Carbon Control and Real Estate Growth: A CRREM Analysis of Challenges to Fulfill the Paris Agreement

CRREM PROJECT

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 785058.

Agenda

- Introduction to CRREM.
- Idea
- Consortium
- What this paper does and its aim
- Model estrategy and steps
- Results
- Conclusions

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What is CRREM

- Carbon Risk Real Estate Monitor
  - Project 785058 of H2020 EU program, Energy and sustainability topic

Main goals:

- To estimate the required investment in the existing comercial building in order to improve their energy efficiency and reduce carbon emissions
  - Speed of energy efficiency renovation requirements the building stock should follow
- Identify and quantify the risk of become stranded asset under the energy perspective
- Build a tool to estimate the likelihood to be energy-stranded and quantify the particular carbon efforts (retrofitting investment), at three levels:
  - Real estate assets
  - Portfolios
  - Aggregate

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Why CRREM is relevant

- International agreements (climatic change) establish a fixed carbon budget by 2016 for consumption by 2050 at the latest
- At the current rate of emissions, we will have consumed our carbon budget in 2039 (2-degrees goal) or in 2036 (1.5-degrees goal).
- More buildings will be constructed that will add CO2 emissions and reduce the available carbon budget of existing stock.
- which means the existing park must make a greater effort to reduce emissions, how much?
  - Lot of uncertainties
  - Firms owning the buildings do

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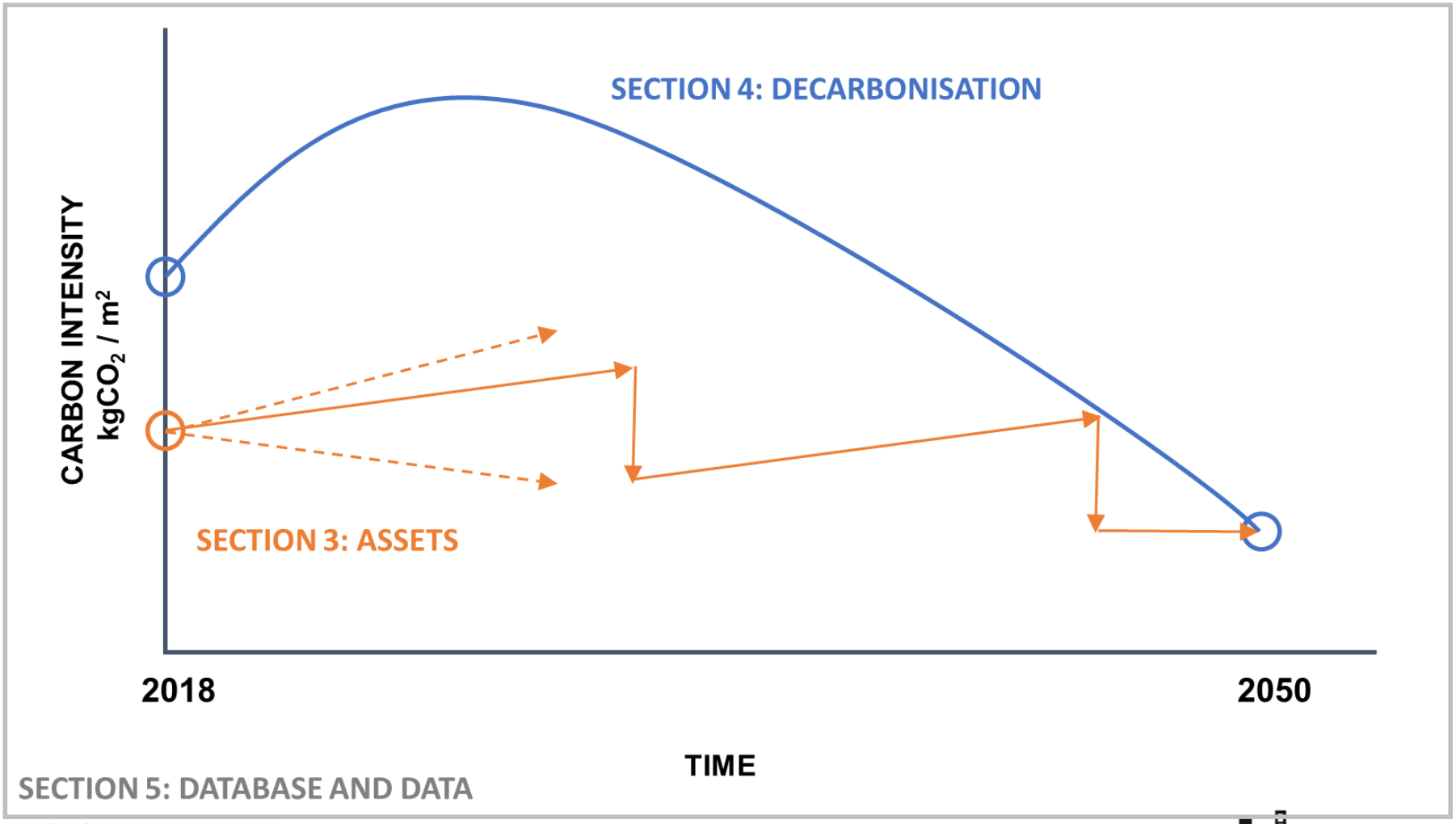
The idea



