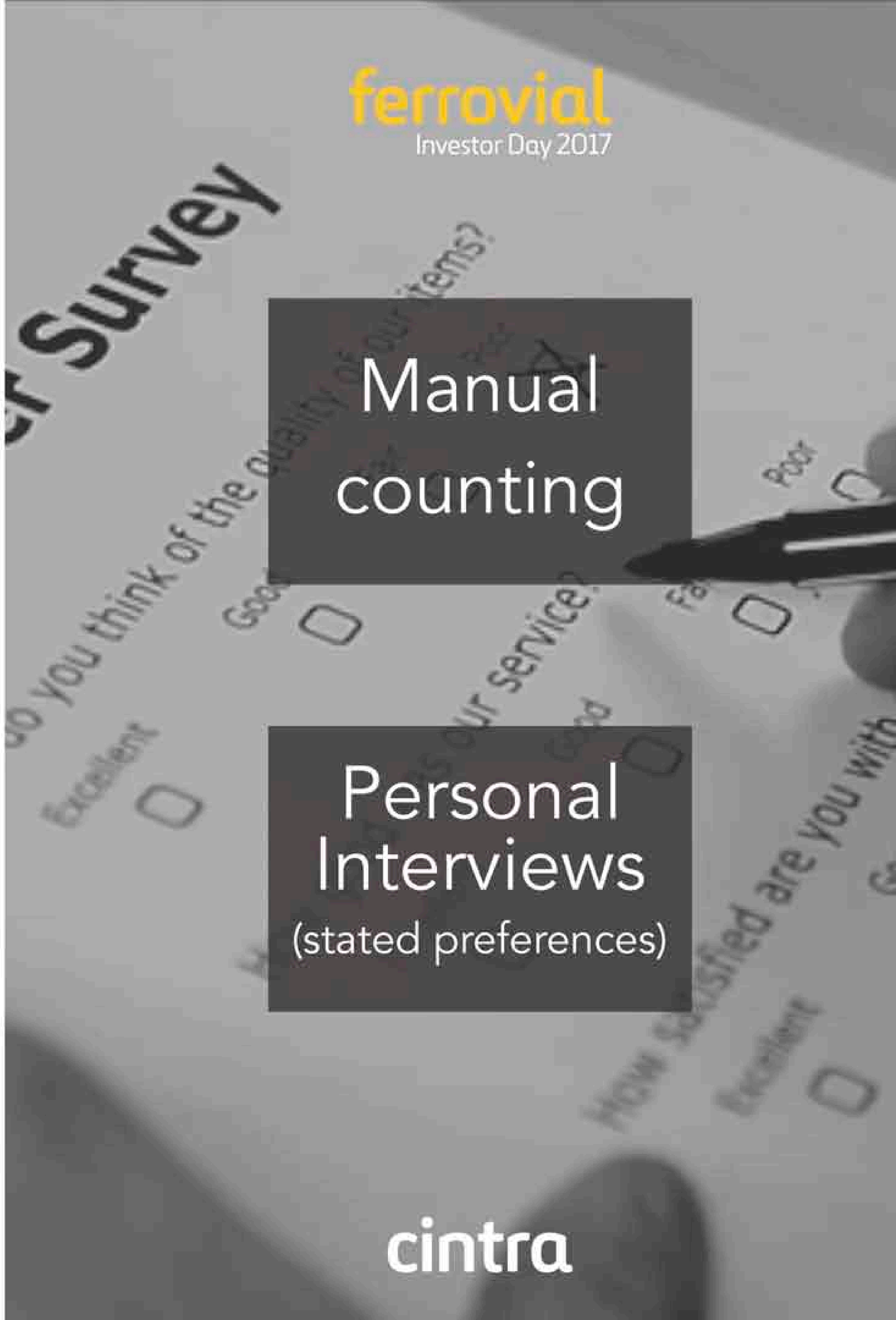
CINTRA IS AHEAD OF THE COMPETITION IN THE USE OF BIG DATA TECHNIQUES

AVAILABILITY OF DATA FOR UNDERSTANDING DRIVERS' BEHAVIOR

THE OLD WORLD

DATA SCARCE, OUTDATED, HARD AND EXPENSIVE TO GET, WITH POOR GRANULARITY AND LOW ACCURACY

- Origin-destination data based on surveys
- Congestion data collected manually
- Willingness to pay not based on real observations **(stated preferences)**



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THE NEW WORLD

OVERABUNDANT AND RELIABLE DATA…
…FROM EXTERNAL SOURCES AND PROJECT PORTFOLIO

- New data sources allow us to understand users' behavior in Cintra's toll roads and alternative free roads
- **Revealed preferences (real data)**, as opposed to the less accurate stated preferences (surveys)

DATA PROVIDED BY BIG DATA TECHNOLOGIES DRAMATICALLY IMPROVE:
- Accuracy of Traffic and Revenue forecasts
- Revenue Optimization in existing projects

Business analytics

IMPROVING ACCURACY OF TRAFFIC & REVENUE FORECASTS FOR NEW PROJECTS

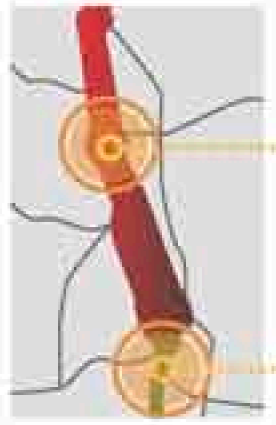
BIG DATA ALLOWS FOR BETTER INSIGHT INTO KEY FORECASTING VARIABLES

1. CORRIDOR CONGESTION LEVELS

Continuous speed data from cellphones or GPS-equipped vehicles

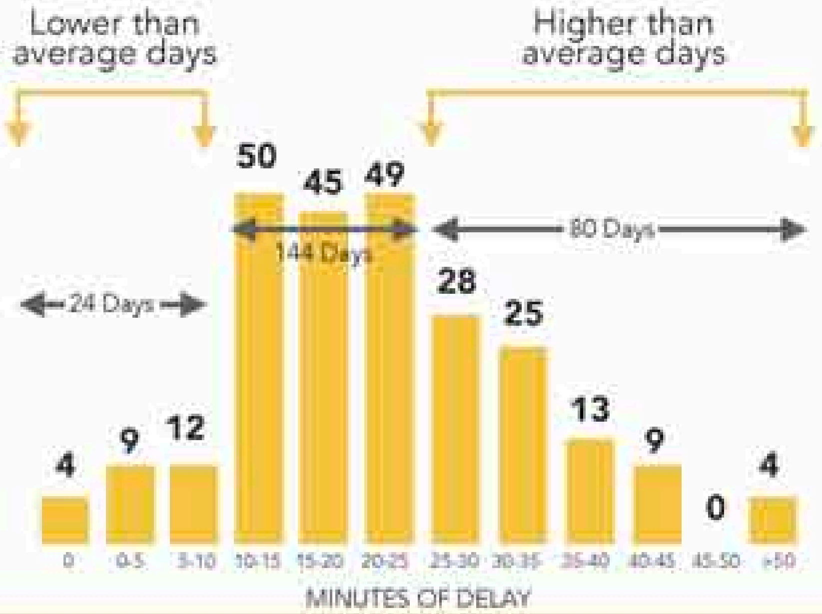
What for:

- Identification of bottlenecks



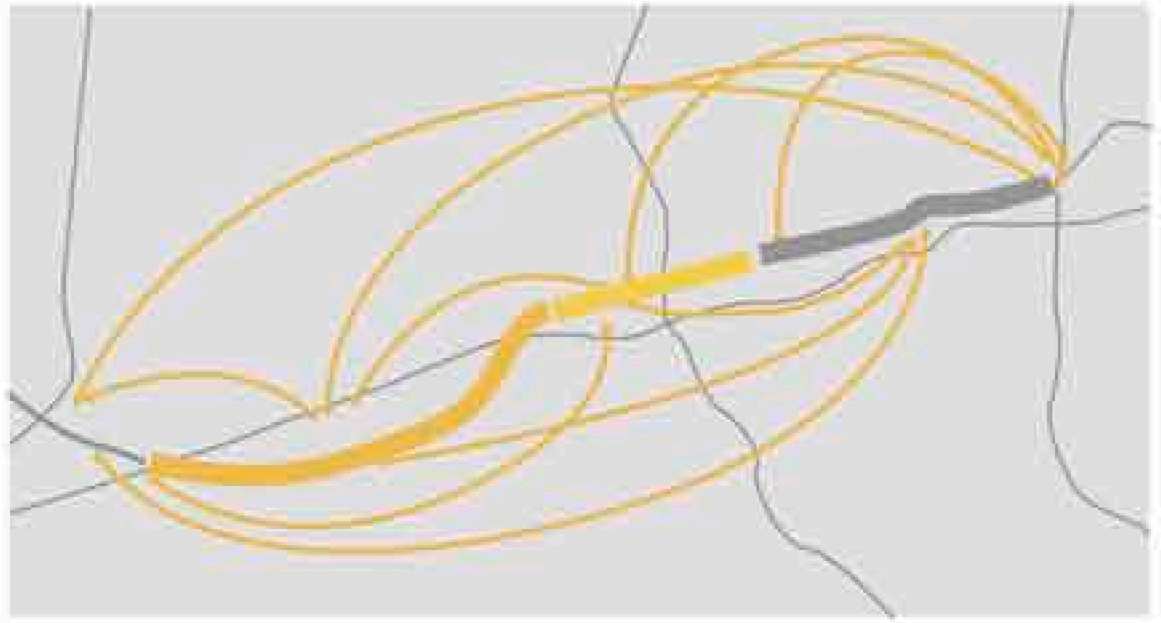
Temporary 3 to 2 lanes reduction due to construction

- Identification of number of days in the year with abnormal congestion levels



2. CORRIDOR TRIP PATTERNS

Bluetooth or GPS location data from cellphones



What for:

Determine potential users of a road project (in-scope traffic)

Optimize Connectivity to maximize potential project users and revenue

3. DRIVER'S WILLINGNESS TO PAY

From users data collected in 407 ETR & Managed Lanes

What for:

Estimate observed willingness to pay of users under different traffic conditions (weather, special events) to refine revenue estimates

Already known by the market. Ahead of competition in usage and skills.
Temporary competitive advantage

Proprietary data.
Permanent competitive advantage

Sources: Cintra Infraestructures, S.E.
Random data for indicative purposes only

IMPROVING REVENUE OPTIMIZATION IN EXISTING PROJECTS: 407 ETR

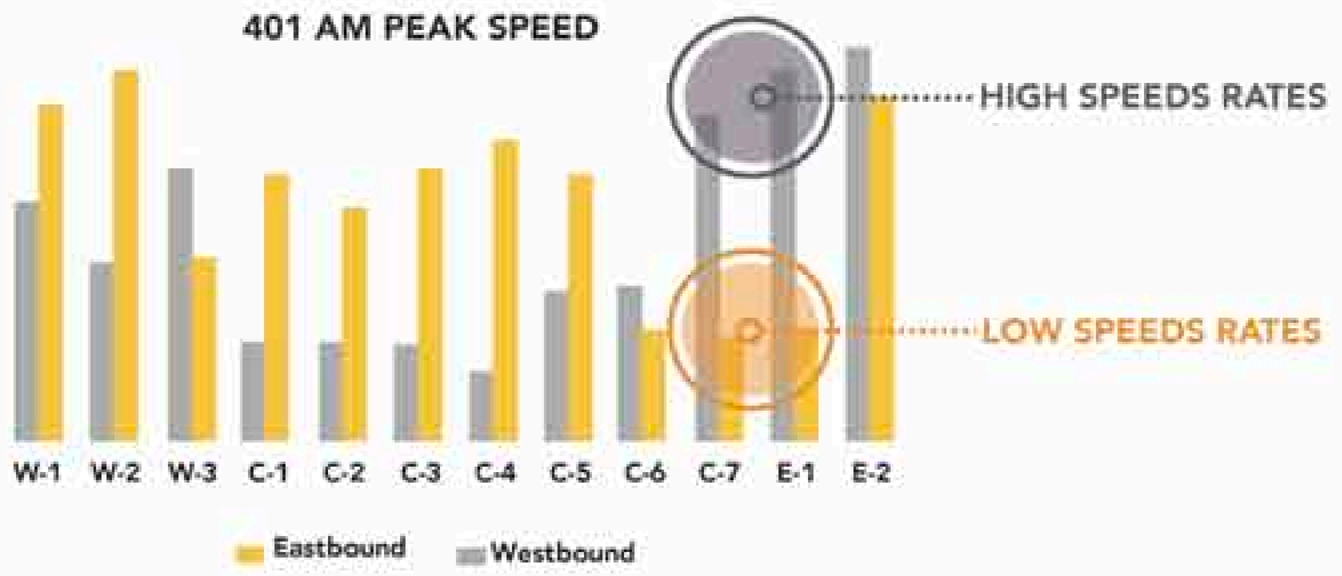
THROUGH BIG DATA, 407 ETR MANAGEMENT HAS ACCESS TO ACCURATE INFORMATION OF USER-BEHAVIOR ON ALTERNATIVE ROADS, KEY TO DESIGN OPTIMAL TOLLING STRATEGIES

- **Former data challenge:** Lack of knowledge of current traffic conditions on main alternative road 401 (outdated and low quality data)

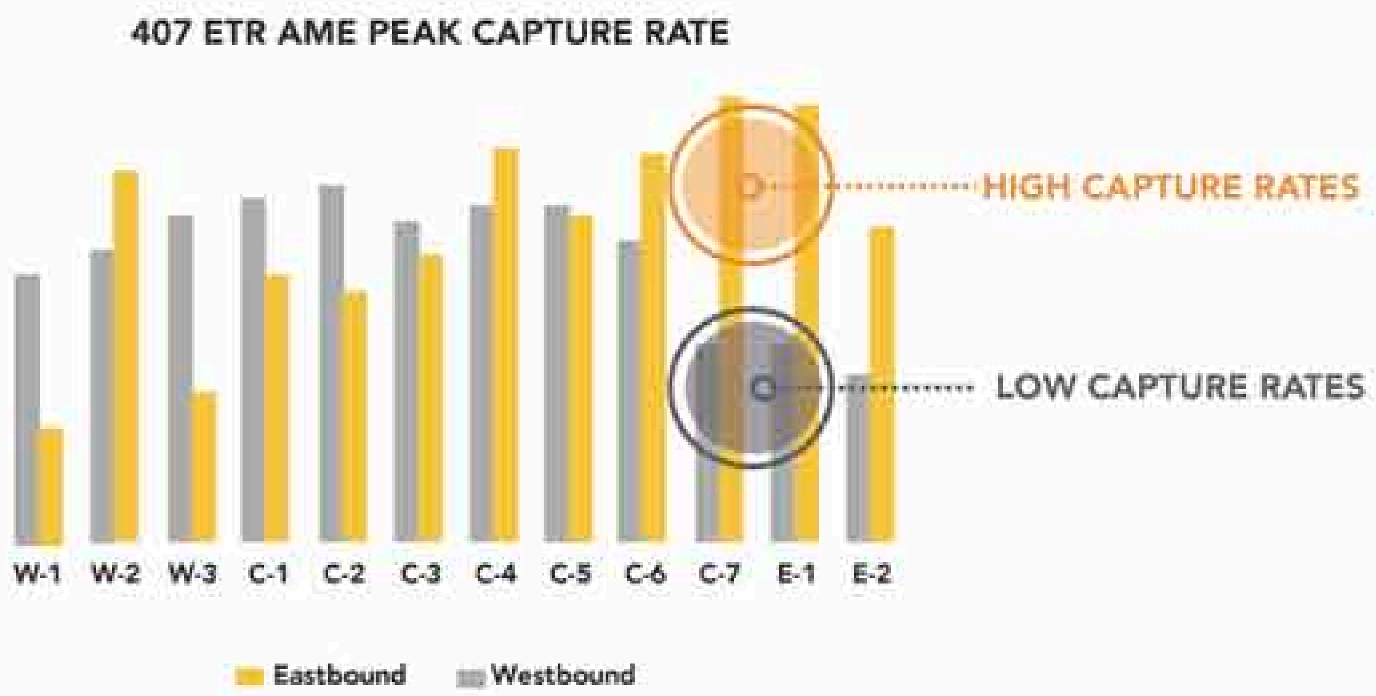
- **Big Data potential:** accurately measuring 401 traffic fluctuations when tolls vary in 407 ETR
    - Key to allow more granular price discrimination by zone, time of day, direction, etc

BIG DATA APPLICATION EXAMPLE: 2017 INTRODUCTION OF DIRECTIONAL TOLLING

Congestion levels in 401



Estimate capture rates of 407 ETR vs 401



OPTIMIZATION OF TOLLING POLICY WITH DIRECTIONAL TOLLING

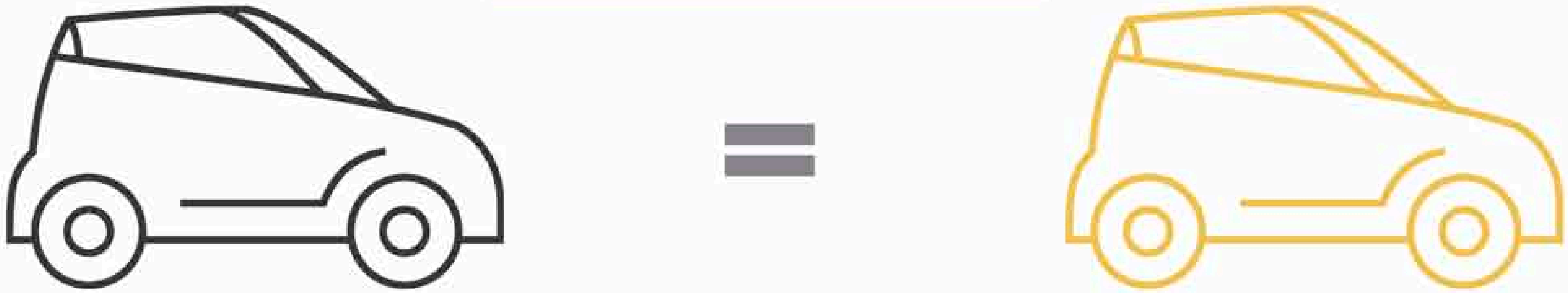
Sources: Cintra Infraestructures, S.E.

