Failing to Protect the Tenant

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How Restricting the Landlord's Right to Pass on Modernization Costs to Tenants Increases Rents

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Abstract

Residential rent control legislation in Germany is based on caps on rent increases for sitting tenants. The cap for so-called "ordinary" rent increases is given by the reference rent customary in the locality ("*Vergleichsmiete*"), which is defined as the average rent agreed upon in new rental agreements over the previous four years. The landlord may increase the rent above the reference rent only in two cases. One is a swap of tenants, the other is an "extraordinary" rent increase following modernization of the building, for example with improvements of thermal efficiency or interior design features. While in the first case the contracting parties are mostly free to agree on any rent level, the extraordinary rent increase in the second case is capped at a certain percentage of the modernization costs. In an effort to alleviate the financial burden of modernizations on tenants, the government coalition intends to lower this percentage. We show that such a move will not only lead to fewer landlords modernizing their property, but that those landlords who do modernize will do so more extensively. This results in higher extraordinary rent increases for tenants in buildings undergoing modernization and more frequent displacement of weak incumbent tenants through more affluent ones. The intended reform will therefore fail in achieving its desired effects and will often induce even opposite effects.

Introduction

About 30 % of the population in the EU are living as tenants[1] and in Germany a majority of all households are renting.[2] Tenancy law and the legal framework surrounding rental agreements are thus frequently and heavily debated in many countries. We study an example of political action resulting from this debate in Germany. Residential rent control legislation in Germany is based on caps on rent increases for sitting tenants. The cap for so-called "ordinary" rent increases is given by the reference rent customary in the locality ("*Vergleichsmiete*"; for brevity, we will simply use the term 'reference

[1] Eurostat: Distribution of population by tenure status, type of household and income group (source: SILC, code ilc_lvho02).
[2] Statistisches Bundesamt, Fachserie 15, Sonderheft 1: Wohnverhältnisse privater Haushalte, EVS 2013, Table 1.5 (p. 27), line 27

rent' in the remainder of this article)[3], which is defined as the average rent agreed upon in new rental agreements over the previous four years. The landlord may increase the rent above the reference rent customary in the locality only in two cases. The first is a swap of tenants, the second is an "extraordinary" rent increase following modernization of the building, for example with improvements of thermal efficiency or interior design features. While in the first case the contracting parties are mostly free to agree on any rent level,[4] the extraordinary rent increase in the second case is capped at a certain percentage of the modernization costs.

The provision for the extraordinary increase and the amount that may be added to the annual rent have been a heavily debated issue in Germany. While the coalition agreement of the current German government calls for a reduction of the cap for the fraction of the modernization costs which may be added to the annual rent by one percentage point from 11 to 10 percent, organizations of landlords argue that further restricting their ability to pass on the cost of modernizations would discourage landlords from modernizing and retard the modernization of the building stock, especially with respect to energy efficiency.[5] Tenant organizations claim that extraordinary rent increases unfairly provide landlords with an opportunity for high yield investments at the expense of the tenants, as there is no sunset for the extraordinarily increased rent. Another issue is that extraordinary rent increases following a modernization which increases the energy efficiency of the building usually far exceed the tenants' savings from reduced heating costs, resulting in significant increases in the combined cost of rent and heating expenses. In several cases reported by the media the rent would more than double as a result.[6]

In this paper we study the effects of the cap on extraordinary rent increases within the current rent control framework and the effect of the proposed reduction of said cap on the extent of modernizations and size of rent increases. We find that introducing or lowering the cap reduces the number of landlords modernizing their property, but that those, who do modernize, do so more extensively. This results in higher extraordinary rent increases for tenants in buildings undergoing modernization and more frequent displacement of weak incumbent tenants through more affluent ones.

After a brief review of the relevant literature at the end of this introduction, we will describe the legal background and develop a simple microeconomic model for the landlord's choice of extent and cost

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[3] Section 558 I BGB

[4] Abusively high rents are prohibited and recently legislators introduced the option for municipalities to declare areas, in which newly agreed rents will be temporarily capped in Section 556d BGB.