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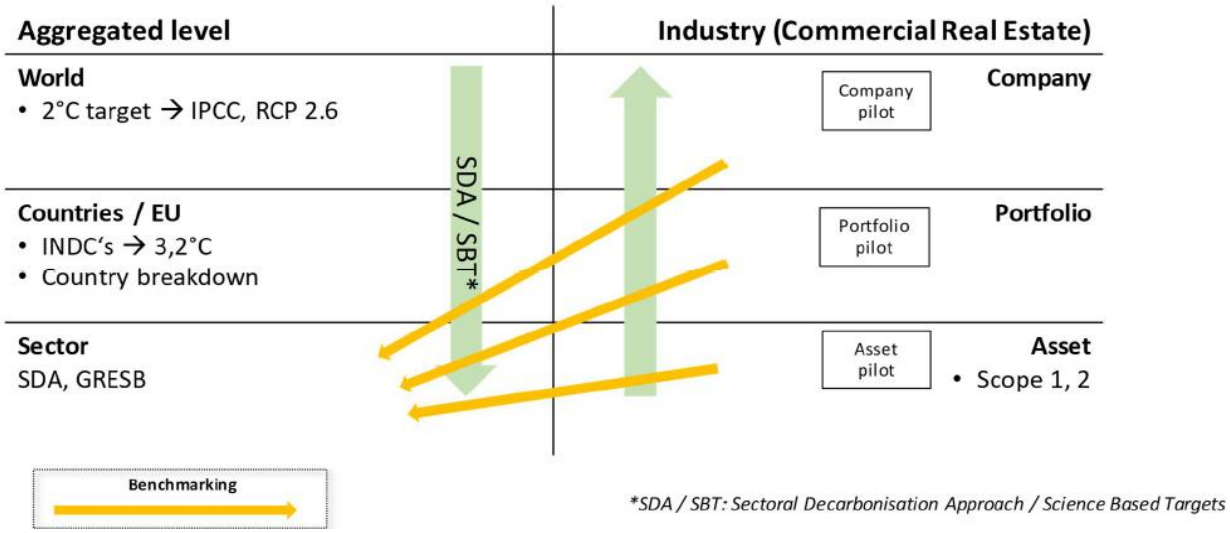
The idea

- Not so simple:
  - At national level in EU (28!!)
  - At portfolio level
  - At building/asset type level
- And..
  - Climate becomes + hot



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What is CRREM

- Consortium: 5 partners
  - Coordinator: IIÖ (research centre), Austria
  - GRESB, The Netherlands
  - University of Tilburg
  - University of Ulster
  - University of Alicante
- Strong links with companies (investor and energy oriented firms)– EIC organization
- http://crrem.eu

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What is CRREM

- Calculation methodology follows several steps:
  - Data base construction
  - Estimate the carbon impact of retrofitting in emissions and monetary investment
  - Fit how emissions evolve with the carbon target
  - Calculate the future increase on emissions
    - Forecast the future building trend
  - All affect the emissions stream: horizon 2050
  - All follow process of VERIFICATION of data and results

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Step covered by this paper: Forecast building activity

- Public forecasting are incompleted for our needs

EU Reference scenario 2016

EU-28: Key Demographic and Economic Assumptions

	2000	2010	2020	2030	2040	2050	'00-'10	'10-'20	'20-'30	'30-'40	'40-'50
Population (in Million)	483.7	500.2	510.0	515.9	520.7	522.4	0.3	0.2	0.1	0.1	0.0
Household size (inhabitants per household)	5.1	2.4	2.3	2.3	2.3	2.2	-7.3	-0.2	-0.2	-0.2	-0.2
Gross Domestic Product (in MEuro'13)	**11250.8**	**12895.0**	**14549.9**	**16682.3**	**19431.1**	**22526.0**	**1.4**	**1.2**	**1.4**	**1.5**	**1.5**
Household Income (in Euro'13/capita)	**13436.7**	**14993.7**	**16610.2**	**19089.5**	**22336.4**	**26163.9**	**1.1**	**1.0**	**1.4**	**1.6**	**1.6**
SECTORAL VALUE ADDED (in MEuro'13)		**11533.3**	**13012.6**	**14918.5**	**17375.3**	**20140.9**		**1.2**	**1.4**	**1.5**	**1.5**
Industry		1755.5	1944.8	2163.8	2404.8	2665.1		1.0	1.1	1.1	1.0
iron and steel		43.1	45.6	48.0	49.4	49.9		0.6	0.5	0.3	0.1
non ferrous metals		22.0	23.6	24.9	26.1	26.8		0.7	0.6	0.5	0.3
chemicals		210.3	236.7	263.4	293.1	323.6		1.2	1.1	1.1	1.0
non metallic minerals		71.0	75.2	84.7	93.3	101.3		0.6	1.2	1.0	0.8
paper pulp		85.5	91.4	99.8	108.9	116.5		0.7	0.9	0.9	0.7
food, drink and tobacco		234.5	259.9	291.7	328.4	366.4		1.0	1.2	1.2	1.1
engineering		723.2	826.2	942.8	1069.3	1212.0		1.3	1.3	1.3	1.3
textiles		66.6	58.4	50.3	44.7	40.3		-1.3	-1.5	-1.2	-1.0
other industries (incl. printing)		299.3	327.7	358.2	391.8	428.3		0.9	0.9	0.9	0.9
Construction		709.1	737.4	815.9	916.4	1019.7		0.4	1.0	1.2	1.1
Tertiary		8730.2	9378.5	11558.6	13842.3	16612.3		1.5	1.5	1.7	1.8
market services		5015.4	5863.6	6926.2	8309.6	9909.8		1.6	1.7	1.8	1.8
non market services		2236.9	2410.3	2655.1	3016.8	3420.7		0.7	1.0	1.3	1.3
trade		1285.6	1502.9	1771.4	2104.9	2468.3		1.6	1.7	1.7	1.6
agriculture		192.3	199.6	205.9	210.9	213.4		0.4	0.3	0.2	0.1
Energy sector and others		338.5	353.9	380.2	411.8	443.8		0.4	0.7	0.8	0.8

Source: EUREF16, in wp2 report,

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Aim of this presentation

- Show the forecasting strategy for new commercial construction space: 2018-2050!
  - Need data (28 countries) …Long term series
  - Yearly data
  - Goal: Forecasting construction (m2)
    - Supply side model
  - Stochastic modelling
    - But: We cannot advance any innovation nor structural change
    - The growth trend in the future done the past knowledge.

