The impact of demographical change on the price level of real estate

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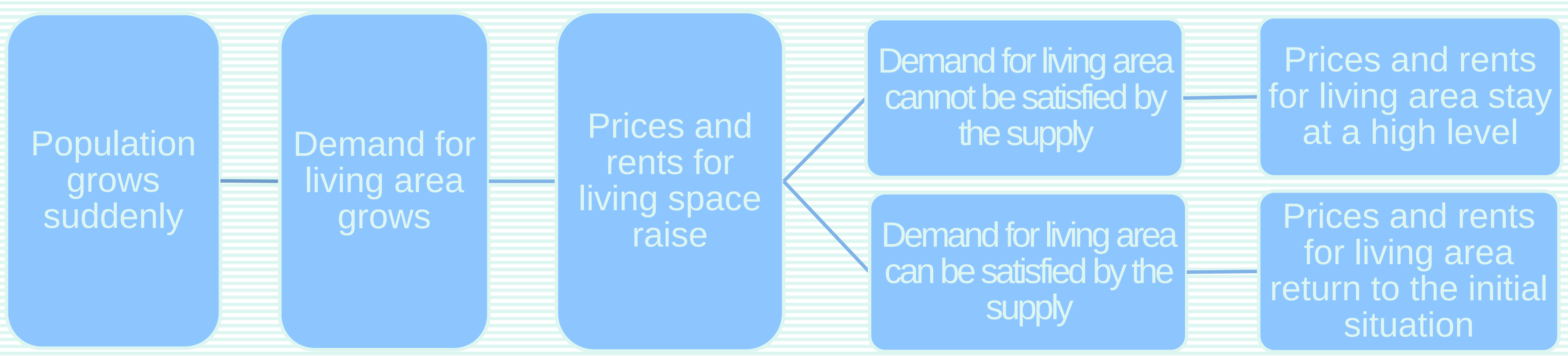
1 Background

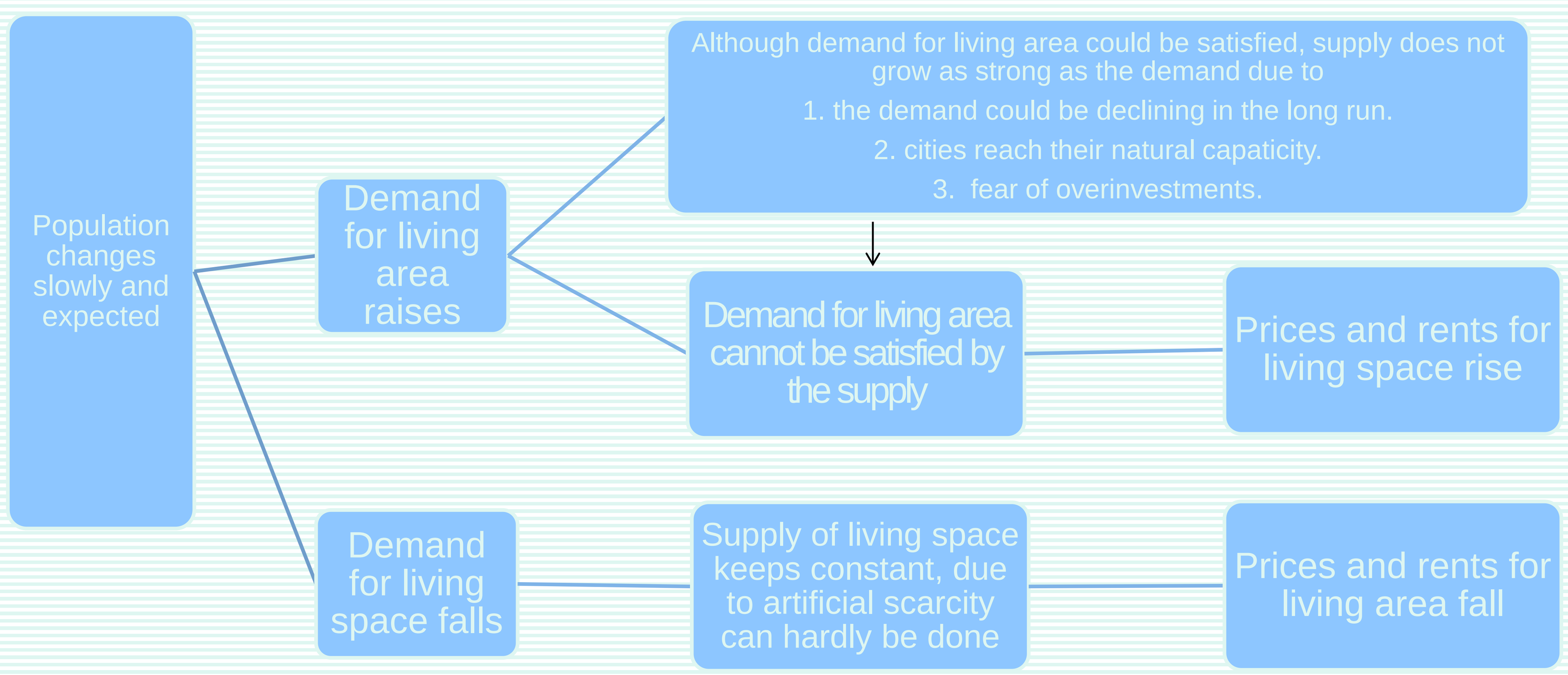
In view of the forthcoming demographical change in Germany, which is caused by a dwindling population with a changing age structure, it is interesting to know if there is an impact on today's real estate prices.