IMPROVING REVENUE OPTIMIZATION IN EXISTING PROJECTS: MANAGED LANES

CASE-IN-POINT: INFREQUENT CUSTOMER CHARACTERIZATION (KEY TO DESIGN TARGETED PRICE STRATEGY)

- Collecting and processing more data is a powerful tool:

With data on ML Trips only



User 1
Infrequent ML user

User 2
Infrequent ML user

UNIFORM TOLLING STRATEGY: SUBOPTIMAL FOR ALL USERS

IMPROVING REVENUE OPTIMIZATION IN EXISTING PROJECTS: MANAGED LANES

CASE-IN-POINT: INFREQUENT CUSTOMER CHARACTERIZATION (KEY TO DESIGN TARGETED PRICE STRATEGY)

- Collecting and processing more data is a powerful tool:

With data on MLs and GPLs trips

User 1
Infrequent ML user
Infrequent Corridor user

User 2
Infrequent ML user
Frequent Corridor user

OPTIMAL TOLLING STRATEGY:

- General toll tailored to User 1, discount plan for User 2
- Revenue optimized while better serving more customers

IF YOU UNDERSTAND IT, WITH THE RIGHT DATA AND KNOWLEDGE OF HOW TO USE IT, BIG DATA CAN LEAD TO BIG VALUE AND REVENUE.

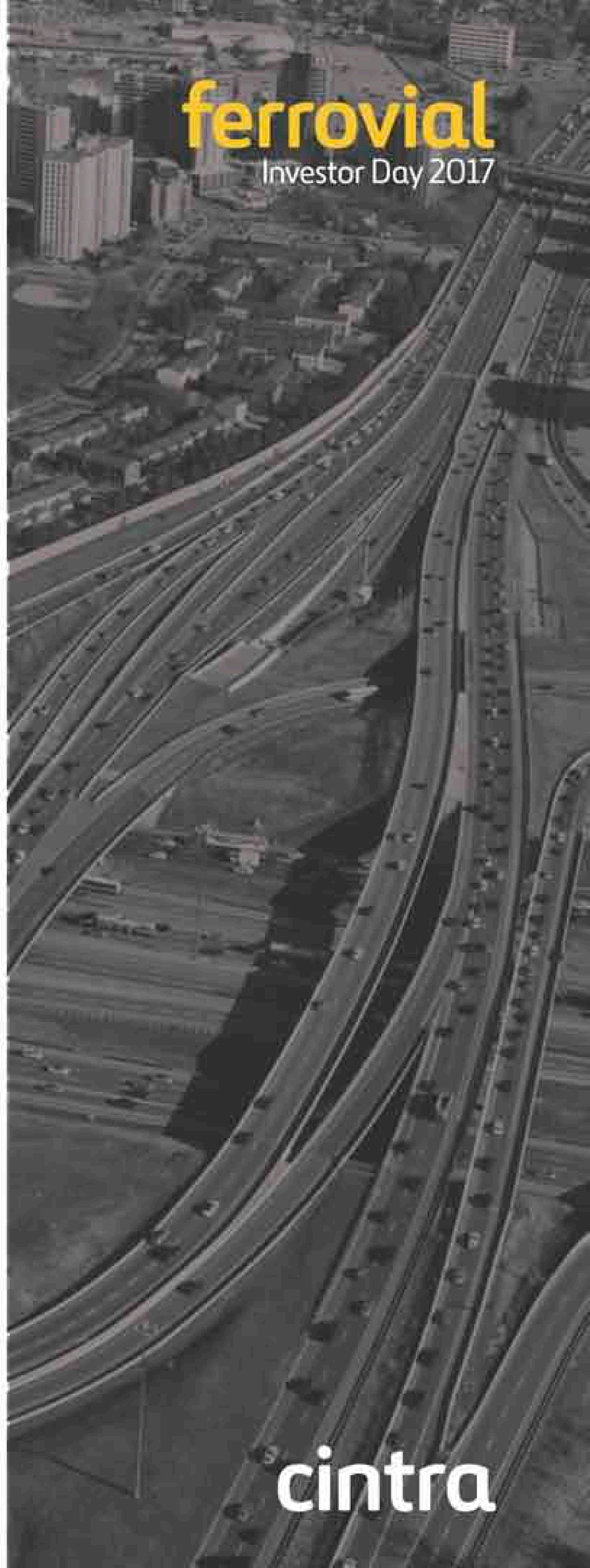
CHALLENGES & OPPORTUNITIES

NICOLÁS RUBIO - RICARDO SÁNCHEZ - FRANCISCO CLEMENTE

INDEX
CHALLENGES & OPPORTUNITIES

1 - Technological developments and mobility trends
- Connected and autonomous vehicles (CAVs)
- Car sharing and ride sharing
- Millennials´, changes in travel behavior and habits

2 - Interest and exchange rate risks
- Categories of assets
- Economic theory
- Effect of interest rates on asset valuation (407 ETR & ML's)



1 TECHNOLOGICAL DEVELOPMENTS & MOBILITY TRENDS

TECHNOLOGICAL & MOBILITY TRENDS: CONTEXT

SPECULATION ON NEW TRENDS AND TECHNOLOGIES' IMPACT ON THE TOLL ROAD BUSINESS:

- Will autonomous vehicles radically change the way we get around?
- Has the Millennial generation shunned cars and driving?
- Will the changes in our way of working and living impact urban congestion?
- Will it be unnecessary to build new roads?

A RIGOROUS LOOK AT THESE TRENDS SHOW

- No grounds for the toll road industry to worry
- Opportunity for business improvement

CONFUSION DUE TO

- Misconceptions on the behavioral impact of new technologies
- Misreading factual data and evidence

CONNECTED AND AUTONOMOUS VEHICLES (CAVs)

Connected and Autonomous vehicles have arrived and will be **fully** deployed in **30 to 50 years**

- Full automation **will have negative and positive effects** on the toll road business:

(−) **Increasing effective road capacity**
- Vehicles driving closer, faster, and interacting more efficiently with each other

(+) **Increasing road demand**
- Lower car-usage cost (consuption and capital cost)
- More valuable use of in-vehicle time (> larger cars?)
- New population on the road: young, old and disabled individuals
- Increasing urban sprawl & commuting distances
- Empty car rides.

End of process balance still unclear. Research points to CAVs deployment **not reducing congestion**

- **Transition Period** to full deployment **will stress urban congestion**

  - Challenging interaction with conventional vehicles: safety and liability concerns
  - Business opportunity
    - Dedicated highways with extensive ITS, better placed to host Connected vehicles

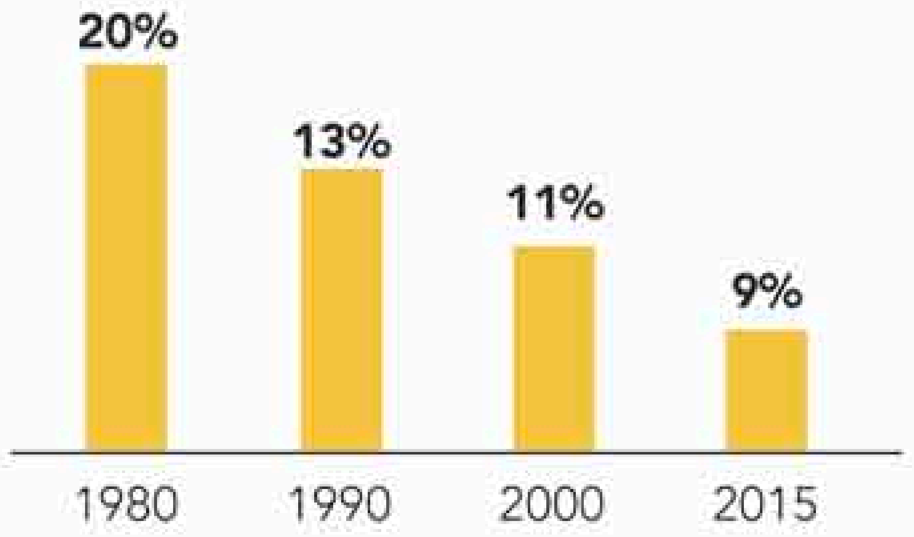
NOT NECESSARILY BAD FOR THE TOLL ROAD BUSINESS IN THE LONG TERM (FULL AUTOMATION)
POSITIVE IMPACT IN THE SHORT AND MEDIUM TERM (TRANSITION PERIOD)

CAR SHARING AND RIDE SHARING

TWO VERY DISTINCT CONCEPTS:

Car-Sharing: Same car used by successive users in successive trips
- **Will reduce vehicle fleet**, parking needs and car usage costs
- **Will increase road traffic** and road congestion (due to lower car usage costs)

Ride-Sharing: several users sharing the same ride (High Occupancy Vehicles –HOVs- or Carpools)
- **Actual data*** shows ride-sharing decline over time:

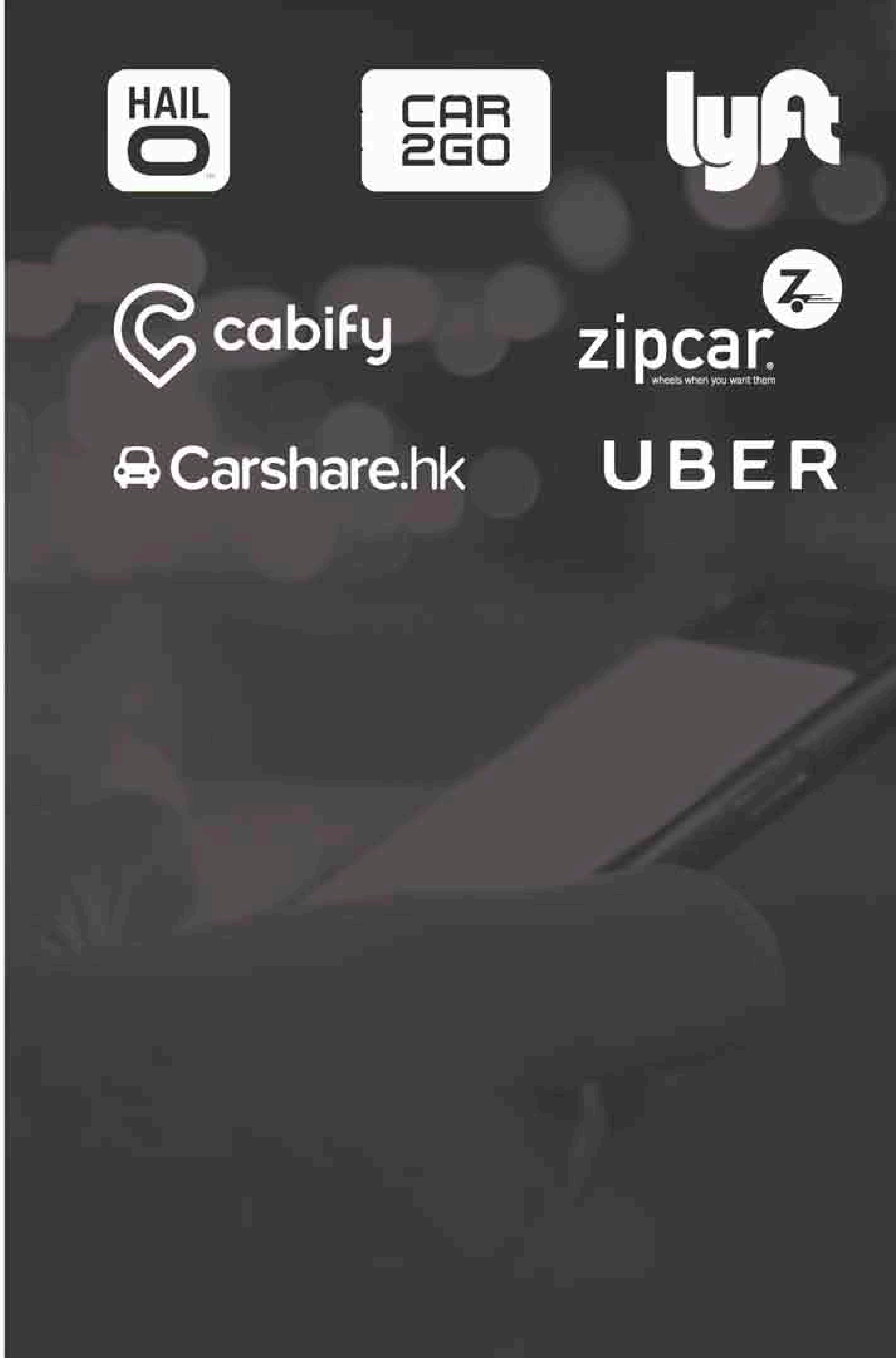


Two factors behind the reduction in carpool:
- Increase in "trip chaining" (multiple purpose trips by growing # of working couples)
- Increased affordability and ease of car use

- **New trend:** ride-sharing Companies (UBER, Lyft,...) having a growing success
  - Ride Sharing capturing transit demand and not drive-alone trips
  - Negatively impacting Transit ridership: NY subway fell in 2016 due to ride-sharing**
  - Ride-sharing companies are increasing car use and urban congestion

CAR SHARING AND RIDE SHARING ARE INCREASING CAR USE AND URBAN CONGESTION

(*) US Census Bureau American Community Survey
(**) NYT, Feb 23, 2017



MILLENIAL'S CHANGES IN TRAVEL BEHAVIOR AND HABITS

MISCONCEPTIONS:

- Millennials' beliefs and behavior change the traditional way of life
  - Later getting their drivers' licenses later and with lower auto ownership
  - Living in city centers, getting around walking, cycling, and transit
- These changes in behavior will negatively impact the toll road business

UNDERSTANDING MILLENNIAL BEHAVIORAL CHANGES:

- Reduction in driving 2000-2010 is a temporary effect of the great recession
  - In 2010, 37% of millennials were under employed or unemployed
  - Unemployed millennials drove 6,000 miles/year vs 12,000 if employed

WHAT THE DATA ACTUALLY SHOW:

- Actual Proportion of under 19's with driving license remained constant from 2001 to 2009
- Millennials are the fastest growing category of US car buyers

- Factual-supported Millennial behavioral changes:

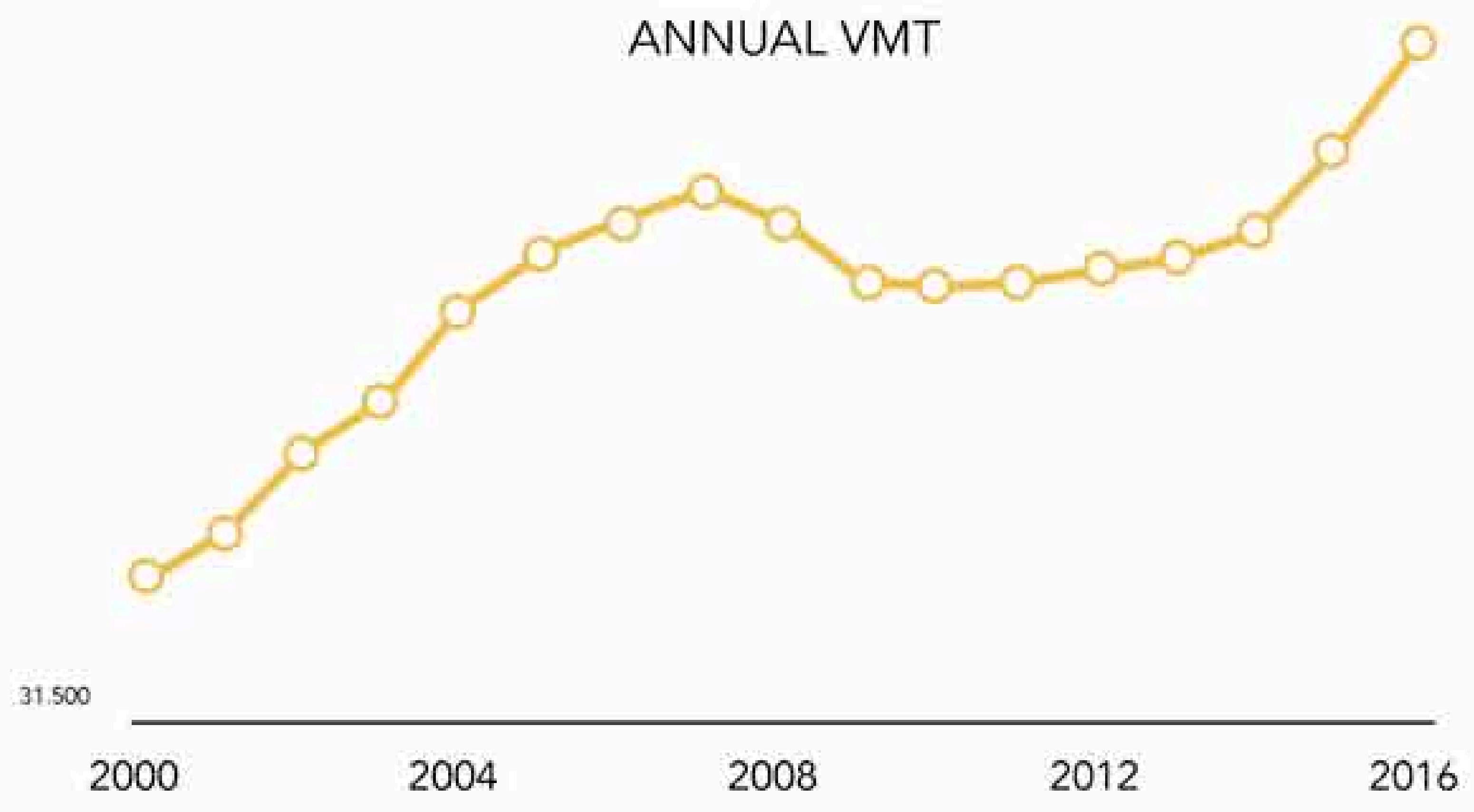
Ages 20 - 29	2000	2010-11	Change
Living in center urban areas	0,19	0,13	**-0,32**
Living in outer suburbs	0,2	0,24	**+20%**
Commuting by car	0,67	0,7	**+4%**

NEGLIGIBLE CHANGE IN TRAVEL BEHAVIOR OF NEW GENERATIONS

Source: Alan Pisarski, "VMT and Its Causes," presentation at Heritage Foundation, October 21, 2014
Mark Mills, "We're a Long Way from 'Peak Car,'" Wall Street Journal, Oct. 1, 2015
Wendell Cox, "Dispersing Millennials", New Geography.com, July 9th, 2014

TECHNOLOGICAL DEVELOPMENTS & MOBILITY TRENDS: CONCLUSION

- POST-RECESSION US TRAFFIC, **BACK TO NORMAL:**
  - VMTs surpassed pre recession levels in 2015 Peak of all times in 2016
  - VMT per capita growing since 2014. In 2016, just a bit lower than all time high levels
  - Annual growth over **3%** pa reflecting population and economic growth



- NEW TRENDS AN OPPORTUNITY RATHER THAN A THREAT:
  - Road use will increase with vehicle automation and ride-sourcing services
  - Toll Roads can take advantage of their state-of-the-art technology to open the way to new trends and take advantage of a new market class

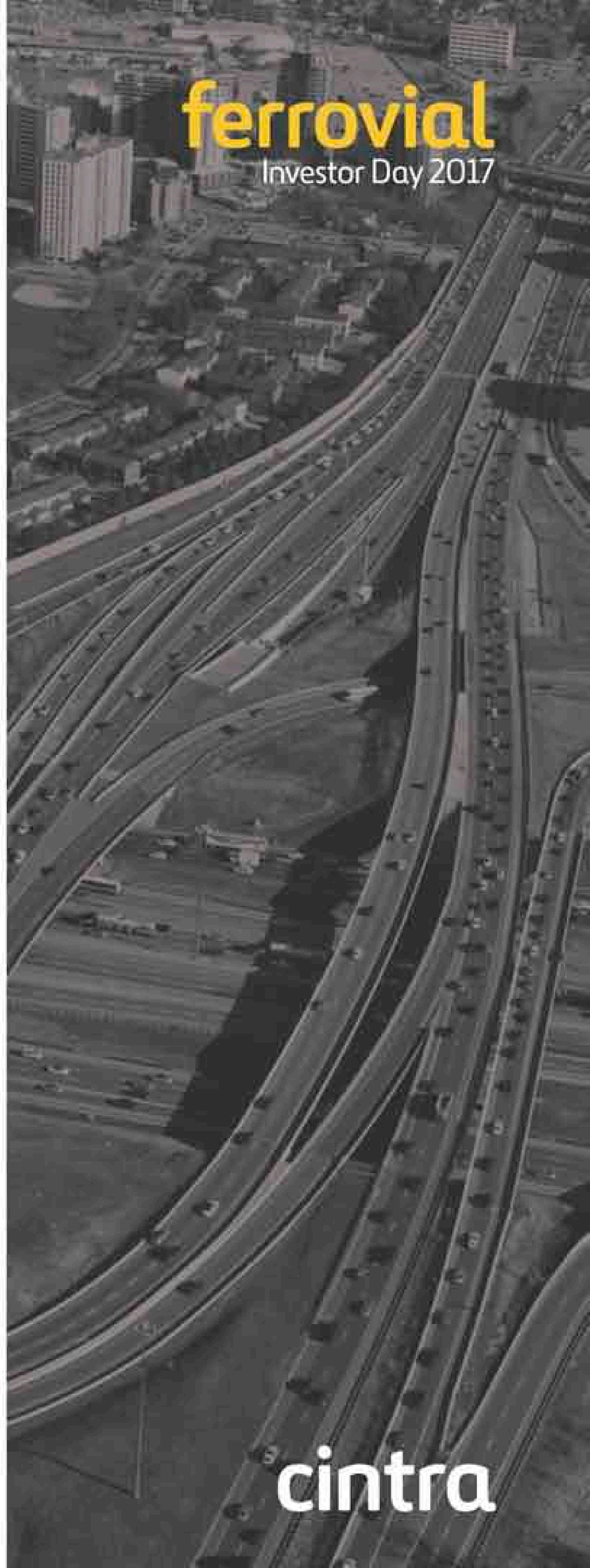
Sources: Cintra Infraestructures, S.E.
Traffic Volume Trends Reports, Federal Highway Administration

2 INTEREST & EXCHANGE RATE RISKS

INDEX
CHALLENGES & OPPORTUNITIES

1 - Technological developments and mobility trends
   - Connected and autonomous vehicles (CAVs)
   - Car sharing and ride sharing
   - Millennials changes in travel behavior and habits
   - Global mobility trends

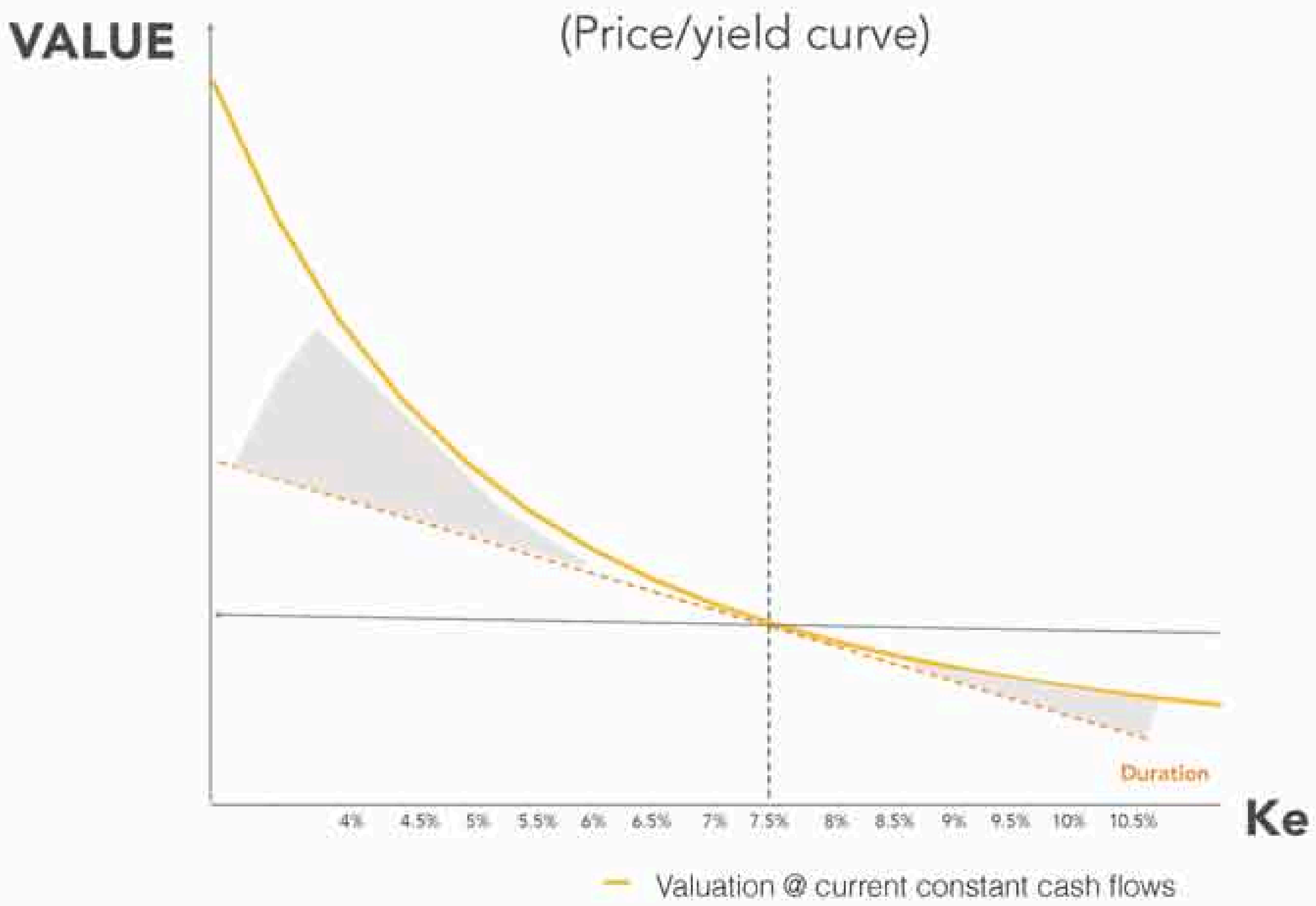
2 - Interest and exchange rate risks (paper of professor Carles Vergara-Alert)
   - Categories of assets
   - Economic theory
   - Effect of interest rates on asset valuation (407 ETR & ML's)



INTEREST RATE RISK IN INFRA-ASSET VALUATION

There is a widespread belief among the investment community that "**an increase in the interest rates reduces the value of the infra-asset".**

In other words: "**INFRASTRUCTURE ARE BOND-LIKE ASSETS"**



Bond:

A string of future **fixed** set of payments

but…

Infra asset:

A string of future **variable** set of cash-flows

The key concept here is VARIABILITY in CASH FLOWS

- On what variables does revenue depend?
- How are these variables affected by interest rates?

Sources: Paper of professor Carles Vergara-Alert

CATEGORIES OF INFRA-ASSETS ACCORDING TO THE VARIABILITY OF THE CASH FLOWS

WITHOUT TRAFFIC RISK (NON-TOLL ROADS)

1	- Availability payment (no CPI adjusted):	*Toowoomba (Australia)*	CF=K
2	- Availability payment (CPI adjusted):	*Norte-Litoral (Portugal)*	CF= f (CPI)

WITH TRAFFIC RISK (TOLL ROADS)

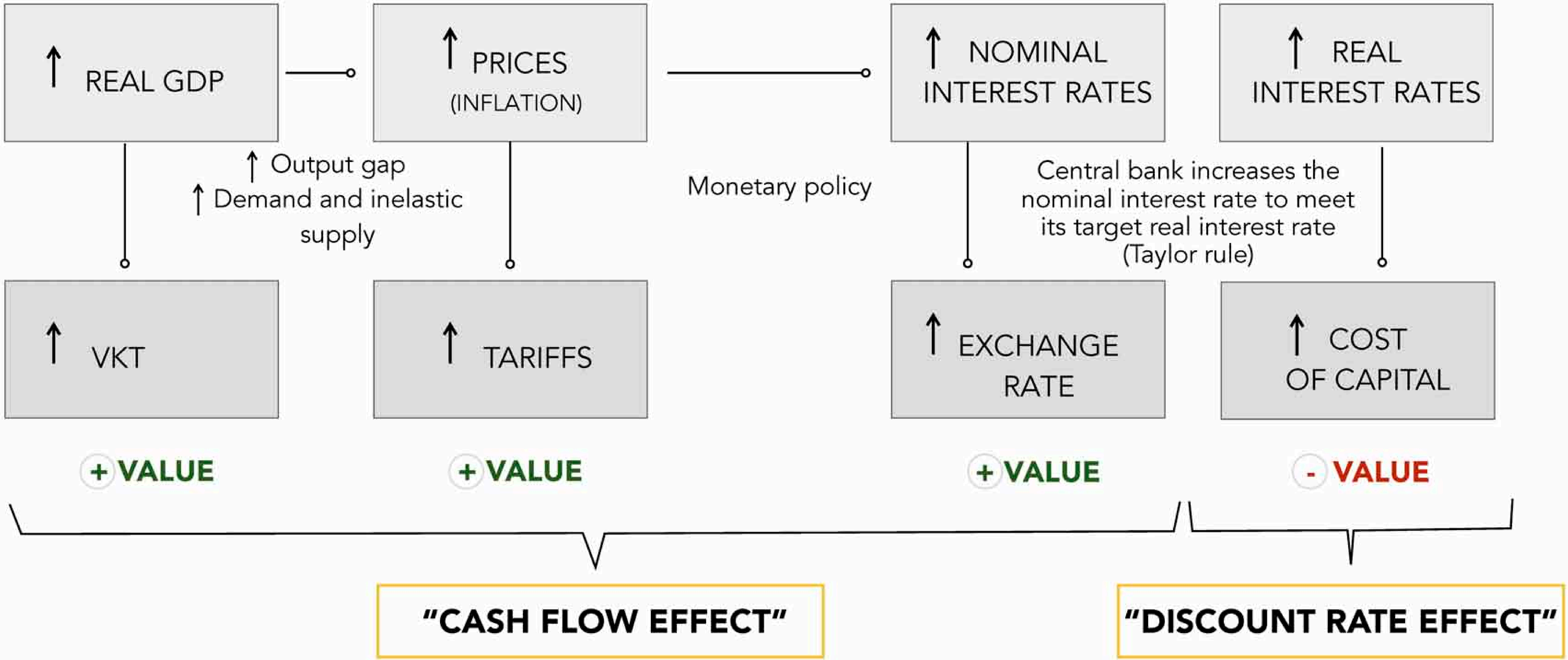
3	- Pre-fixed toll rate (CPI escalated):	*AUSOL (Spain)*	CF= f (CPI, traffic)
4	- Tolls escalated to a maximum (GDP per capita):	*"Chicago Skyway", ITR (USA)*	CF= f (CPI, traffic, GDP per capita)
5	- Free-rate tolling mechanism:	*407 ETR (Canada), ML (USA)*	CF= f (CPI, traffic, willingness to pay)

"INTEREST RISK METER OF CONCESSION VALUE"