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Conceptual model

- Di Pasquale & Wheaton (1996) shows that new supply space reacts to changes on market prices and construction costs.

$$\Delta Qre_t^s = f(P_{re,t}, Cc_t, S_{t-1}, G_t^k) = e^{\alpha 1} P_{re,t}^{\alpha 2} C_t^{\alpha 3} I_t^{\alpha 4} S_{t-1}^{\alpha 5} [G_t^k]^{\alpha 6} \varepsilon_t$$

  - where:
  - $P_{re,t}$ corresponds to real estate prices in real terms (market prices not developer prices)
  - Cc_t corresponds to the costs associated with construction materials and labor
  - i_t reflects the real interest rates paid by developers for building credits
  - S_{t-1} is the existing stock at the previous moment
  - G_t^k is a matrix of the regional market characteristics, including physical features as well as other aspects like land and market size
  - ε_t is a random term
  - $\alpha_{1..6}$ are the estimated parameters.

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Problems?

- Long term data is not available enough.
  - Time series comes from 1990 (quarterly) but prices from 2005!
- Yearly base forecasting is better (less estimated points than quarterly and with no seasonal effects) but requires long term evidence.
- Proxies solution (solving sort-run timeseries)
- Forecasting method.
  - Ideal: stochastic
  - Deterministic

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Econometric Strategy

The analytical process follows the conventional sequential steps for a dynamic model:

- 1.- stationary analysis,
- 2.- VAR definition and lag structure analysis,
- 3.- Cointegration tests identification,
- 4.- VECM definition, diagnosis and final model estimation,
- 5.- Forecasting.

- Separate country to country

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Econometric Strategy

- Different methods for forecasting..
  - Deterministic method using a proxy
- 1st. Looking for a proxies: housing prices?
  - Prices prediction other prices?. Evidence
  - Exogenous prove, using GDP

- 2nd. Forecasting with proxies
  - Supply model for commercial building permits
    - Offices
    - Commercial real estate (no-offices sector)

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1st stage: housing prices model

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1st. Housing price model: Evidence

- Dynamics seems to follow similar (lagged) cycle
- Supporting the idea of co-movements and the availability to be used as proxy (with the correct lag)

Figure 5.1.5- Prices: housing and offices

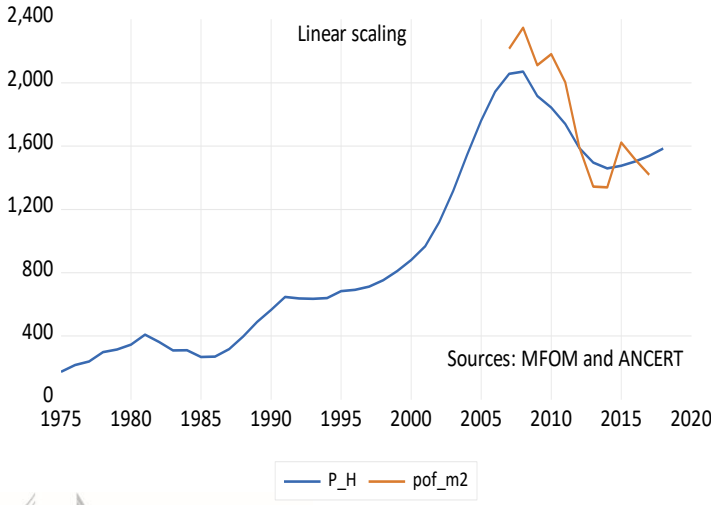
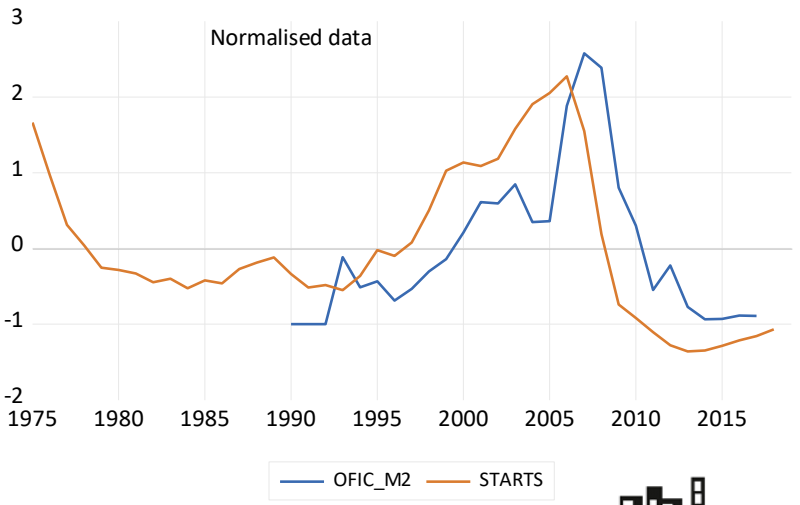


Figure 5.1.6. Starts of housing and offices (m2)



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1st. Housing price model

Meen(2001):

$$P_h^d{}_t = f(X, Z)_t = \alpha_1 + \alpha_2 (Pop)_t + \alpha_3 (y)_t + \alpha_4 (K)_t - \alpha_5 (Dh)_t - \alpha_6 (Cu)_t + \mu_t$$

-

Table 1. Variables in Model 1 of Housing Prices

Variable	**Concept**	**Available period**	**Source**
Phdt	Housing prices by m2 - Ph	1971-2018	MFOM, Dallas Fed and Taltavı and Juárez 2015
Pop	population older than 20 years. Taken in differences Pob>20	1971-2018	INE
Y	GDP real terms -RGDP	1971-2018	INE
K	Finance flow to buy houses (number of mortgages to buy a house)- FF	1971-2018	INE, mortgage statistics
Δh	Changes in the stock measured by the flow of starts STARTS	1971-2018	MFOM
Cu	User costs, measured by interest rates (real) and inflation, RIRM, INF	1971-2018	Bank of Spain, INE