2 Theory

Traditional theory



New theory



Caused by changing prices and rents in the future, todays prices should react

3 Estimating the demand for living area

$$\begin{pmatrix} x_{1;1} & x_{2;1} & \cdots & x_{m;1} \\ x_{1;2} & x_{2;2} & \cdots & x_{m;2} \\ \vdots & \vdots & \vdots & \vdots \\ x_{1;n} & x_{2;n} & \cdots & x_{m;n} \end{pmatrix} \begin{pmatrix} \phi_1 \\ \phi_2 \\ \vdots \\ \phi_m \end{pmatrix} = \begin{pmatrix} \Phi_1 \\ \Phi_2 \\ \vdots \\ \Phi_n \end{pmatrix}$$

$$f_j = \sqrt[2025-2006]{\frac{\Phi_{j;2025}}{\Phi_{j;2006}}}$$

Notation:

$x_{i;j}$	Population in age cohort i and city j
m	Total number of age cohorts
n	Total number of cities
φ_i space	Average individual living demand in age cohort i
Φ_j	Total living space demand in city j
f_j living	Average growth factor of space demand in city j

4 Regression analysis

Variable		Obs	Mean	Std. Dev.	Min	Max
p	Price per m²	127	1986.969	469.0497	1100	3850
m	Rent per m²	127	6.882283	1.36798	4.5	12.5
f	Forecasted living demand growth	127	-0.5501897	3.786662	-12.36949	6.603684
b	Forecasted population growth	127	-3.196011	6.801222	-32.3964	14.62815
al	Unemployment rate	127	9.525984	3.11543	3.8	16.1
k	Purchasing power	127	98.04961	11.11934	75.2	135
od	Eastern-Germany-Dummy	127	0.2125984	0.4107662	0	1
e	Population	127	226.1632	371.5177	38.169	3442.675
eqm	m² per inhabitant	127	40.22341	2.612552	35.05022	47.78779
wp	Historical growth rate of prices	127	0.3082906	1.060501	-2.814129	2.74262
wm	Historical growth rate of rents	127	0.6319016	0.9481344	-2.239705	2.609281
fq	Completion ratio	127	0.1402973	0.0705231	0.0364669	0.4463085

$$P = \beta_0 + \beta_1 \cdot f + \beta_2 \cdot b + \beta_3 \cdot al + \beta_4 \cdot k + \beta_5 \cdot OD + \beta_6 \cdot e + \beta_7 \cdot eqm + \beta_8 \cdot wp$$

Source	SS	df	MS
Model	21918647.2	7	3131235.31
Residual	5802310.69	119	48758.9134
Total	27720957.9	126	220007.602