High	Mid	Low	Very Low	None
1	2	3	4	5

Sources: Paper of professor Carles Vergara-Alert

WHAT THE ECONOMIC THEORY SAYS…



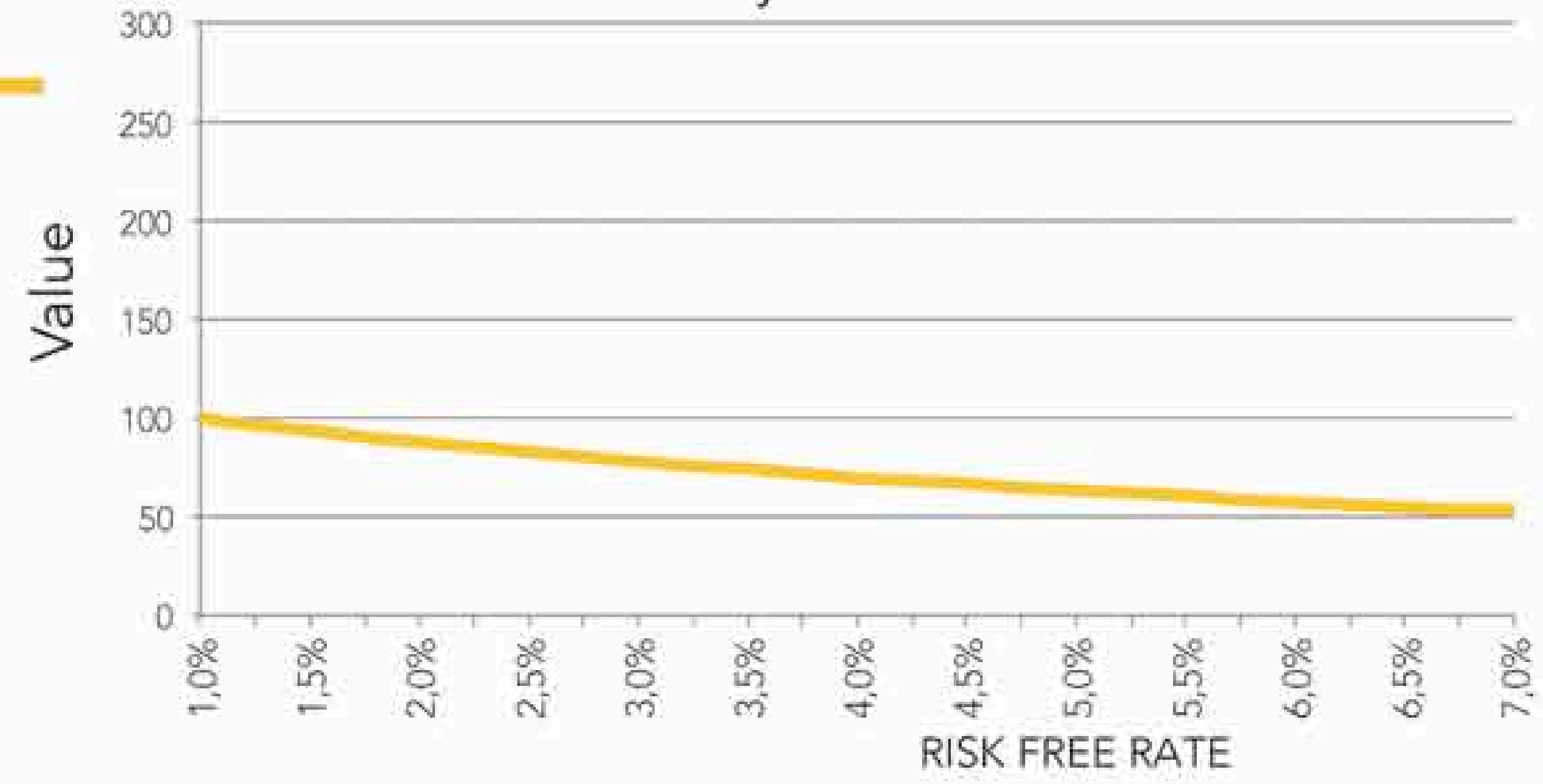
Which is the prevailing effect… and how does it affect infra-assets value, especially 407 ETR & MLs?

Sources: Paper of professor Carles Vergara-Alert

EFFECT OF INTEREST RATES ON ASSET VALUATION BY CATEGORY[1] (I)

1

AVAILABILITY
Project i.e.: TOOWOOMBA

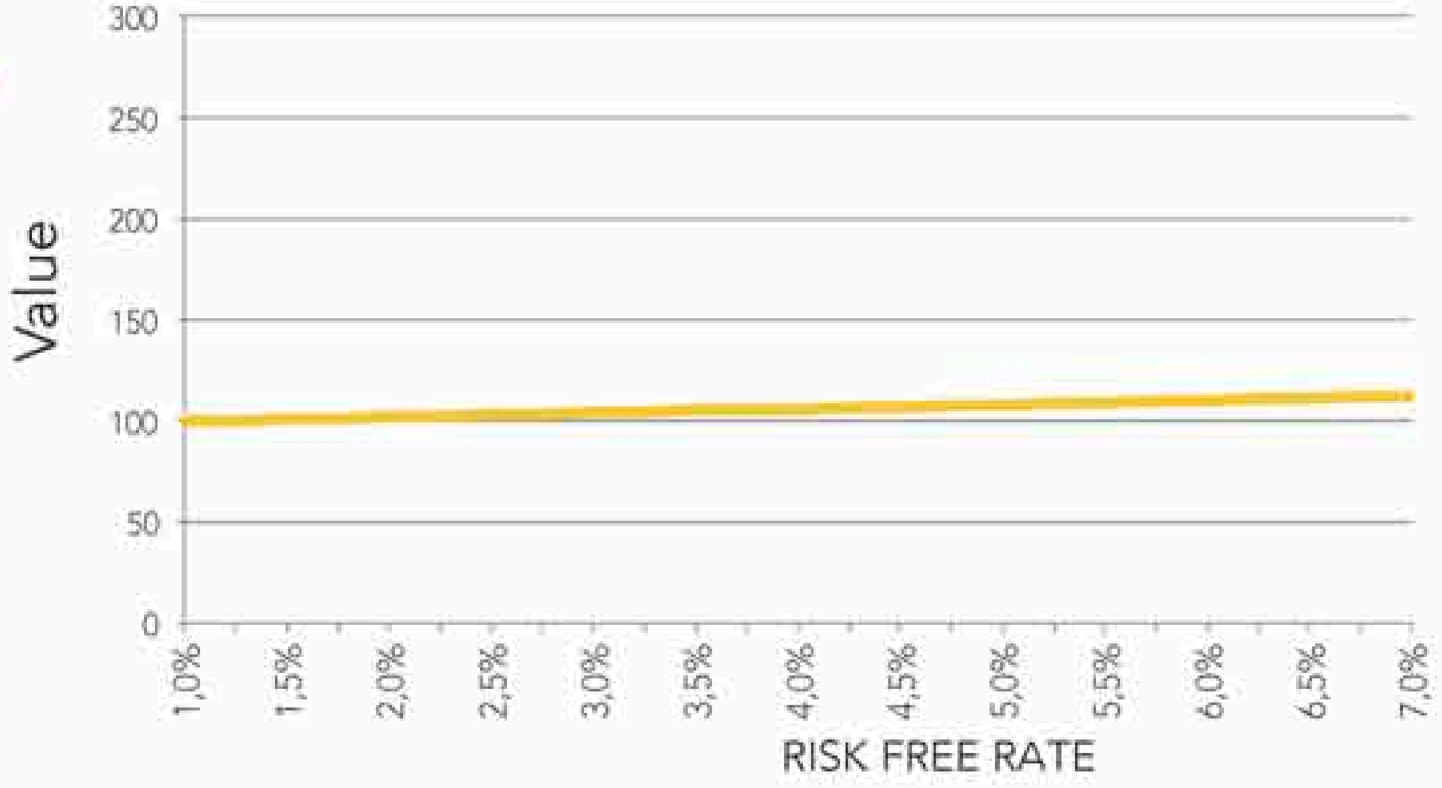


0%
Cintra´s Value

Significant value decrease
(Bond proxy)

3

DEMAND RISK & CPI Adj
Project i.e: AUSOL

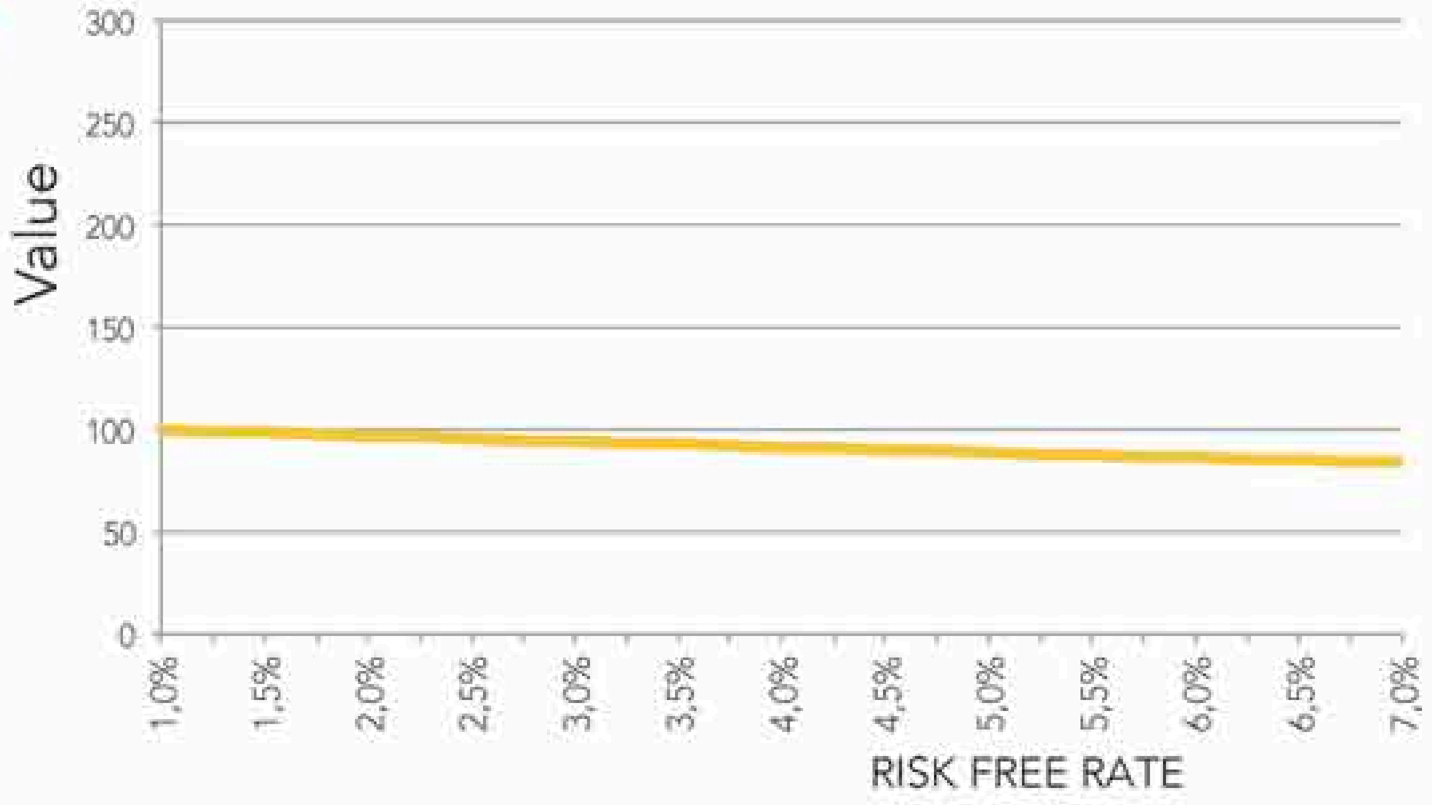


3%
Cintra´s Value

Stable value

2

AVAILABILITY & CPI Adj
Project i.e: NORTE LITORAL

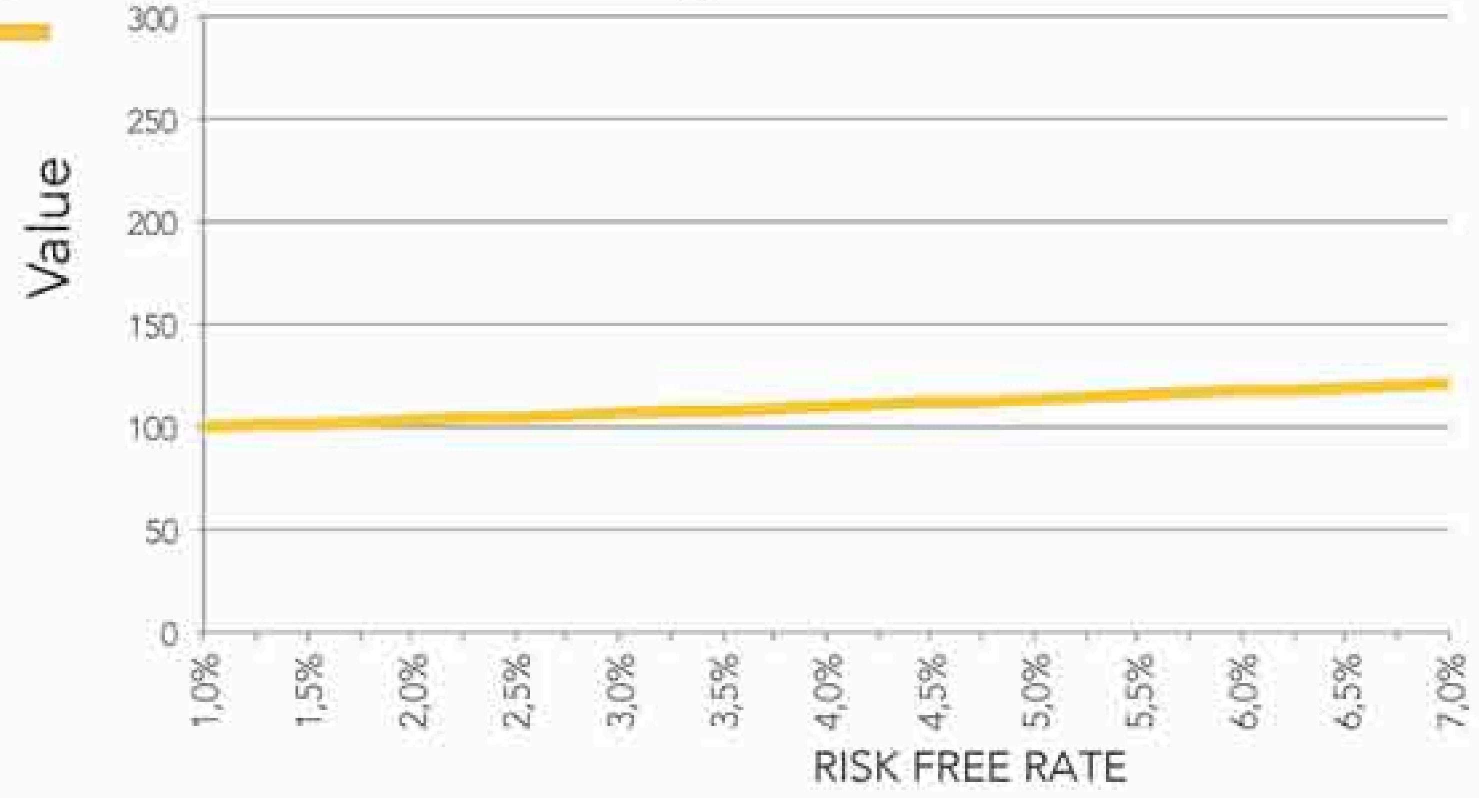


3%
Cintra´s Value

Slight value decrease

4

DEMAND RISK & CPI, GDP Adj
Project i.e: CHICAGO SKYWAY



- Capture the consumer's surplus generated by CPI/GDP per capita
- **Inability to capture "optimal price"**