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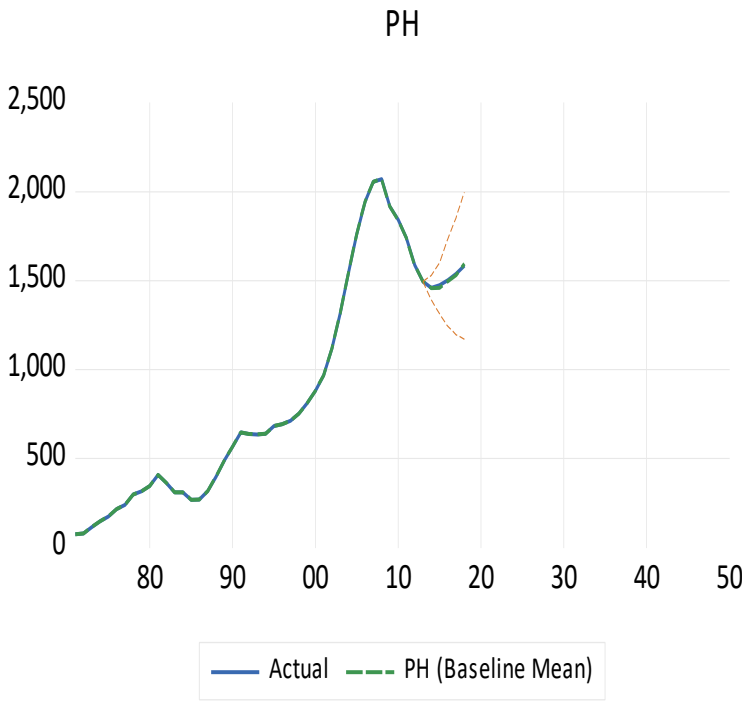
In-sample forecast

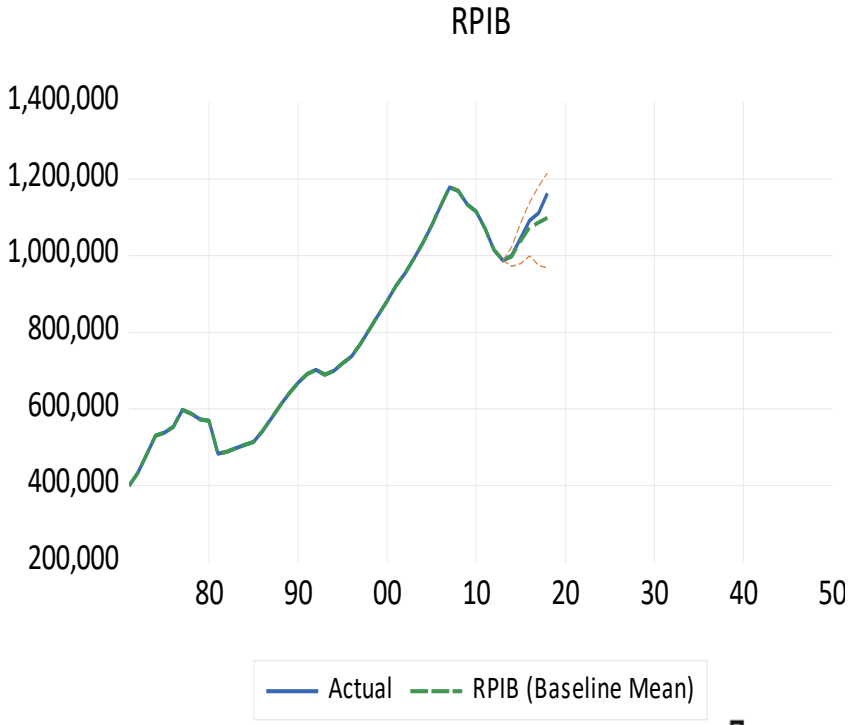
- Quite accurate in house price and starts predictions. Also in GDP!!