[5] For example: „Änderungen bei der Modernisierungsumlage: ZIA fürchtet Investitionsstopp", press release by Zentraler Immobilien Ausschuss e.V.

[6] For example: http://www.eikon-nord.de/produktionen/details/justice-alle-mieter-raus-wenn-die-energetische-modernisierung-unbezahlbar-wird.html

of modernization and rent increases and use the model to predict the effects of the proposed policies. Following this we will discuss several variations of the model to prove the robustness of our results before concluding in the final section.

There are two strands of literature. The first strand is the wide economic literature on rent control and its' effects for which Jenkins (2009) provides a good overview. Considering rent control as a price ceiling studies like Hohm (2003) and Gyourko and Linnemann (1990) generally find that rent control retards investment into rental properties and leads to poorly maintained buildings. The second strand is the economic literature on the principal-agent problem that exists in the absence of rent control when landlords invest in modernizing their properties and tenants reap the rewards. Murtishaw and Sathaye (2006) investigate investment decisions by landlords in thermal insulation of dwellings and energy efficient appliances and attempt to quantify the effect of the principal-agent problem for the USA using empirical data. Gillingham et al. (2012) use empirical data to quantify the effect for dwellings in California; they find, that owner-occupied dwellings are 20 % more likely to be insulated and like Murtishaw and Sathaye (2006) suggest minimum performance standards to correct the issue. Charlier (2014) develops a two-period microeconomic model for the investment decisions of landlords and tenants into energy efficiency of a rented property, she finds, that both, landlords and tenants, underinvest and recommends subsidies for investment.

Our work brings these two strands together, taking into account the effect of investment on maximum allowed rent, as prescribed by the specific provisions in German tenancy law, and the resulting incentives for landlords to (over)invest. A study by Discher et al. (2010) for the German Energy Agency, dena, on the economic feasibility of investment into energy efficient modernization of rented building stock briefly considers a similar approach as ours, where the increase due to modernizing is ultimately matched by the steady increase in the reference rent. The study however abandons this in favor of a model, in which rent can permanently be increased after modernization and uses the present value of the permanent rent increase to compare with the cost of the modernization. Finally, Benjamin et al. (2008) show that it is profitable to convert condos to serve a clientele with higher willingness to pay than average renters. This supports the assumptions we make in the first variation of our model, where the landlord intends to drive a "weaker" incumbent tenant out and replace him with a tenant who has a higher willingness to pay for an extensively modernized apartment.

The Legal Background

Rent control legislation in Germany builds on the insight that residential rental contracts are among the most classical long term contracts imaginable. Without regulation landlords are in a position to opportunistically take advantage of switching costs sitting tenants would face upon cancellation of the

rental contract (see Farrell and Shapiro, 1996, for a general discussion of long term contracts and when regulation is required). The German Civil Code (BGB)[7] therefore leaves tenants and landlords ample freedom to agree on the initial rent level, but allows increases of the rent for a sitting tenant only under very restrictive preconditions.

As far as rent control exists in Germany, most of its rules refer to the "reference rent customary in the locality" ("*ortsübliche Vergleichsmiete"*) which is defined as the "usual payments that have been agreed or […] that have been changed in the last four years in the municipality or in a comparable municipality for residential space that is comparable in type, size, furnishings, quality and location, including the energy systems and characteristics" (Section 558 II BGB). There are different ways of determining this reference rent. In many larger cities, there is an official rent index, sometimes even a so-called "qualified rent index" which is "produced according to recognized scientific principles and agreed upon by tenants' and landlords' representatives" (Section 558d BGB). If no official rent index exists, less official data bases may be relied upon and even naming three examples of comparable dwellings may be sufficient.