0%
Cintra´s Value

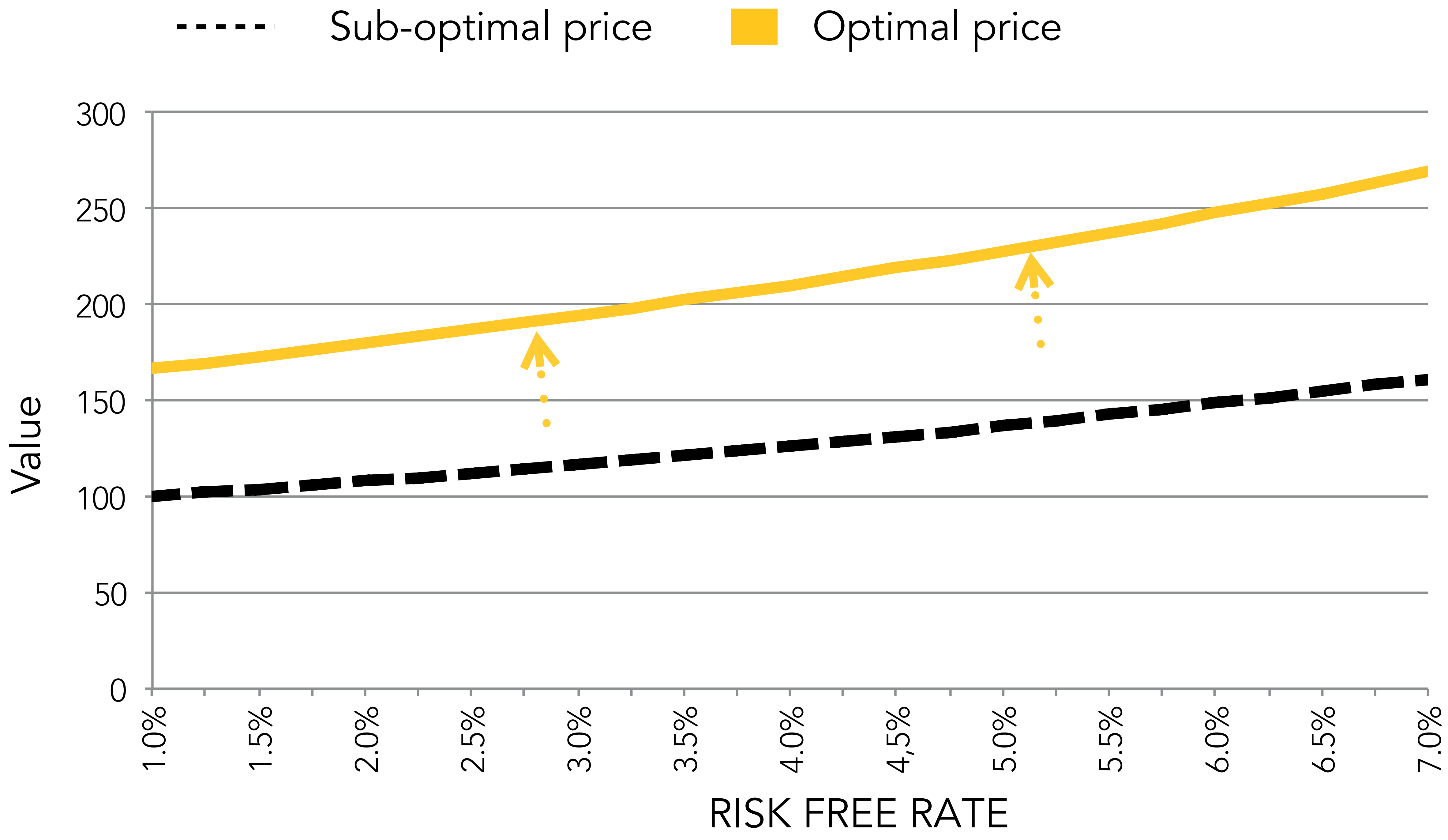
Modest value increase

[1] Assumptions of the exercise: 100 "currency units" of investment, 50 years concession, Beta=1.0, ERP=5%, Leverage = 50%, Debt premium = 4.0%, Tax rate 30%.
Sources: Paper of professor Carles Vergara-Alert

EFFECT OF INTEREST RATES ON ASSET VALUATION BY CATEGORY (II)

94%
Cintra´s Value

DEMAND RISK & TOTAL FREE-RATE TOLLING
Project i.e.: 407 ETR



TRAFFIC
- Traffic (VKT) increases when the real GDP increases

TARIFFS
- Maximum discretional adjustment
- Ability to capture the consumer's surplus generated by **higher willingness-to-pay**

5th category is the only one that:
- Is able to reach "optimal tariffs" and to extract full value from a rise of interest rates
- Has a "cash flow effect" much higher than the "discount effect"

The exchange rate operates as a bonus effect in our Canadian-US assets' value:
- Short-term: next 18-24 month of dividends fully hedged
- Long-term: from a € based investor, US and Canada provided a better future economic outlook, that will lead us to a likely revaluation

Sources: Paper of professor Carles Vergara-Alert

VALUATION MODEL OF THE COMPANY

CARLOS RAMÍREZ

INDEX
VALUATION MODEL OF THE COMPANY

1 - What we are providing you within one week

2 - Future updates

1 WHAT WE ARE PROVIDING YOU WITHIN ONE WEEK?

ferrovial
Investor Day 2017

cintra

WHAT WE ARE PROVIDING YOU WITHIN ONE WEEK?

We are providing the market in one week with a "simplified valuation model" of the company with the intention of updating recurrently in the future

DELIVERIES

- Financial Models: 407 ETR, LBJ and NTE
- Cintra Portfolio valuation presentation

FINANCIAL MODELS DESCRIPTION

- Simplified but fully operational models
- Formulas audited
- Developed on an annual basis
- With Cintra internal operative and financial estimations for periods of 5 years
- With historic real shareholder CF's included
- Model handbook attached

FINANCIAL MODELS OUTPUTS

- Cash Flow statement
- Profit & Loss account
- Balance sheet
- Sources and Uses of Funds
- Equity IRR calculations
- Valuation sheet

WHAT WE ARE PROVIDING YOU WITHIN ONE WEEK?

We are providing the market in one week with a "simplified valuation model" of the company with the intention of updating recurrently in the future

CINTRA PORTFOLIO VALUATION PRESENTATION

- Complete Portfolio Valuation Asset by Asset
- Date of Valuation: December 2016
- Valuation Methodology:
  - Construction Phase: Equity Injected
  - Operation Phase: DDM / APV [1]

ATTACHMENTS

- Main assets [2] Operative and Financing Assumptions:
  - Macroeconomic Assumptions
  - Revenue CAGR Assumptions
  - EBITDA Margins
  - Lifecycle assumptions
  - Refinancing / Regearings
  - Dividends

1. DDM: Discounted Shareholder CF's / APV: Discounted Unleveraged Op CF's (adjusted with Debt Interests Tax Shield) – Net Debt
2. 407 ETR, LBJ and NTE 1&2

2 FUTURE UPDATES

FUTURE UPDATES

- Periodically **on a yearly basis** (March of each year) as of December preceding year
- **Isolating** de-risking, rolling forward and CF performance to understand value updates
- Including **new financial models** of high complexity projects after 2 years of operation

WRAP-UP

ENRIQUE DÍAZ-RATO

WRAP-UP

CINTRA: UNIQUE PORTFOLIO, UNIQUE GROWTH PROSPECTS

VAST UNTAPPED VALUE IN EXISTING PORTFOLIO

- **Quality assets:** high value creation potential and high resilience
- **Premium operator:** ability to extract maximum value

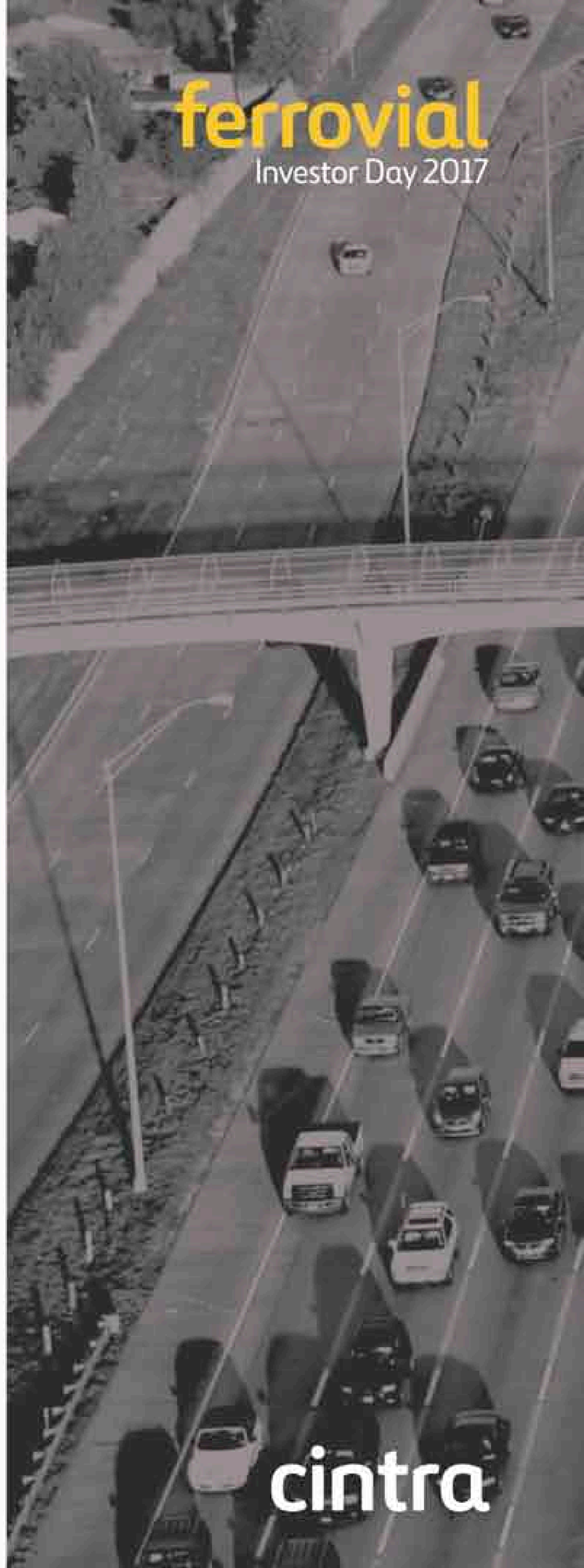
Right assets run by the right operator

EXCELLENT PROSPECTS OF PROFITABLE GROWTH

- **Strong pipeline** of High Complexity Concessions
- **Growth success** determined by **competitive advantages**

CINTRA'S **UNIQUE KNOW-HOW**

In the right business, with the right skills to succeed



Q&A SESSION

FINAL REMARKS

IÑIGO MEIRÁS

ferrovial Investor Day 2017

cintra

Q&A SESSION

ANNEX

The effects of interest rates on the valuation of highway infrastructure assets

Carles Vergara-Alert[1]

Abstract

This paper studies the impact of changes in interest rates on the value of different types of highway infrastructure assets. *Ceteris paribus* the discounted value of cash flows of assets is negatively related to interest rates. We denote this relationship as the *discount rate effect*. However, economic activity (e.g., detrended GDP growth) is positively related to interest rates and positively related to the cash flows of assets with tariffs that can be adjusted to manage demand (e.g., adjustable-rate toll roads), but uncorrelated to assets that do not bear demand risk (e.g., non-toll roads). We denote this relationship as the *cash flow effect*. This effect arises in some types of assets from: (i) the positive correlation between economic activity and demand for the infrastructure assets; and (ii) the positive correlation between economic activity and inflation. We find that the cash flow effect dominates the discount rate effect for assets with tariffs that can be adjusted to manage demand and, therefore, the value of these assets increases in periods of economic expansion. Nevertheless, the opposite occurs for assets that do not bear demand risk, in which the value of these assets decreases.

1. INTRODUCTION

The valuation of any asset that produces cash flows is affected by the dynamics of interest rates. Specifically, the value of an asset that produces a given stream of cash flows decreases when interest rates increase because we discount this stream of expected cash flows at a higher discount rate. Therefore, *ceteris paribus*, the discounted value of cash flows of assets is negatively related to interest rates. We denote this relationship as the *discount rate effect*.

[1] IESE Business School, University of Navarra. Pearson Avenue 21, 08034 Barcelona, Spain. Email: cvergara@iese.edu.

Since a large amount of infrastructure assets present cash flows that are uncorrelated (e.g., constant) or with little correlation with interest rates (e.g., tariffs adjusted according to a concession contract), investors could imply that an increase in interest rates would cause a decline in the value of infrastructure assets. However, many infrastructure assets present a stream of cash flows that is positively related to the dynamics of interest rates. This is due to the fact that periods of increasing interest rates are usually related to economic expansions and, therefore, periods of growth in tariffs and traffic, which increase the cash flows of the infrastructure asset. Therefore, *ceteris paribus*, the discounted value of cash flows of assets is positively related to economic activity (e.g., detrended GDP), which is positively connected to interest rates. We denote this positive relationship between cash flows and the value of the asset as *the cash flow effect*.

In this paper, we show that the negative relationship between interest rates and the value of infrastructure assets is only present in infrastructures in which the *discount rate effect* dominates the *cash flow effect*, that is, in infrastructures in which the cash flows do not grow in a substantial amount in periods of increasing interest rates. There are many infrastructures in which the *cash flow effect* dominates the *discount rate effect* and, therefore, there is a positive relationship between interest rates and the value of infrastructure assets. We specifically analyze the effect of interest rates in the value of the 5 types of highway infrastructure assets according to the payments that they obtain:

i. Category 1: Infrastructure assets with total fixed payments and no price adjustments. The Government periodically pays a predetermined fixed amount. This type of assets does not bear demand risk because the total fixed payments do not depend on the use of the asset. A non-toll road in which the Government pays a fixed amount to a firm that operates a private concession on the road is an example of a Category 1 asset.

ii. Category 2: Infrastructure assets with total fixed payments and inflation-adjusted prices. The Government periodically pays a predetermined inflation-adjusted amount. This type of assets does not bear demand risk because the total fixed payments do not depend on the use of the asset. A non-toll road in which the Government pays a fixed amount that is periodically adjusted with inflation to a firm that operates a private concession on the road is an example of a Category 2 asset.

iii. Category 3: Infrastructure assets with a pay-per-use pre-fixed inflation-adjusted tariff. This type of assets bears demand risk. A toll road in which users pay a pre-fixed toll rate amount that is periodically adjusted with inflation is an example of a Category 3 asset.

iv. Category 4: Infrastructure assets with a pay-per-use escalated tariff. The scale of tariffs is determined in terms of economic activity (e.g., GDP per capita) and there is usually a maximum value for the tariff increase. This type of assets bears demand risk. A toll road in which users reimburse a pay-per-use escalated toll that is periodically adjusted with respect to changes in the economic activity is an example of a Category 4 asset.

v. Category 5: Infrastructure assets with a free adjustable-rate tariff mechanism subject to a certain level of service. This type of assets bears demand risk and the operator of the infrastructure can raise or decrease the tariffs according to the willingness-to-pay of the users. Specifically, notice that the tariffs for the use of this type of infrastructure assets can increase above the inflation rate of the economy. A toll road in which users reimburse a pay-per-use toll that is used to manage its demand is an example of a Category 5 asset.

We first focus on the *discount rate effect*, which is the effect of the discount rate at which we discount cash flows to obtain an estimation of the value of an infrastructure asset. Because the relationship between economic activity and interest rates is positive, *ceteris paribus* the discounted value of cash flows of assets is negatively correlated to economic activity. In other words, higher interest rates usually lead to higher discount rates, which provide lower present value of future cash flows.

We also study the *cash flow effect*, which is the effect of interest rates and economic activity on the value of infrastructure assets. Because economic activity (e.g., GDP growth) is positively correlated to the cash flows of assets with tariffs that can be adjusted to manage demand (e.g., category 5 assets), but uncorrelated to assets that do not bear demand risk (e.g., category 1 assets), an increase in economic activity increases the cash flows of the former but not the later type of assets. This effect arises in some types of infrastructures assets from two sources. First, the positive correlation between economic activity and demand for infrastructure assets increases their cash flows, that is, the number of users of the infrastructure asset increases in periods of economic expansion. Second, the positive correlation between economic activity and prices of goods and services increases the cash flows of infrastructure assets. For example, the tariffs that users pay for the use of an infrastructure asset tend to increase in periods of economic expansion. This price increase is in play because supply cannot account for the shock in demand derived from the economic expansion. Notice that tariffs will increase above inflation in infrastructure assets of category 5 in which supply is inelastic (e.g., most of transportation infrastructure assets) because the operators of these assets may raise tariffs according to the high willingness-to-pay in periods of economic expansion.

We develop an econometric analysis and we find that the cash flow effect dominates the discount rate effect for assets with tariffs that can be adjusted to manage demand (e.g., category 5 assets). Therefore, the value of these assets increases in periods of economic expansion. Nevertheless, the opposite result occurs for assets that do not bear demand risk (e.g., category 1 assets), in which the value of these assets decreases.

The reminder of the paper is organized as follows. In section 2, we describe the macroeconomic framework that rationalizes the relationships among inflation, interest rates and GDP and the effect of monetary policy on these variables. Section 3 provides an econometric analysis of the joint effects of economic activity in Canada (i.e., Canadian inflation, GDP growth, nominal interest rates, and real interest rates) and the revenue growth of a category 5 infrastructure in Canada: highway 407 ETR. Section 4 studies a valuation model of highway infrastructure assets and compare the effects of economic activity on the 5 categories of infrastructure assets described above on their values. Finally, section 5 concludes.