Figure 5.1.8. In-Sample predictions of the model. Accuracy and confidence bands

Panel 1- housing prices



Panel 2.- GDP



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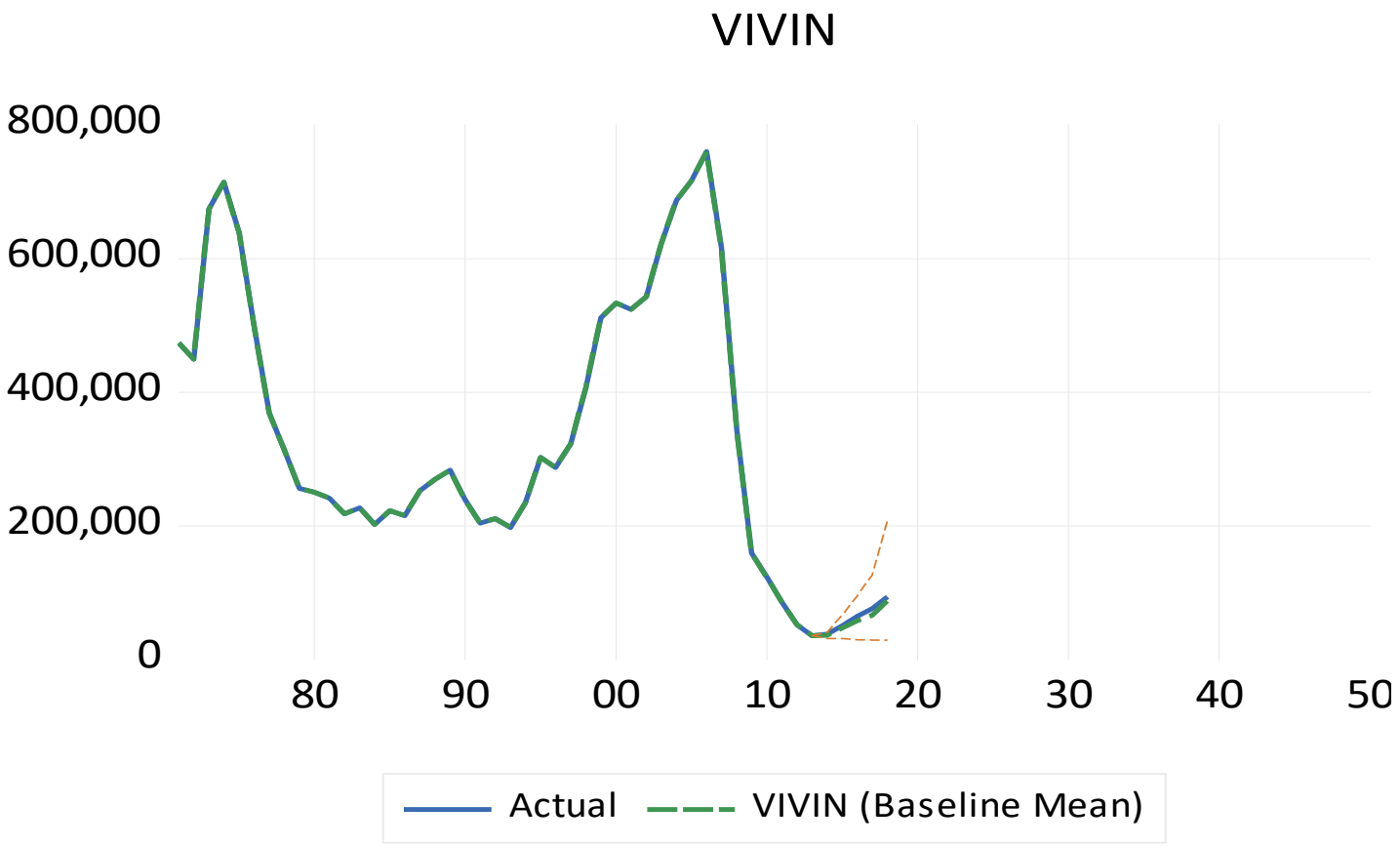
In-sample forecast



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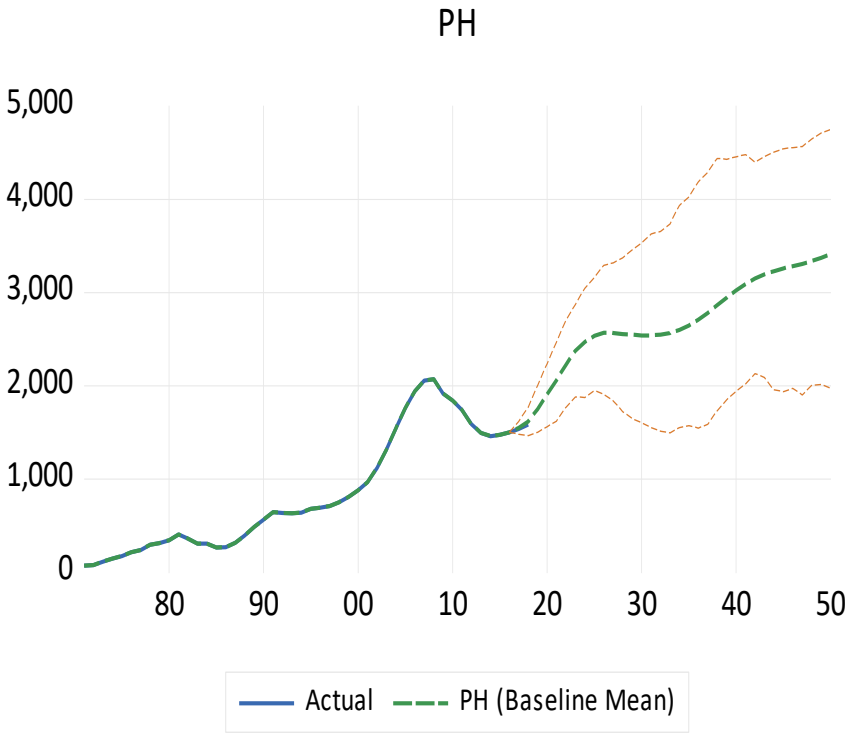
Prediction for 2018-2050

Figure 5.1.9. Out of-Sample predictions of the model with the horizon in 2050. Accuracy and confidence bands

Panel 1- housing prices



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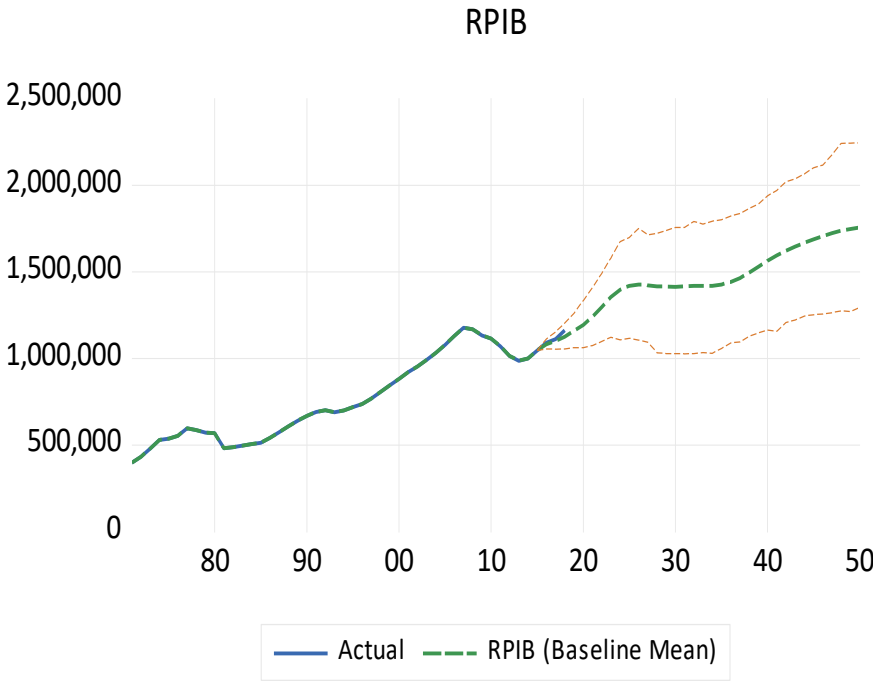