For new rental contracts landlords and tenants are free to agree on any rent unless it is abusive. In order to be abusive the level of the rent would have to be deemed excessively high (more than 20 percent higher than the reference rent customary in the locality) *and* the landlord (knowingly) "exploited the distress, inexperience, lack of sound judgement or considerable weakness of will of the tenant" (Section 138 II BGB), a case which today is extremely rare, given that there is no substantial housing shortage and thus no distress for the tenant in the legal sense in any German city as a whole. Since June 2015 Section 556d BGB provides municipalities with the option to declare areas that suffer from a tight housing market and within which for up to five years the initial rent must not exceed the reference rent by more than 10 percent. While most major German cities have areas qualifying for the restriction to date only Berlin has enacted an ordinance to effect respective restrictions. The restrictions do not apply to units which are used for the first time after October 1st, 2014 or have just undergone extensive[8] modernization (Section 556f BGB) and do not prevent landlords from increasing the rent according to Section 559 I BGB if a modernization has taken place within the previous three

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[7] For the English translation of the German Civil Code we rely on http://www.gesetze-im-internet.de/englisch_bgb/index.html, a translation produced by Langenscheidt Translation Service and provided by juris® and the German Ministry of Justice and Consumer Protection. Unfortunately at the time of writing this article (September 2015) the version is not current and does not yet contain the new Sections 556d to 556g dealing with caps for rent in new rental contracts, amended in April 2015.

[8] Extensive modernization is defined as having cost at least one third the cost of a comparable newly build property.

years (Section 556e II BGB). We ignore this complication for the most part and only touch on it in the variations of our model.

Once a rental contract has been concluded and the tenant has moved into the dwelling, he is susceptible to the landlord's opportunistic behavior, who could demand a rent increase up to a point where the sitting tenant is indifferent between paying the increased rent and bearing the costs of moving to another dwelling (switching costs) while foregoing all utility from any specific investments into the dwelling he made. To prevent the landlord from abusing his position Section 557 I BGB restricts increases of the rent to mutual agreements. However, due to general inflation, the landlord needs some way to increase the rent even against the will of the tenant. Sections 557 II through 560 BGB take account of the problem by allowing the landlord to increase the rent up to the reference rent customary in the locality every fifteen months (Section 558 I BGB) but not by more than 15 to 20 percent within three years (Section 558 III BGB).

This legal situation obviously impedes investments into the quality of the rented property. German law does not allow the landlord to pass on the cost for repair and maintenance to the tenant. However, when the landlord improves the quality of the dwelling above and beyond merely repairing and maintaining, i.e. "modernizes", he is allowed a onetime extraordinary rent increase irrespective of the reference rent customary in the locality and irrespective of previous ordinary rent increases. If rent as a result of such an extraordinary increase exceeds the reference rent, the landlord cannot demand another ordinary rent increase until after the reference level catches up. In order not to allow the landlord to abuse this exception from rent control, Section 559 I BGB restricts this extraordinary increase of the annual rent to 11 percent of the costs of modernization net of (hypothetical) maintenance cost. We show in the following sections that this restriction fails to achieve its alleged goal of limiting the rent increase but on the contrary exacerbates the situation of the tenant by causing higher rents.