2. THE MACROECONOMIC FRAMEWORK: MONETARY POLICY, INTEREST RATES, INFLATION, GDP, AND EXCHANGE RATES

Monetary authorities such as the Federal Reserve, the European Central Bank, the Bank of England, the Bank of Canada, and other central banks, influence interest rates and, indirectly they affect employment rates, the output gap, and inflation. The monetary transmission mechanism is the process that links the monetary policy to the performance of the economy. Monetary policy is referred to the actions of central banks. The performance of the economy is measured in terms of indicators such as the real gross domestic product (GDP), the output gap, and inflation. Central banks respond to the economic performance with their monetary policies, which affect the short-term nominal interest rates and closes the circle. Figure 1 summarizes this cyclical process that goes from the performance of the economy, to the monetary policy of the central bank, and the transmission of this monetary policy back to the economy. This figure also displays how this cycle affects infrastructure assets.

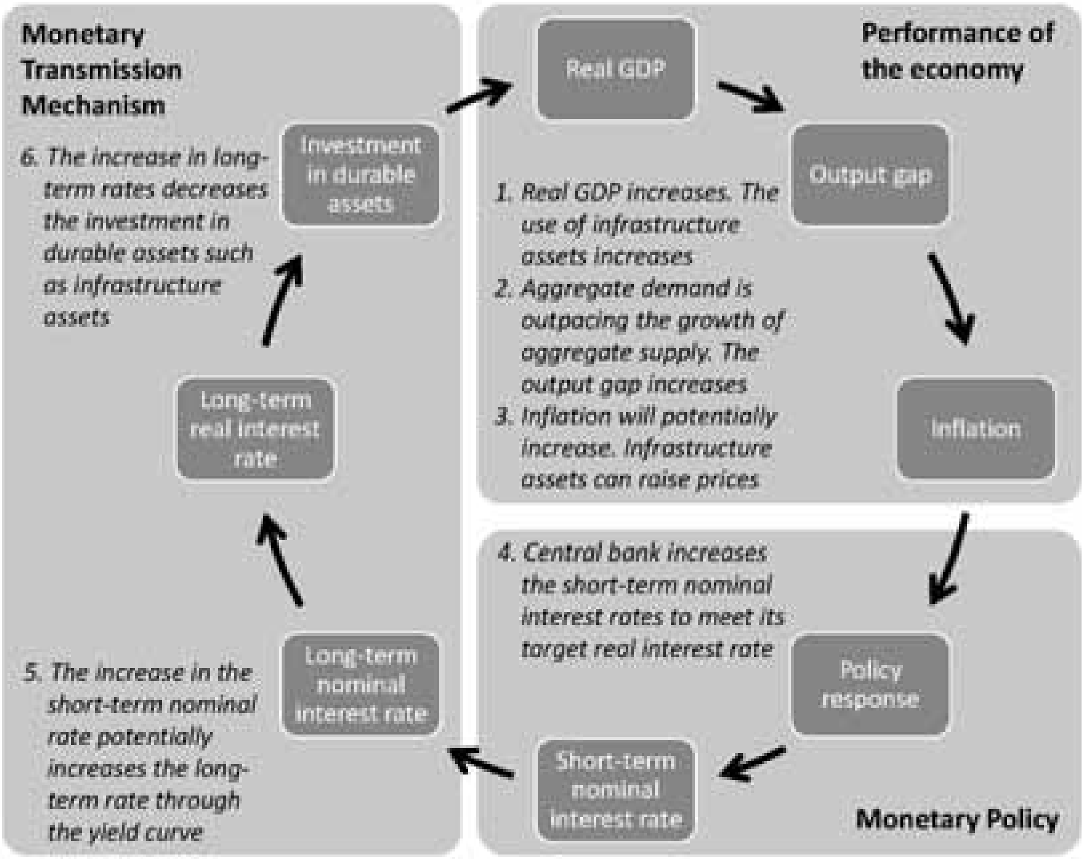


Figure 1. Performance of the economy, monetary policy, and its transmission. This figure shows how a shock in the real GDP affects interest rates through inflation, monetary policy and the monetary transmission mechanism.

The monetary transmission mechanism shows the effects of monetary policy in the macroeconomic variables, in particular the real GDP. It explains how the central bank's target interest rate (i.e., the short-term nominal interest rate) affects different interest rates in the economy and, consequently, how it affects investments. This mechanism goes as follows. The central bank operates in the financial markets to target a specific short-term nominal interest rate, which affects the long-term nominal interest rate through the yield curve or term structure of interest rates. This leads to a change in the long-term real interest rate, which in turn has an effect on long-term investments, such as investments in durable goods and infrastructure assets. Finally, these changes in investments affect the real GDP.

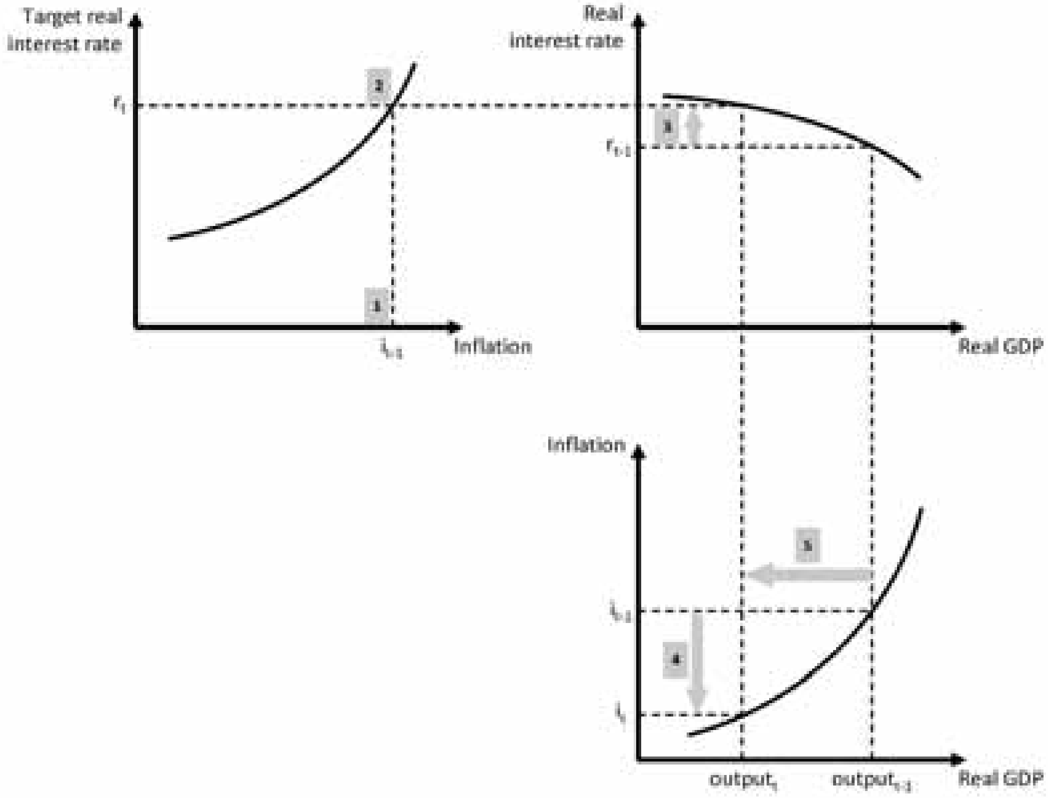


Figure 2. Monetary policy, inflation, interest rates, and GDP. This figure summarizes the economic theory behind the monetary transmission mechanism.

Figure 2 summarizes in economic terms the monetary transmission mechanism developed in figure 1 and rationalizes how central banks adjust inflation. Let us assume that the economy is in a period of expansion, the real GPD is high (i.e., the output at time *t-1* is high), and as a result, inflation, i_{t-1}, is high (point 1 of this figure). The central bank implements its rules such as a Taylor-type of model (point 2) and increases the short-term nominal interest rate to target an increase of real interest rate from r_{t-1} to r_t (point 3). This real interest rate increase should decrease inflation from i_{t-1} to i_t (point 4) at the expenses of a reduction of the real GDP from $output_t$ to $output_{t-1}$ (point 5). In summary, <u>if the economy is in a period of expansion and inflation is high, the central bank will most likely increase the short-term nominal interest rate, which will decrease</u>

the real GDP. The three graphs in figure 2 also display the three relationships among the three main variables that drive the standard macroeconomic policy research models: the real GDP, the real interest rate, and inflation.

Positive relationship between inflation and the real interest rate. (Top left graph in figure 2). When inflation increases, the central bank raises the short-term nominal interest rate. This increase in the nominal interest rate should be enough to raise the real interest rate. The goal of the central bank with this action is to stop inflation from raising and make it decrease (see Taylor, 1999)

Negative relationship between real GDP and the real interest rate. (Top right graph in figure 2). As discussed in Taylor (2000), higher real interest rates reduce the demand for goods and services in the economy, because higher real interest rates dissuades investments and decreases consumption, which reduces demand and the real GDP.

Positive relationship between inflation and real GDP. (Bottom right graph in figure 2). In a standard expectations-augmented Phillips curve, inflation increases when real GDP rises above the potential GDP. The increase in real GDP signals a positive demand shock.

There is a vast body of literature that studies the direct relationship between interest rates and inflation. In an efficient capital market without uncertainty, the one-period nominal interest rate is the equilibrium real interest rate plus the fully expected inflation rate (Fisher, 1930). The initial point of view in theoretical economics was that changes in short-term interest rates reflect fluctuations in expected inflation. In other words, short-term interest rates are positively correlated with future inflation. This relationship is commonly known as the Fisher effect (see Fisher, 1930; Fama, 1975; Nelson and Schwert, 1977; Mishkin, 1981; Mishkin, 1988; and Fama and Gibbons, 1982).

However, empirical evidence shows that the Fisher effect is not robust to different time periods or countries. Several studies in the 1970s and 80s documented the failure of the short-run Fisher effect in which changes in interest rates are related to changes in expected inflation (see Barsky, 1987; Mishkin, 1981; Summers, 1983; Huizinga and Mishkin, 1984; and Huizinga and Mishkin, 1986). A few years later, Mishkin (1992) demonstrated the existence of a long-run Fisher effect in which inflation and interest rates present a common stochastic trend when both variables exhibit trends, that is, when they are cointegrated. As a result, only if inflation and interest rates exhibit trends, then these two variables trend with a positive relationship and we observe a strong Fisher effect in the data. Lee (1992) developed a multivariate vector-autoregression (VAR) model to show that interest rates explain a substantial fraction of the variation in inflation, while inflation does not explain the variation in real activity. In summary, the Fisher effect is stated as the positive long-run relationship between inflation and interest rates.

Positive relationship between the real interest rate and the real exchange rate. The exchange rate is part of the transmission mechanism in monetary policy because net exports and, therefore, GDP depend on it. The exchange rate enters as part of a no-arbitrage condition that relates the interest rate in one country to the interest rates in other countries through the expectation about the exchange rate in the future. The exchange rate has an effect on the flow of imports and export and the relationship between the real interest rate and the real exchange rate is positive (see Mendoza, 1995; Kamin and Rogers, 2000).

Taylor (2001) develops the theory behind this positive relationship. He shows that there is an indirect effect between these two variables even if the central bank follows a policy rule that does not include a direct exchange rate effect. This indirect effect is caused by inertia and rational expectations and provides lower and more effective fluctuations on the interest rate.

In summary, a positive performance of the economy in terms of a high output or high real GDP translates into an increase in the inflation rate because economic expansion increases demand, while supply is usually not perfectly elastic. Therefore, prices increase in response to this demand increase and supply cannot grow at the same rate than demand. Moreover, the central bank reacts to this raise in inflation by increasing interest rates. If the monetary policy of the central bank is successful, it will decrease inflation at the expense of a decrease in the output or real GDP. Moreover, higher interest rates increase the exchange rate and, as a result, net exports weaken. In the rest of the paper, we study how a positive shock in the real GDP that leads to an increase in inflation and interest rates affects the valuation of highway infrastructure assets.

3. EMPIRICAL ANALYSIS OF THE EFFECT OF INFLATION AND INTEREST RATES ON TRAFFIC AND TARIFF GROWTH: THE 407 ETR CASE

We first study the joint effect of inflation, nominal and real interest rates on traffic and tariff growth for a category 5 type of infrastructure asset: the highway 407 Express Toll Route (407 ETR) in Ontario, Canada. Highway 407 goes from Burlington to Oshawa through the Greater Toronto Area suburbs of Oakville, Mississauga, Brampton, Vaughan, Markham, Pickering and Whitby. The segment between Burlington and Pickering (107.9 km or 67.0 mi) is leased to and operated by a private concession company and it is known as the 407 ETR.

Variable	Definition	Obs.	Mean	Std. Dev.	Min.	Max.
Revenue	Total monthly revenue	168	54,200,000	20,100,000	24,200,000	110,000,000
$g_{revenue}$	Growth in monthly revenue	167	0.0102	0.0684	-0.1776	0.1712
$TR_{exc\_TTC\_VTC}$	Total monthly revenue excluding TTC and VTC	168	41,200,000	15,500,000	15,900,000	83,900,000
TTC_VTC	Monthly revenue from TTC and VTC	168	7,898,922	3,739,996	3,639,591	17,500,000
fees	Monthly revenue from fees	168	5,048,594	1,217,743	3,456,181	11,600,000
avg_toll	Average toll price	168	0.21	0.0600	0.12	0.34
avg_trip_length	Average trip length	168	20.16	0.8600	18.08	22.61
trips	Number of trips	168	9,311,412	1,008,908	6,698,980	11,700,000
VKT	vehicles-km	168	188,000,000	27,100,000	121,000,000	260,000,000
inflation	Inflation from Canadian CPI (%)	156	0.14	0.3801	-1.04	1.15
GDP	Canadian GDP	157	1,487,990	102,552	1,298,317	1,663,948
g_{GDP}	Growth in Canadian GDP	156	0.0016	0.0035	-0.0138	0.0122
$r_{nominal}$	Nominal Canadian interest rate (%)	157	3.29	1.09	1.32	5.13
r_{real}	Real Canadian interest rate (%)	157	3.04	1.14	0.95	4.90
usd_cad	USD/CAD exchange rate	106	1.08	0.10	0.96	1.37
eur_cad	EUR/CAD exchange rate	106	1.43	0.10	1.23	1.66

Table 1. Summary statistics. This table exhibits the summary statistics of the main variables that we use in our empirical analyses. The data period is March 2003- December 2016.

We use proprietary data on revenues, tolls and characteristics of the trips for the highway 407 ETR from March 2003 to December 2016. The macroeconomic data that we need for our analyses has been collected from the Bank of Canada and the Statistics Canada website. We employ data on Canadian inflation and Canadian GDP. Regarding the real interest rates, we use the "average yield (5 to 10 years) marketable bonds" from the Bank of Canada website. Finally, we obtain the exchange rates between the Canadian dollar and two currencies (the US dollar and the Euro) from the Bank of Canada. Monthly exchange rate data is only available from March 2007. Table 1 reports the summary statistics of the main variables that we use in our analysis.

Standard OLS regressions do not account for possible endogeneity problems and the reverse causality of the explanatory variables. For example, revenues from the infrastructure, inflation, GDP, and interest rates might be endogenously determined since they all depend on future expectations about economic activity. To address these issues, we base our main empirical methodology in a vector autoregression (VAR) model. This model allows us to estimate the joint dynamics of revenues from the infrastructure, inflation, GDP, real and nominal interest rates, exchange rates, etc. as in Holtz-Eakin, Newey, and Rosen (1988) and Pesaran and Smith (1995). For a given set of variables, our VAR specification is given by:

$$z_t = \beta_0 + \beta_1 z_{t-1} + \beta_2 z_{t-2} + \beta_3 z_{t-3} + \theta_t + \varepsilon_t \qquad (1)$$

where z_t denotes the vector of endogenously determined variables (e.g., revenues from the infrastructure, inflation, growth in GDP, real and nominal interest rates, exchange rates, etc.) Notice that we will include different sets of variables in different parts of our econometric analysis and that we use 3 lags (i.e., z_{t-1}, z_{t-2}, and z_{t-3}) throughout the analyses. Let θ_t and ε_t denote the monthly time-effects and the error term, respectively.