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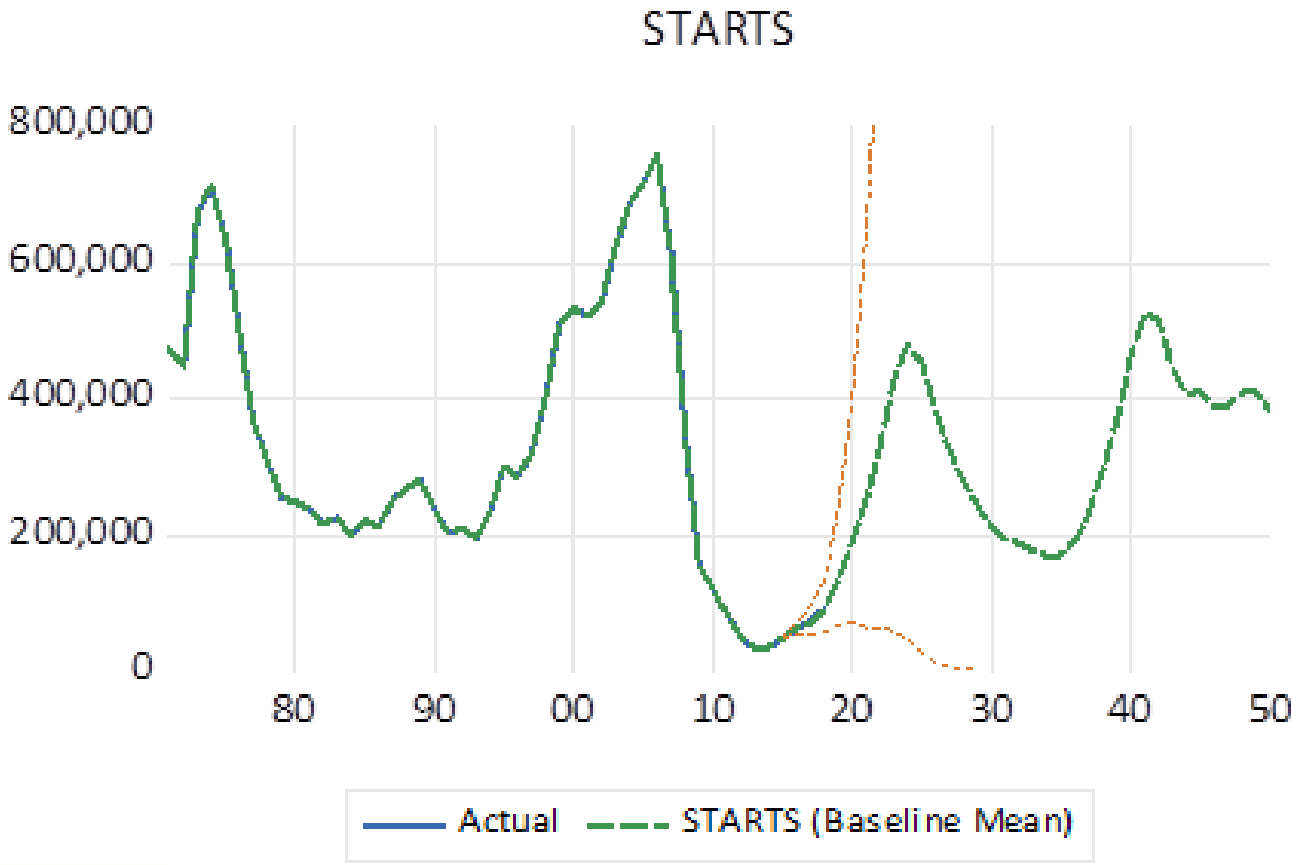
Prediction for 2018-2050

- Less accurate in the case of starts



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2nd stage: commercial space new supply (permissions)