A Simple Model

We propose a simple microeconomic model for the landlord's choice of extent and cost of modernization and rent increases. We assume that due to sunk investments of a sitting tenant (e.g. costs of moving between apartments) his willingness to pay for keeping the apartment is higher than the reference rent and non-decreasing and concave in the amount the landlord invests in modernization. For simplicity, we assume that the landlord can make take-it-or-leave-it offer to his tenant, i.e. that the tenant only has the choice to agree to a proposed rent increase or vacate the property. Absent any regulations the landlord is thus able to extract the sitting tenant's quasi-rent by capturing his full willingness to pay.
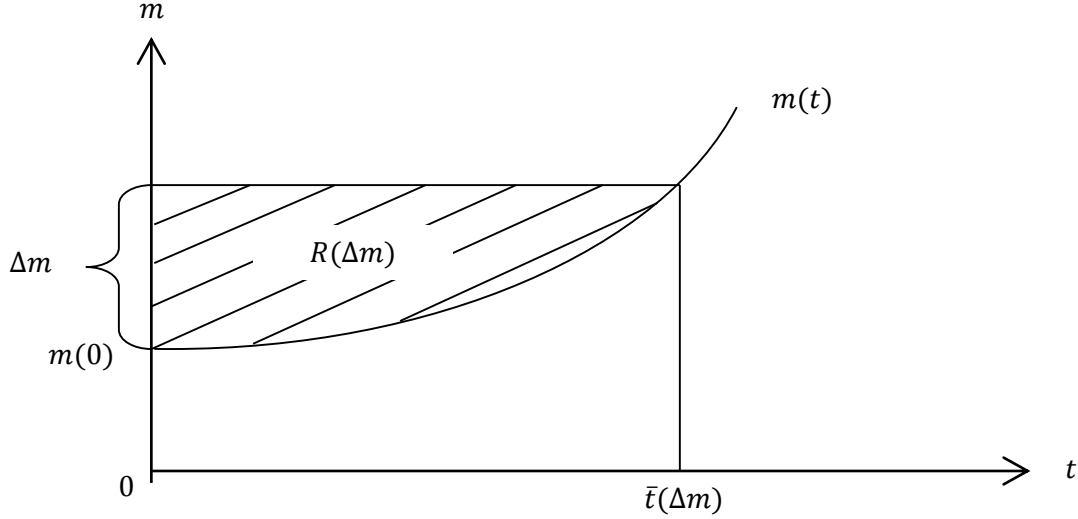
Fig. 1: Extraordinary rent increase and landlord's additional revenue

Note: The graph shows the increase of the reference rent over time, $m(t)$. Modernization in $t=0$ allows an extraordinary rent increase by Δm and results in additional revenue $R(\Delta m)$. At $t = \bar{t}(\Delta m)$ the reference rent $m(t)$ catches up with the extraordinarily increased rent $m(0)+\Delta m$.

We start from a situation in which the landlord considers modernizing a residential property and has to decide on the extent of the modernization (and the corresponding cost) as well as on the demanded rent increase. For ease of presentation, we make a number of simplifying assumptions, some of which we will loosen in the next section. First, we assume that the property in occupied by a single tenant. Second, we assume that the rent has reached the reference rent and that the latter is increasing continuously over time and is not affected by the landlords decisions. Third, we assume that time preferences do not exist so that we can abstract from any discounting.

Finally, we assume that at time $t=0$ the landlord may choose between two alternatives. He may either abstain from investing into modernization and continue to merely maintain and repair his property while charging the reference rent $m(t)$ which is increasing in t without any upper bound. Or he may invest an amount c, increase the current rent by an amount Δm immediately, leave it unchanged until the reference rent has caught up with $m(0)+\Delta m$ at $t = \bar{t}(\Delta m)$ and then charge the reference rent $m(t)$ again (see Figure 1 for a graphical presentation of the argument). It is easy to see from Figure 1 that, the larger the rent increase, the later the reference rent will catch up: $\bar{t}'(\Delta m) > 0$.

The additional revenue for the landlord from increasing the rent by an amount Δm is thus