Number of obs =	127
F(7, 119) =	64.22
Prob > F =	0.0000
R-squared =	0.7907
Adj R-squared =	0.7784
Root MSE =	220.81

p	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
f	33.56651	11.12934	3.02	0.003	11.52931	55.60372
b	-.8963048	5.286093	-0.17	0.866	-11.3633	9.570688
al	-4.516654	10.85055	-0.42	0.678	-26.00182	16.96852
k	20.40437	2.773751	7.36	0.000	14.91207	25.89668
od	174.5085	72.02168	2.42	0.017	31.89833	317.1186
eqm	-43.45495	8.312074	-5.23	0.000	-59.91368	-26.99621
wp	176.5005	27.41015	6.44	0.000	122.2257	230.7753
_cons	1701.349	455.3285	3.74	0.000	799.7534	2602.945

$H_0: \beta_1 = \beta_2 = 0 \quad F(2, 118) = 5.19 \longrightarrow$ reject on 1% significance

$$M = \beta_0 + \beta_1 \cdot f + \beta_2 \cdot b + \beta_3 \cdot al + \beta_4 \cdot k + \beta_5 \cdot OD + \beta_6 \cdot e + \beta_7 \cdot eqm + \beta_8 \cdot wm$$

Source	SS	df	MS
Model	180.093032	8	22.5116289
Residual	55.6996073	118	.47203057
Total	235.792639	126	1.87137015

Number of obs =	127
F(8, 118) =	47.69
Prob > F =	0.0000
R-squared =	0.7638
Adj R-squared =	0.7478
Root MSE =	.68704

m	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
f	.0305945	.0357127	0.86	0.393	-.0401264	.1013154
b	.0180205	.0161333	1.12	0.266	-.0139278	.0499687
al	-.0052293	.0377801	-0.14	0.890	-.0800442	.0695856
k	.0646122	.0090715	7.12	0.000	.0466481	.0825763
od	.6228708	.2198544	2.83	0.005	.1874992	1.058242
e	.000907	.0001942	4.67	0.000	.0005225	.0012915
eqm	-.1534669	.0266417	-5.76	0.000	-.2062246	-.1007092
wm	.4980325	.0879675	5.66	0.000	.323833	.6722321
_cons	6.192019	1.442213	4.29	0.000	3.336044	9.047994

$H_0: \beta_1 = \beta_2 = 0 \quad F(2, 118) = 3.49 \longrightarrow$ reject on 5% significance

5 Estimating the growth rate

$$P = \sum_{t=0}^{\infty} M \cdot \left(\frac{1+g}{1+r}\right)^t = M \cdot \frac{1+g}{r-g}$$

$$g = \frac{P \cdot r - M}{P + M}$$

$$g = \beta_0 + \beta_1 \cdot f + \beta_2 \cdot b + \beta_3 \cdot eqm + \beta_4 \cdot wp + \beta_5 \cdot wm + \beta_6 \cdot fq$$

Source	SS	df	MS
Model	59.5883885	6	9.93139808
Residual	23.1072907	120	.192560756
Total	82.6956792	126	.656314914

Number of obs =	127
F(6, 120) =	51.58
Prob > F =	0.0000
R-squared =	0.7206
Adj R-squared =	0.7066
Root MSE =	.43882

g	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
f	.0491356	.018518	2.65	0.009	.0124712	.0858001
b	.0079293	.0099662	0.80	0.428	-.011803	.0276616
eqm	.0478141	.0158233	3.02	0.003	.016485	.0791432
wp	.7449531	.0577231	12.91	0.000	.6306653	.8592409
wm	-.5522207	.0599293	-9.21	0.000	-.6708764	-.4335649
fq	-1.342634	.6093935	-2.20	0.029	-2.54919	-.1360769
_cons	-1.956089	.6306165	-3.10	0.002	-3.204666	-.7075123

6 Conclusions

1. Current real estate markets in Germany react on the forecasted demographic changes.
2. Rental yields shift, due to changing house prices and stable rents.
3. Investors rather observe estimations of living demand space then population forecasts to valuate real estates.
4. Arbitrage over time is not possible with demographic change anymore, because it's already priced.
5. There are no risks for the economy due to over- or undervaluation.

7 References

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Original paper and more informations:
www.immobilienoekonomik.de