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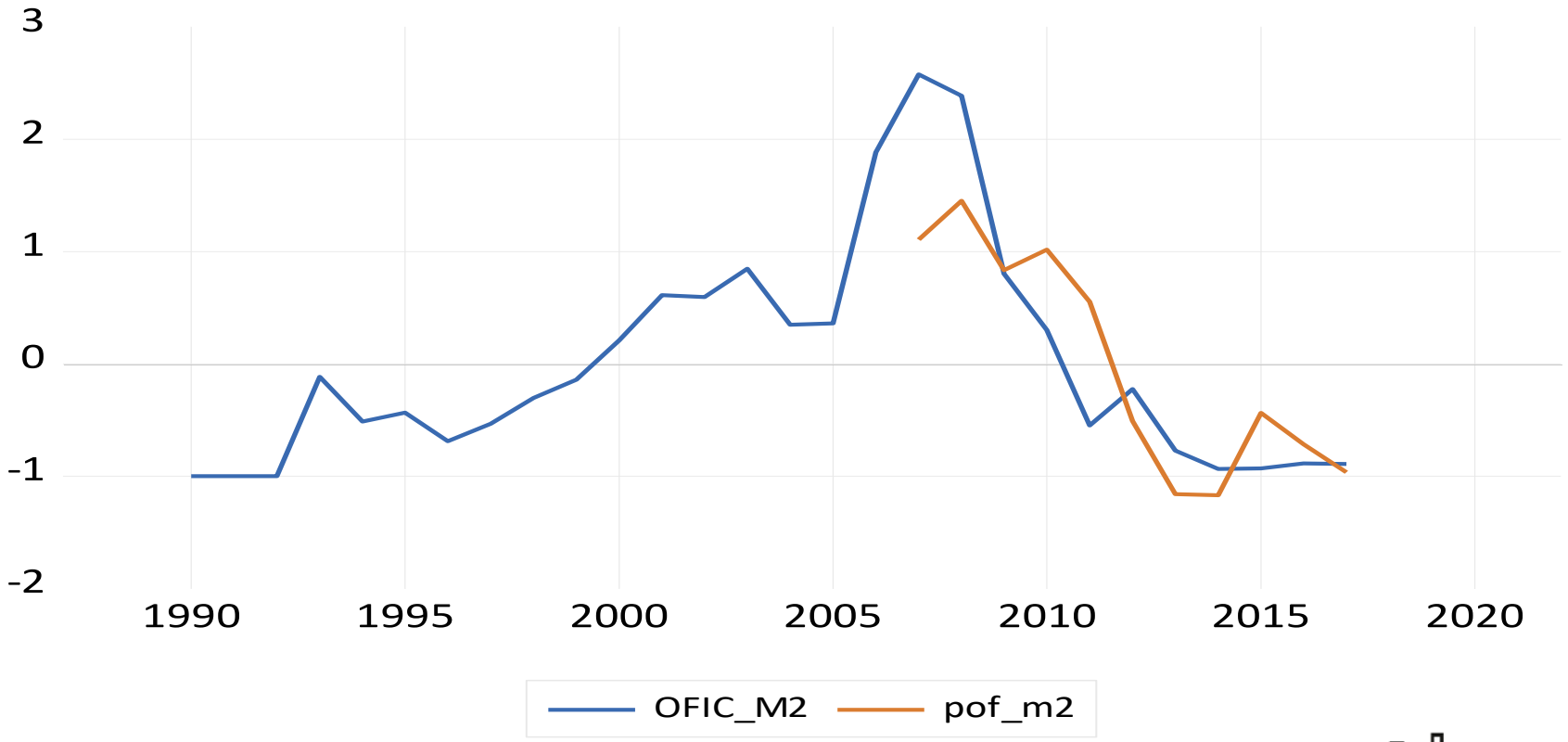
2nd stage: office space

Figre 5.1.4. Office building space and office transaction prices. Spain



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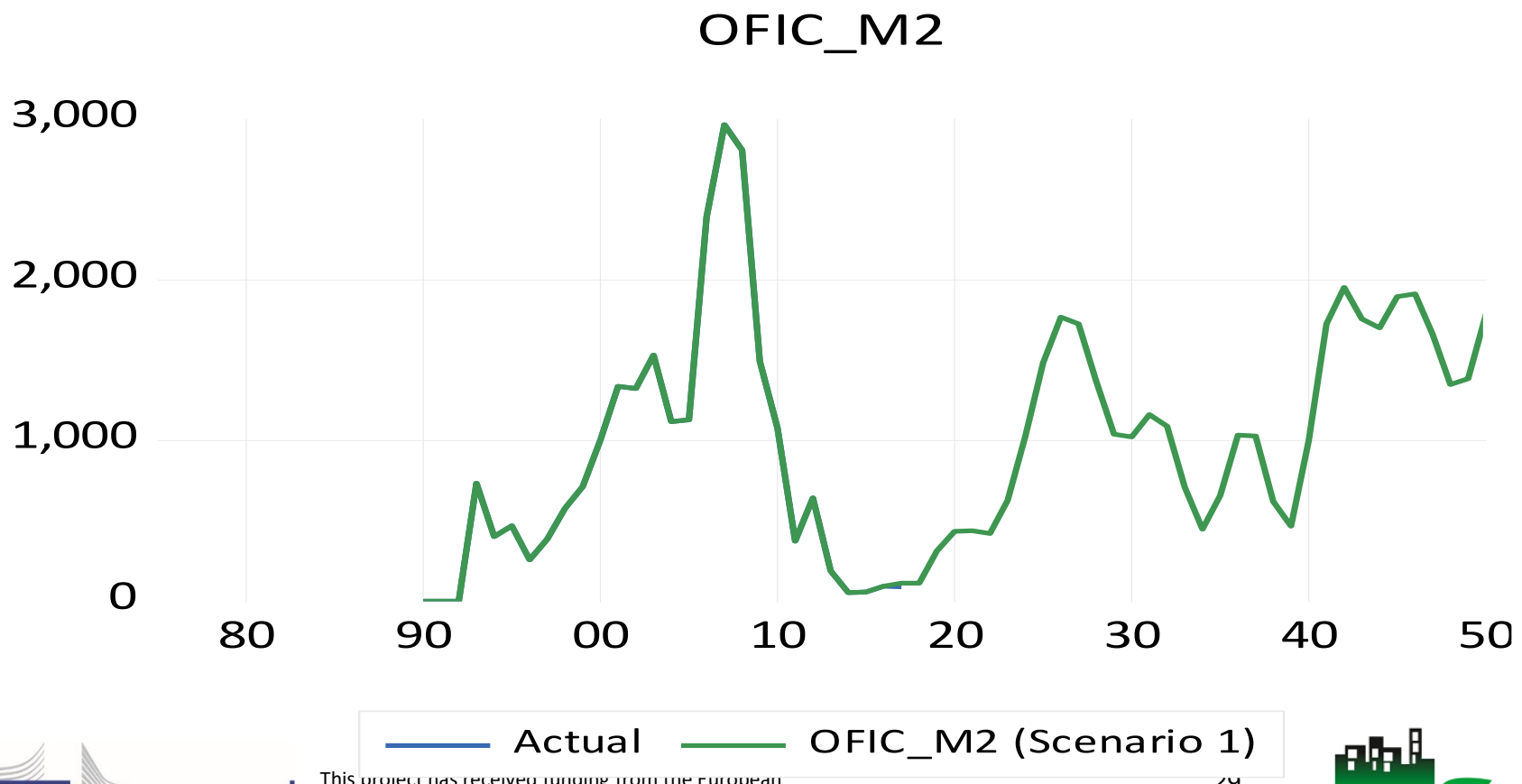
2nd step: Office space prediction