We first study the effect of inflation, and real and nominal interest rates on traffic growth in terms of vehicle kilometers traveled (VKT) and growth in tariffs in order to analyze the separate effects on quantities and prices, respectively. To do so, we run two separate multivariate VAR analyses. The first analysis includes the 4 following variables: the VKT growth in highway ETR 407, g_{VKT}; inflation; the nominal interest rate $r_{NOMINAL}$; and the real interest rate r_{REAL}. Table 2 displays the results of this first analysis. The second analysis includes the 4 following variables: the growth in tariffs in highway ETR 407, g_{Tariff}; inflation; the nominal interest rate $r_{NOMINAL}$; and the real interest rate r_{REAL}. Table 3 exhibits the results of this second analysis.

		g_{VKT}		inflation		$r_{nominal}$		r_{real}	
g_{VKT}	lag 1	0.1680	*	1.3209	***	0.6734	**	0.8005	**
	lag 2	0.4465	***	1.2461	***	-0.0002		0.0457	
	lag 3	0.1695	*	-0.6952		-0.2093		0.0226	
inflation	lag 1	0.0462	***	0.2000	**	0.1060	**	0.1375	***
	lag 2	0.0506	***	0.0368		0.0155		0.0045	
	lag 3	0.0227		-0.0730		0.0078		0.0101	
$r_{nominal}$	lag 1	0.1168		0.7492		0.9516	***	0.1890	
	lag 2	-0.0354		-0.7392		0.2754		0.3409	
	lag 3	-0.0354		0.2632		-0.4238		-0.6141	*
r_{real}	lag 1	-0.1506		-0.5294		0.0159		0.7961	**
	lag 2	0.0795		0.3929		-0.4496		-0.5167	
	lag 3	0.0273		-0.1082		0.4857	*	0.6489	**
constant		0.21		15.92		76.42	***	85.33	***
Time FE		Yes							
Num. Obs.		116							
R^2		0.3736		0.2516		0.9725		0.9721	

Table 2. Multivariate VAR analysis with growth in VKT (vehicles kilometer traveled). This table shows the multivariate (joint) analysis of growth in traffic, inflation, nominal, and real interest rates. *, **, and *** indicates statistical significance at the 10%, 5%, and 1% level, respectively.

		g_{Tariff}		inflation		$r_{nominal}$		r_{real}	
g_{Tariff}	lag 1	0.6817	***	-6.7455		-2.3782		-3.2375	
	lag 2	0.3304	***	6.3021		5.2399		5.0861	
	lag 3	-0.0471		-0.8311		-1.6519		-0.0263	
inflation	lag 1	0.0013	*	0.1909	*	0.1235	**	0.1729	***
	lag 2	0.0007		0.1159		0.0535		0.0461	
	lag 3	-0.0008		-0.0247		0.0086		0.0143	
$r_{nominal}$	lag 1	0.0033		0.6497		1.0093	***	0.2570	
	lag 2	0.0018		-0.5102		0.2871		0.3325	
	lag 3	-0.0060		0.2000		-0.4524		-0.6102	*
r_{real}	lag 1	-0.0035		-0.3537		-0.0520		0.7075	**
	lag 2	-0.0016		0.0141		-0.4859		-0.5136	
	lag 3	0.0058		0.0509		0.5548	*	0.6812	**
constant		-0.82		-33.17		103.56		125.57	*
Time FE		Yes							
Num. Obs.		116							
R^2		0.9978		0.1310		0.9714		0.9704	

Table 3. Multivariate VAR analysis with growth in the average tariff. This table shows the multivariate (joint) analysis of growth in tariffs, inflation, nominal, and real interest rates. *, **, and *** indicates statistical significance at the 10%, 5%, and 1% level, respectively.

Several results arise from these two tables. First, we show that past inflation has a strong positive effect on the growth in traffic (i.e., VKT) and a weak positive effect on the growth in tariffs. The coefficients 0.0462 and 0.0506 in Table 2 show that there is a positive and significant relationship between past inflation (1 and 2 months, respectively) and traffic growth. The coefficients 0.0013 and 0.0007 in Table 3 show that this positive relationship is weak for growth in tariffs.

Second, we show that there is a positive relation between traffic growth and both nominal and interest rates, but there is no relation between the growth in tariffs and interest rates. The coefficients 0.6734 for nominal interest rates and 0.8005 for real interest rates in Table 3 show their positive relationship with traffic growth, while the no significance of the coefficients -2.3782 and -3.2375 in Table 2 show the no relation between growth in tariffs and interest rates at the short-term period (less than 3 months).

Third, we also shows that there is a significantly positive autocorrelation in traffic up to 3 months, that is, if VKT increases today, then VKT will most likely increase during the next 3 months. The coefficients 0.1680, 0.4465, and 0.4695 in Table 2 display this positive autocorrelation for 1, 2, and 3 months. Similarly, there is a significantly positive autocorrelation in tariffs up to 2 months. The coefficients 0.6817 and 0.3304 in Table 2 display this positive autocorrelation for 1 and 2 months.

Although the interesting results for our analysis arise when we study the separate effects on traffic and tariffs, we also perform an analysis with of the effect of inflation, and real and nominal interest rates on the revenue growth of the ETR 407 (see Appendix A)[2]. This analysis shows that there is a positive and significant relationship between the past and current growth in revenue, which indicates that the growth in revenues is persistent. , that is, when there is a period of positive (negative) growth in revenues, the probability that the revenue growth is positive (negative) in the following months is high. We also find that the revenue growth in the recent past is positively related to current inflation, which corroborates the persistence in revenue growth. Moreover, we find that revenue growth and interest rates are positively related, but the

[2] We show the main results with traffic (quantities) and tariffs (prices) in separate tables instead of analyzing total revenues, which account for both traffic and tariffs. The reason behind this split is that infrastructure assets of category 5 present free adjustable tariffs. Therefore, the current tariff could be below the tariff that reflects the willingness-to-pay of the infrastructure users. For example, the fact that ETR 407 shows an increase in traffic (i.e., an increase in VKT) even when there is an increase in tariffs during economic recessions suggests that the tariffs of this infrastructure is lower than the *optimal tariff* that the operator could charge in order to maximize its profits.

positive (negative) growth in revenues anticipates the increase (decrease) in interest rates. The lagged effects that we obtain from these results are consistent with the macroeconomic framework and the monetary policy transmission channels that we discussed in section 2. In particular, notice that the growth in revenues and the increase in inflation lead the increase in nominal and real interest rates.

Moreover, VAR models can be used to estimate the reaction of a particular endogenous variable to a shock in another endogenous variable. Figure 3 displays impulse-response graphs with the response of the highway 407 ETR revenue growth over 12 months to a one standard deviation shock to inflation and the nominal interest rate. It also shows the 95% bootstrapped confidence intervals (CI) based on 1000 simulations. These results confirm some of our findings from the previous VAR analysis. First, revenue is positively related to inflation. Second, nominal interest rates do not predict growth in revenue. These shocks are persistent. Specifically, the increase in revenue growth in the highway 407 ETR from a shock of one standard deviation in inflation is still present six months after the shock.

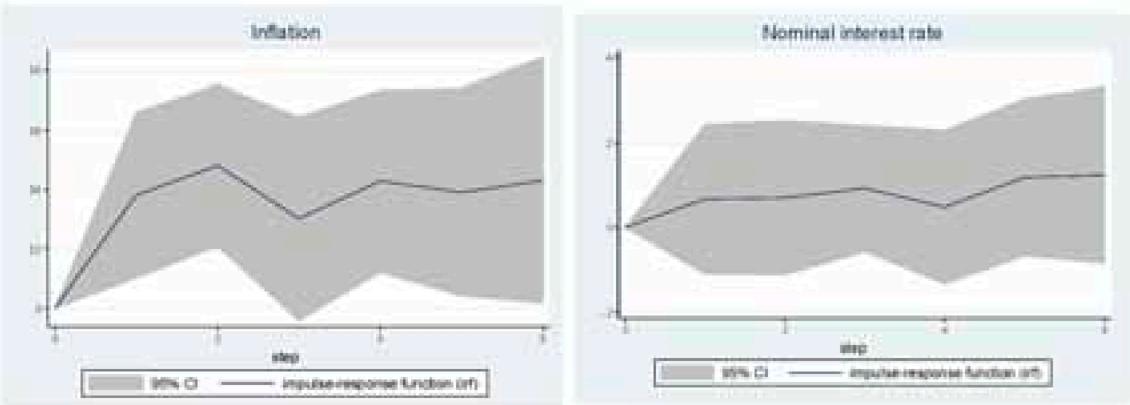


Figure 3. Impulse-response functions. This figure displays impulse-response functions with the responses of the highway 407 ETR revenue growth over 12 months to a one standard deviation shock to inflation and the nominal interest rate.

Figure 4 shows how economic activity affects the value of infrastructure assets of category 5 and summarizes the channels that drive the value of these assets. The economic intuition goes as follows. In a period of expansion of the economy the real GDP increases, which increases the output gap and, equivalently, increases demand. Because the supply of most assets, goods and services is inelastic (or limited in some corridors, for example, in the Toronto 401/407 corridor), prices go up. In the aggregate, inflation in the economy goes up. The central bank reacts to this raise in inflation by increasing the short-term nominal interest rate to meet its target real interest rate.

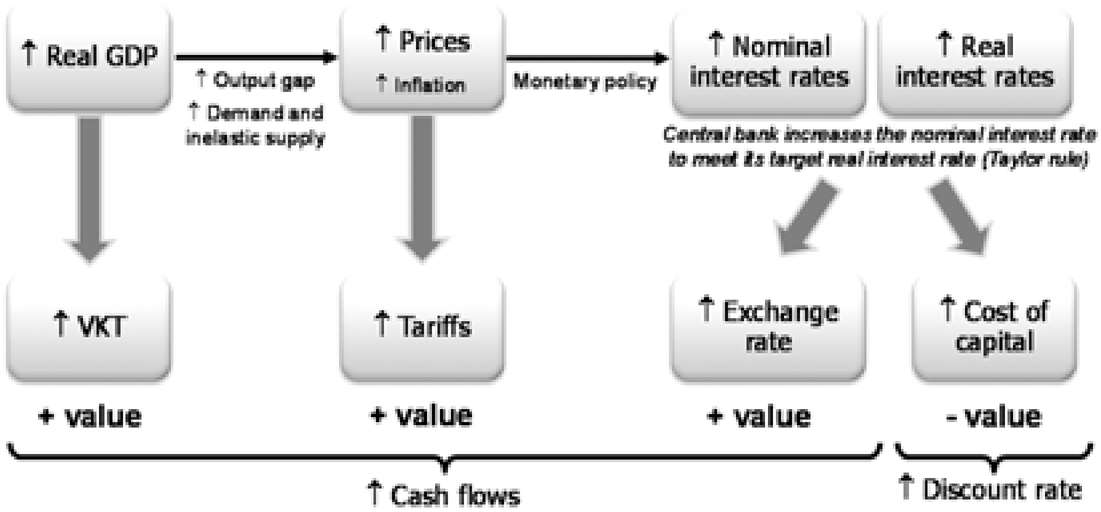


Figure 4. Channels that drive the value of infrastructure assets of category 5. This figure shows how economic activity affects the value of infrastructure assets of category 5 and exhibits the channels that drive the value of this type of assets

How does this affect infrastructure assets of category 5? An increase in real GDP in the area increases traffic (i.e., vehicle kilometers traveled, VKT). Moreover, an increase in prices in the economy allows the operator to increase in tariffs because users present a higher willingness to pay.[3] Both the increase in traffic and in tariffs increase the cash flows generated by the infrastructure assets and *ceteris paribus* it increases its value. However, an increase in nominal and real interest rates increases the exchange rate and the cost of capital. Therefore, an increase in the cost of capital increases the discount rate and *ceteris paribus* it decreases the value of the infrastructure asset.

The empirical results that we have provided show that, when interest rates increase, then the increase in the value of the 407 ETR from the increase in cash flows is higher than the decrease in value from the increase in the discount rate. In the following section, we will setup and solve a partial equilibrium model for the valuation of the 5

[3] See Appendix B for an analysis of the relationship of local GDP on traffic, tariffs, and revenues for the 407 ETR.

different categories of infrastructure assets in order to study the effects of the economic activity in the value of these different assets.

4. ECONOMIC ACTIVITY AND THE VALUATION OF DIFFERENT TYPES OF INFRASTRUCTURE ASSETS: A STRUCTURAL MODEL

In the previous section, we have empirically analyzed the effects of economic activity on a specific category 5 infrastructure asset. In this section, we set up and develop a parsimonious valuation model of infrastructure assets to compare the effects of economic activity on the value of assets across the 5 types of infrastructure assets that we described in section 1. We assume that the value of an infrastructure asset, V, is determined by all the free cash flows that it can generate in the future, discounted at its weighted average cost of capital as follows:

$$V = \sum_{t=0}^{T} \frac{FCF_t}{1+WACC_t} \qquad (2)$$

where FCF_t is the free cash flow at any time t, $WACC_t$ is the weighted average cost of capital, and T is the terminal period of the asset or the end of the concession.[4]

Asset category	Growth in free cash flows
Category 1	0%
Category 2	Inflation
Category 3	Inflation and traffic growth
Category 4	max(Inflation; GDP per capita growth) and traffic growth
Category 5	Growth in WTP and traffic growth

Table 4. Assumptions about the free cash flows of the 5 categories of assets. This table shows the description of the growth in free cash flows that the model assumes for the different categories of infrastructure assets.

To be able to compare among the different categories of assets, we assume that there is one infrastructure asset and we analyze the impact of interest rate changes in its

[4] Note that it is standard to compute the total value of an asset as the sum of expected free cash flows that this asset will produce discounted at the WACC. Equivalently, one could estimate the value of the equity of this asset using the dividend discount model (DDM) and, then, add its debt to obtain its total value.

value in the 5 different categories of assets that we described above. We assume that the asset produces the same initial FCF (e.g., FCF at year 0 is CAD 100,000,000) and the cost of capital that investors will apply to the cash flows that it generates is the same in the 5 categories. The main difference among the 5 categories of assets is the free cash flows that they produce. Table 4 summarizes the assumptions about the free cash flows of the 5 categories of assets.

Parameter		Value
Initial free cash flows (millions of CAD)		100
Years to end concession (years)		50
Inflation parameters:		
	α_1	-0.04
	α_2	1.50
	α_3	0.02
GDP growth parameters:		
	δ_0	0.01
	δ_1	0.2
	δ_2	0.9
Traffic growth parameter:		
	γ	0.4
GDP per capita growth parameters:		
	μ_1	0.005
	μ_2	0.9
Growth in willingness-to-pay parameter:		
	θ	1.2
WACC parameters:		
	Beta	1.0
	Market risk premium	5%
	Average leverage, Debt/(Debt+Equity)	0.50
	Tax rate	30%
	Debt premium	4%

Table 5. Parameters of the model. This table displays the baseline parameterization of the model.

We assume that the concession will end in 50 years from now and presents a leverage that is defined by a constant debt to value ratio of 0.50. We assume a Taylor rule as in Taylor (1999) such that *inflation = (interest rate –* α_1*)/* α_2 + α_3. We assume that GDP growth is a linear function of interest rates and inflation such that *GDP growth =* δ_0 + δ_1**interest rate +* δ_2**inflation*. We also consider a traffic growth factor of γ times the *GDP growth* and a *GDP growth per capita* equal *to* $\mu_1 + \mu_2$**GDP growth*. Table 5 summarizes the parameterization of the model.

We estimate the value of the different categories of infrastructure assets for different levels of the risk-free rate ranging from 1% to 7%. Figure 5 exhibits the results of this valuation. We normalize the results to investing 100 units of currency in each category of infrastructure in a scenario of interest rates of 1%. Then we can analyze how the value of each category changes with an increase in interest rates. Several conclusions arise from this figure. First, the values of infrastructure assets of categories 1 and 2 decrease with an increase in interest rates. This result indicates that the *discount rate effect* dominates the *cash flow effect* for infrastructure assets of categories 1 and 2.

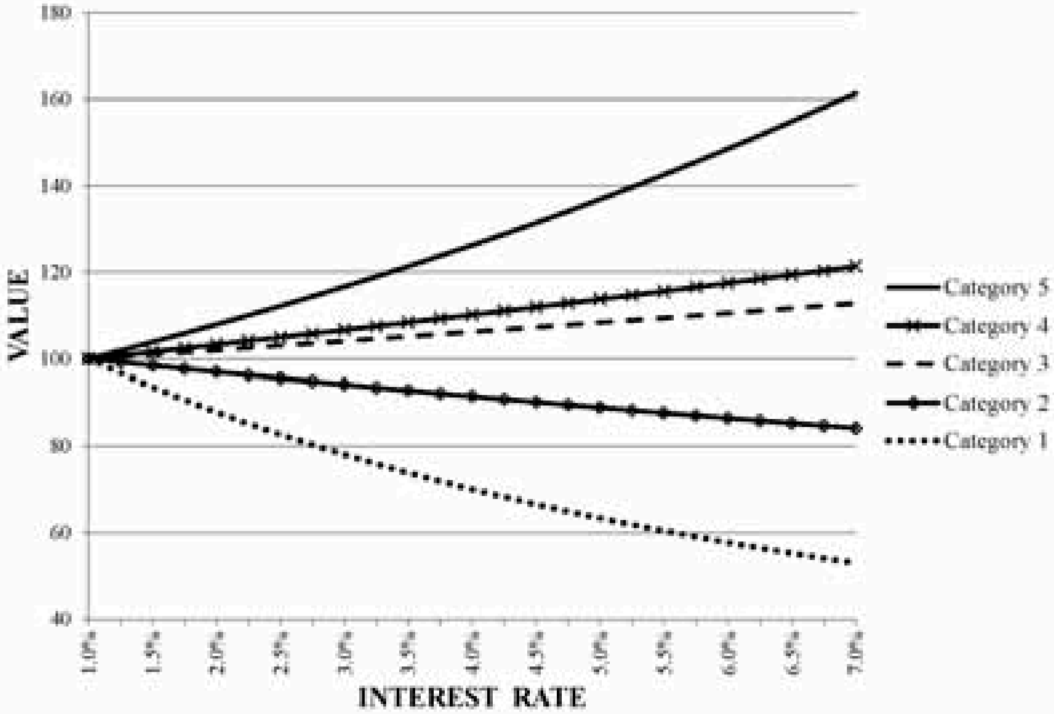


Figure 5. The effect of interest rates in the value of 5 categories of infrastructure assets. This figure shows how the value of an investment of CAD 100 million in an economy with a risk-free interest rate at 1% changes when there is a permanent increase in the risk-free rate for the 5 categories of infrastructure assets.

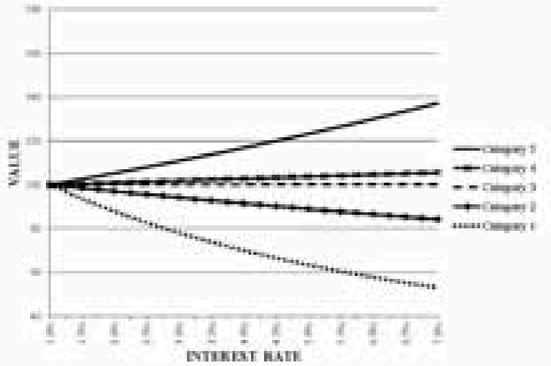
Second, the decrease in value with an increase in interest rates is lower for assets of category 2 than the decrease for category 1 assets because cash flows of the former can increase with inflation while cash flows of the latter are constant. Therefore, the cash flow effect is higher for assets of category 2 than for assets of category 1.

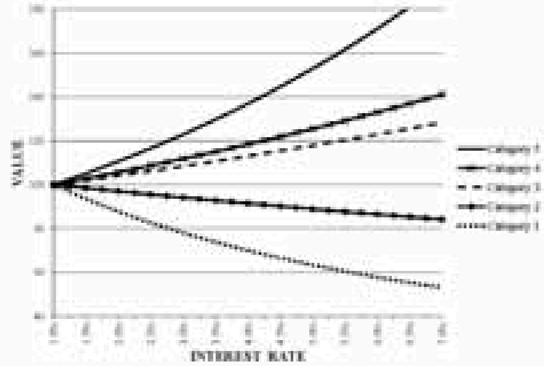
Third, the effect of interest rates in the value of assets of category 3 is low. This result suggests that the *discount rate* has an effect of slightly lower magnitude than the *cash flow effect*. The results from the parameterization of the model show that a 6% increase in interest rates from 1% to 7% for assets of this category would increase the value of the asset by 13%.

Fourth, the magnitude of the effect of interest rates in the value of assets of category 4 is relevant. Therefore, the *discount rate* has an effect of lower magnitude than the *cash flow effect* for this category of assets. The results from the model show that a 6% increase in interest rates from 1% to 7% for assets of this category would increase the value of the asset by 21%.

Fifth, there is a high positive relationship between interest rates and the value of assets of category 5 because the *cash flow effect* clearly dominates the *discount rate effect* for this category of assets. The results from the model show that a 6% increase in interest rates from 1% to 7% for assets of this category would increase the value of the asset by 61%. Overall, these results show that the value of asset categories 4 and 5 increase with interest rates, while the value of asset categories 1 and 2 decrease.

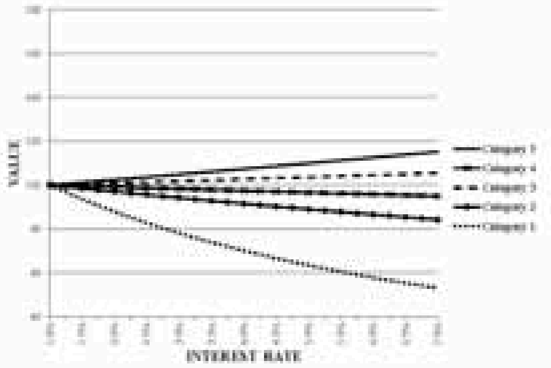
Finally, we run a sensitivity analysis to the key parameters of the model. Figure 6 shows the results of this analysis. We specifically analyze the sensitivity to the traffic growth parameters (Panel A), the GDP growth parameters (Panel B), and the GDP per capita growth parameters (Panel C). Overall, we observe that the values of the infrastructure assets of categories 3, 4, and 5 are the most sensitive to different parameters related to traffic growth, GDP growth, and GDP per capita growth. Most importantly, the trend of the relationship between interest rates and value of the infrastructure does not change for any type of asset, except for category 3 that goes from a positive to a negative relationship when we decrease the GDP growth parameters (Panel B; left).

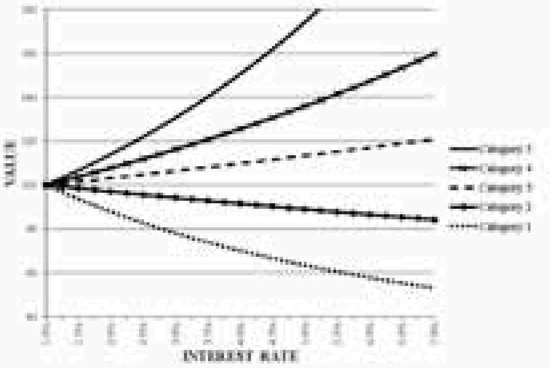




$\gamma = 0.25$ $\gamma = 0.55$

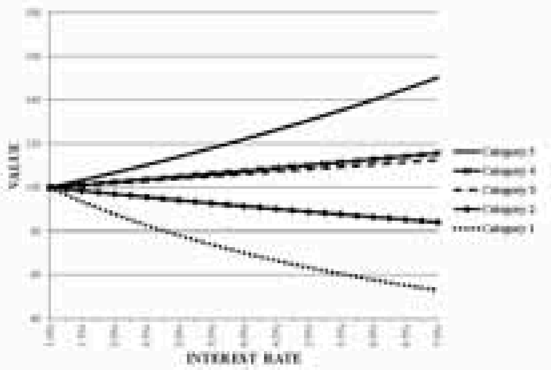
Panel A. Sensitivity to traffic growth parameter

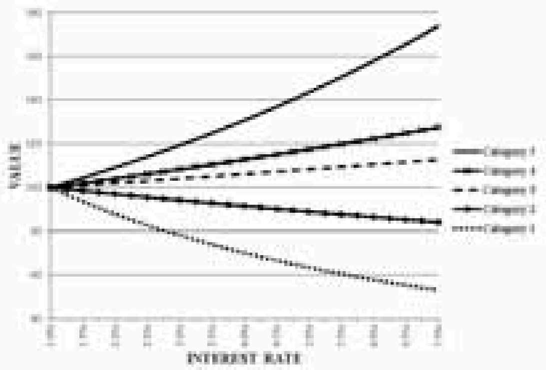




$\delta_1 = 0.1$ and $\delta_2 = 0.8$ $\delta_1 = 0.3$ and $\delta_2 = 1.0$

Panel B. Sensitivity to GDP growth parameters





$\mu_1 = 0.000$ and $\mu_2 = 0.85$ $\mu_1 = 0.010$ and $\mu_2 = 0.95$

Panel C. Sensitivity to GDP per capita growth parameters

Figure 6. Sensitivity analysis to the key parameters of the parameterization. This figure shows the sensitivity of the value of the infrastructure to the traffic growth parameters (Panel A), the GDP growth parameters (Panel B), and the GDP per capita growth parameters (Panel C).

5. CONCLUSIONS

Changes in interest rate have an effect on the value of infrastructure assets. On the one hand, an increase in interest rates decreases the value of infrastructure assets because it decreases the present value of their cash flows (the *discount rate effect*). On the other hand, increases in interest rates are usually related to increases in economic activity because central banks increase interest rates as a response to increases in inflation provoked by economic expansions. Therefore, an increase in interest rates increases the value of infrastructure assets because it increases the value of their cash flow (the *cash flow effect*).

In this paper we have analyzed whether the discount effect dominates the cash flow effect. We find that the cash flow effect dominates the discount rate effect for assets with tariffs that can be adjusted to manage demand (e.g., adjustable-rate toll roads) and, therefore, the value of these assets increases in periods of increasing interest rates and economic expansion. Nevertheless, the opposite occurs for assets that do not bear demand risk (e.g., non-toll roads), in which the value of these assets decreases.

Further research could address the effects of exchange rates on the performance of infrastructure assets. For example, if the US and Canadian economies are expected to grow at a higher rate than the Euro zone, then the USD and CAD would increase their value with respect to the EUR. Therefore, an investor based in the European Union using the euro as a base currency could benefit from investing in infrastructure assets located in the US or Canada (and, therefore, with revenues collected in USD and CAD, respectively) not only because the US and Canadian economies are performing well, but because the increase in the exchange rates of the US$ and CAD with respect to the EUR.

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Appendix A. Univariate and Multivariate Analyses of Revenue Growth

We run 1 univariate VAR analysis and 4 bivariate VAR analyses using the following specifications: [1] the growth in the monthly revenues in highway ETR 407 only, $g_{REVENUE}$; [2] $g_{REVENUE}$ and inflation; [3] $g_{REVENUE}$ and GDP growth, g_{GDP}; [4] $g_{REVENUE}$ and the nominal interest rate $r_{NOMINAL}$; and [5] $g_{REVENUE}$ and the real interest rate r_{REAL}. Table A1 exhibits the results of these 5 specifications.

Six main results arise from these analyses. First, lagged revenue growth predicts current revenue growth up to three months across all the 5 specifications. The coefficients are statistically significant for all the specifications. Second, past inflation is positively related to current growth in revenues. This effect is significant up to 2 months. Third, past growth in revenue is also positively related to current inflation up to 2 months. Fourth, the relationship between the revenue growth and past GDP growth is weak. Later in the analysis, we will focus on the study of the correlation structure of revenue growth and GDP. Fifth, nominal interest rates and real interest rates do not predict growth in revenue. Sixth, both nominal and real interest rates present a strong one month autocorrelation.

These results are one-to-one (specification [1]) and bivariate (specifications [2]-[5]). Next step is to study the full multivariate model with all the endogenous variables together, that is, growth in revenue, inflation, GDP growth, nominal interest rates, and real interest rates. Table A2 displays the results of this VAR specification.

		[1]	[2]		[3]		[4]	
		$g_{revenue}$	$g_{revenue}$	inflation	$g_{revenue}$	$r_{nominal}$	$g_{revenue}$	r_{real}
$g_{revenue}$	lag 1	0.2549 ***	0.0734	1.4072 ***	0.2518 ***	0.9900 ***	0.2541 ***	1.1088 ***
	lag 2	0.4959 ***	0.3984 ***	1.9547 ***	0.5062 ***	0.0465	0.5159 ***	-0.037
	lag 3	0.3910 ***	0.3820 ***	-0.1757	0.3902 ***	-0.3998	0.3954 ***	-0.0954
inflation	lag 1		0.0358 **	0.1834 **				
	lag 2		0.0390 ***	0.0317				
	lag 3		0.0104	-0.0849				
$r_{nominal}$	lag 1				-0.0196	0.9799 ***		
	lag 2				0.0324	-0.1562		
	lag 3				-0.0125	0.0368		
r_{real}	lag 1						-0.2383	0.9907 ***
	lag 2						0.0274	-0.209
	lag 3						-0.0066	0.0746
constant		0.4390	0.6406	24.76	-0.0467	75.67	1.8931	82.43
Time FE		Yes	Yes	Yes	Yes	Yes	Yes	Yes
Num. Obs.		125	116	116	116	116	116	116
R^2		0.295	0.365	0.213	0.285	0.971	0.285	0.969

Table A1. Univariate and bivariate VAR analysis. Specification [1] studies the univariate effects of growth in revenues with lags up to 3 months. [2] shows the bivariate analysis of growth in revenues and inflation. [3] shows the bivariate analysis of growth in revenues and nominal interest rates. [4] shows the bivariate analysis of growth in revenues and real interest rates. All the specifications include time fixed effects. *, **, and *** indicates statistical significance at the 10%, 5%, and 1% level, respectively.

		$g_{revenue}$	inflation	$r_{nominal}$	r_{real}
$g_{revenue}$	lag 1	0.0504	1.2088 **	0.7290 **	0.8687 **
	lag 2	0.4386 ***	1.7818 ***	0.0221	-0.0041
	lag 3	0.3997 ***	-0.0327	-0.3565	-0.1772
inflation	lag 1	0.0383 ***	0.1774 **	0.1124 **	0.1425 ***
	lag 2	0.0462 ***	0.0536	0.0148	-0.0021
	lag 3	0.0122	-0.0786	0.0158	0.0179
$r_{nominal}$	lag 1	0.0998	0.7586	0.9702 ***	0.1859
	lag 2	0.0011	-0.6939	0.2502	0.3215
	lag 3	-0.0692	0.1871	-0.4061	-0.5788 *
r_{real}	lag 1	-0.1315	-0.5468	-0.0093	0.7936 **
	lag 2	0.0230	0.3142	-0.4039	-0.4782
	lag 3	0.0770	0.0043	0.4564	0.6036 *
constant		1.15	18.57	75.27 ***	83.76 ***
Time FE		Yes			
Num. Obs.		116			
R^2		0.3933	0.2410	0.9726	0.9720

Table A2. Multivariate VAR analysis with growth in revenues. This table displays the joint effects of growth in revenues, inflation, nominal interest rates, and real interest rates. *, **, and *** indicates statistical significance at the 10%, 5%, and 1% level, respectively.

The main results from Table A2 are the following. First, there is a positive and significant relationship between the past and current growth in revenue. Specifically, we obtain that the 2 and 3 months lagged growth in returns forecasts 44.3% and 40.2% of the current growth in revenues, respectively. This result indicates that the growth in revenues is persistent, that is, when there is a period of positive (negative) growth in revenues, the probability that the revenue growth is positive (negative) in the following months is high. Second, we find that recent past inflation has a positive effect on revenue growth. This result indicates that revenues grow in periods of increasing prices in the economy. We also find that the revenue growth in the recent past is positively related to current inflation, which corroborates the persistence in revenue growth. Third, we do not find any significant effect of past real nor nominal interest rates on revenue growth. However, we do find a positive relationship between the revenue growth in the past month and the current nominal and real interest rates. This result indicates that revenue growth and interest rates are positively related, but the positive (negative) growth in revenues anticipates the increase (decrease) in interest rates. The lagged effects that we obtain from these results are consistent with the macroeconomic framework and the monetary policy transmission channels that we discussed in section 2. In particular, notice that the growth in revenues and the increase in inflation lead the increase in nominal and real interest rates.

Appendix B. Analysis of the relationship of local economic activity on traffic, tariffs, and revenues

In this appendix, we further analyze the relationship of local GDP and the performance of the infrastructure asset. We study the relationship between local economic activity measured in terms of employment growth in the Toronto area and the following three measures: (1) growth in revenues; (2) growth in traffic in terms of VKT; and (3) growth in tariffs. Table B1 exhibits the results of this analysis and shows that there is a positive relationship among GDP growth (measured in terms of employment growth in the Toronto area), growth in traffic, and growth in tariffs.

		[1]			[2]			[3]			
		$g_{revenue}$	$g_{employment}$		g_{VKT}	$g_{employment}$		g_{Tariff}		$g_{employment}$	
$g_{revenue}$	lag 1	0.1058	0.0224	***							
g_{VKT}					0.0262	0.0221	***				
g_{Tariff}								0.7853	***	0.0547	
$g_{employment}$	lag 1	0.2107	0.5286	***	1.5908	0.4947	***	0.2530	***	0.5678	***
constant		-1.3827	0.1137		-0.3259	0.0960		-6.9026	***	1.7608	
Time FE		Yes			Yes			Yes			
Num. Obs.		120			120			120			
R^2		0.0102	0.4023		0.0177	0.4160		0.0102		0.4023	

Table B1. Relationship of local GDP and the performance of the infrastructure asset. This table shows the of local economic activity measured in terms of employment growth in the Toronto area with growth in revenues (specification [1]), growth in VKT (specification [2]), and the growth in the average tariff (specification [3]) in the 407 ETR. *, **, and *** indicates statistical significance at the 10%, 5%, and 1% level, respectively.

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