Figures 5.1.12. Semilog supply model forecast of Office_m2

Figures 5.1.14. Demand model. Deterministic forecast of Office_m2 using the predictor



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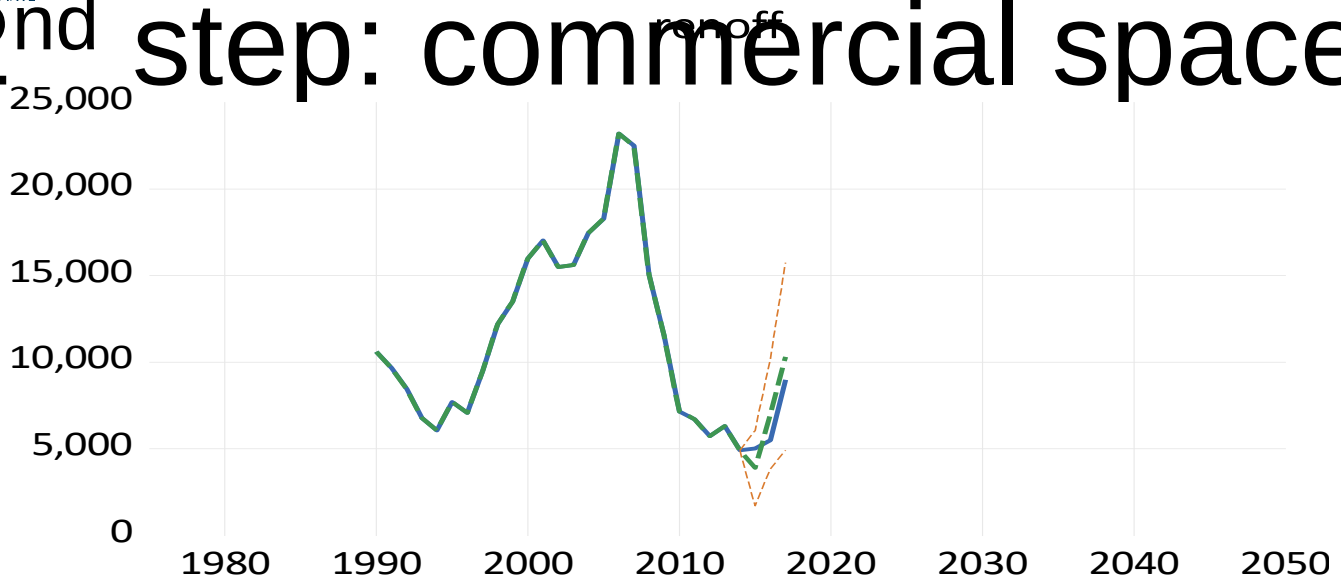
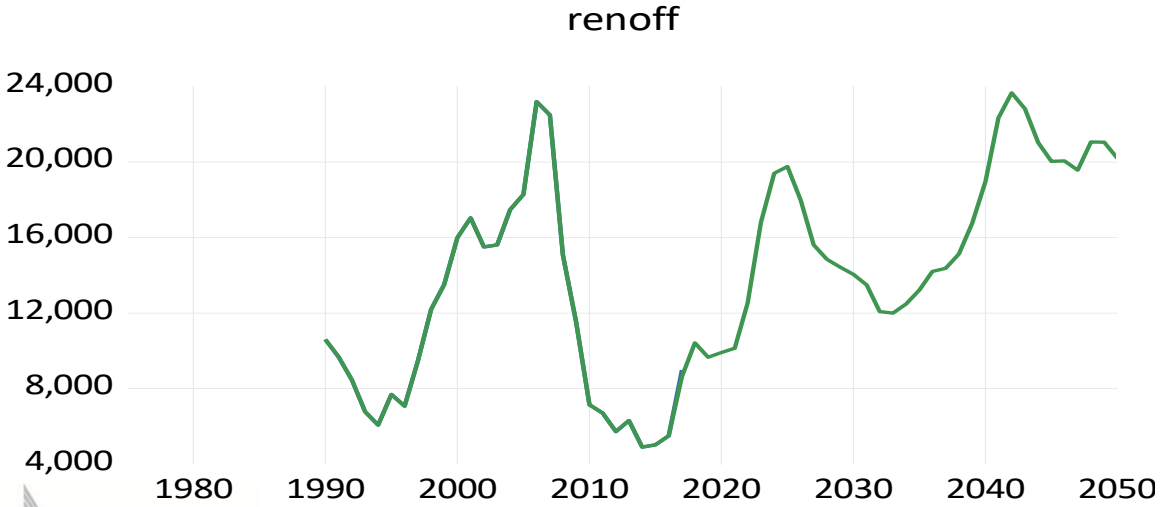
2nd step: commercial space



Figures 5.3.5. Demand model. Deterministic forecast of Commercial real estate_m2 using the predictor



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Conclusions

- Strong needs to forecast basic variables in order to take decisions
  - Climate change: reduce energy consumption by increasing efficiency but…. How much??
  - No data
- Socioeconomic relationships explain main variables to be forecast
- Needs to use econometric techniques based on the theory and evidence in real estate markets
- It works! (at the moment)
  - High uncertainty but we do not have the cristal ball

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