$$R(\Delta m) = \int_0^{\bar{t}(\Delta m)} \left(m(0)+\Delta m - m(t)\right)dt \text{ with } R'(\Delta m) = \int_0^{\bar{t}(\Delta m)} 1\, dt = \bar{t}(\Delta m) > 0 \text{ and } R''(\Delta m) = \bar{t}'(\Delta m) > 0.$$
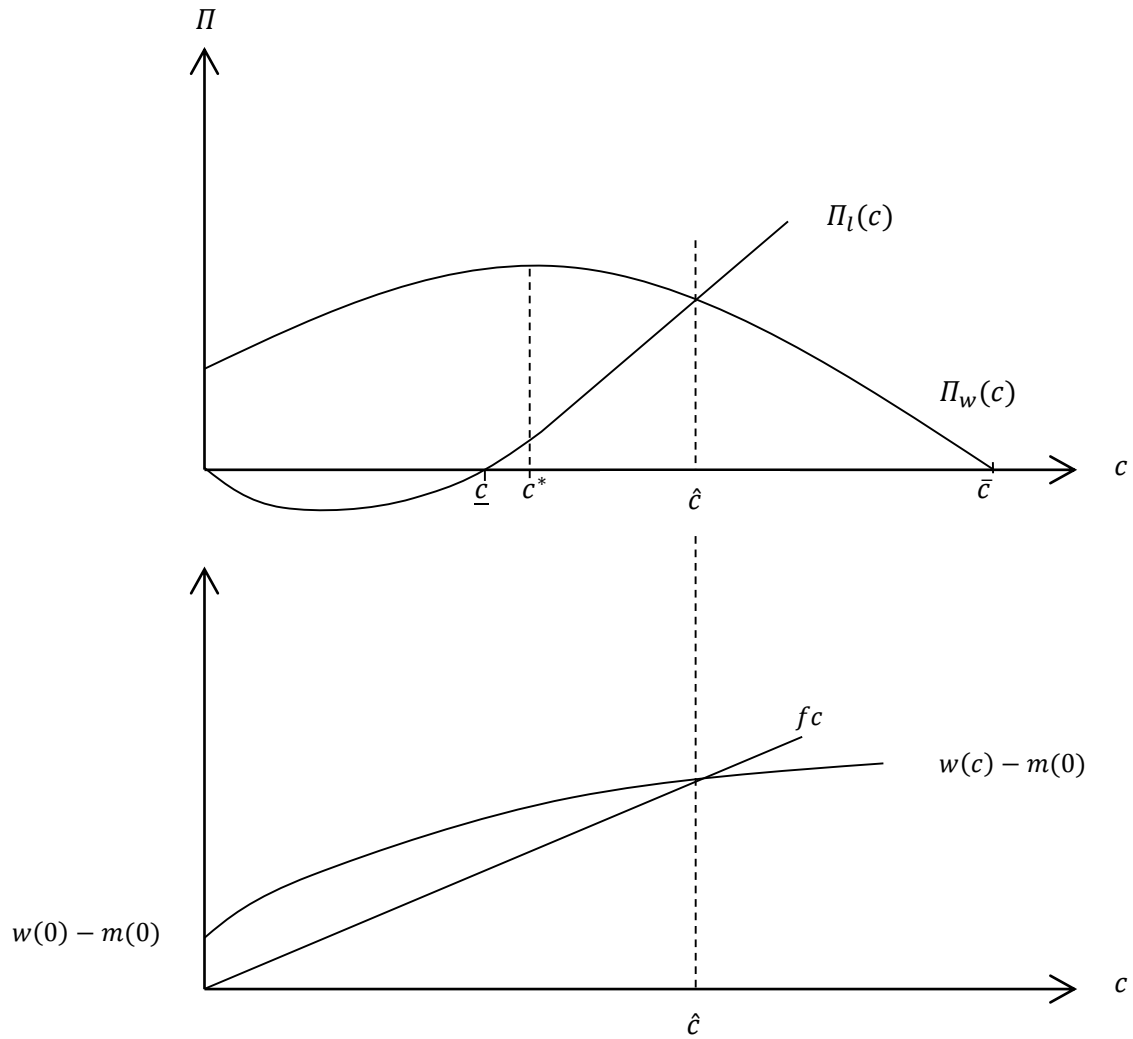
Fig. 2: Landlord's profit and extraordinary rent increase as function of modernization cost

Note: The top graph shows the landlord's profit from modernization as a function of modernization cost when bound by the legal restriction, $\Pi_l(c)$, and when bound by the willingness to pay, $\Pi_w(c)$. The bottom graph shows the extraordinary rent increase possible after modernization: fc when bound by the legal restriction and $w(c) - m(0)$ when bound by the willingness to pay.

The post-modernization increase of the rent Δm is limited by the tenant's willingness to pay for keeping the apartment. We assume that absent any modernization, the tenant's willingness to pay exceeds the reference rent due to his specific investment. If modernization occurs, $w(c)$ measures the maximum post-modernization rent the tenant accepts before vacating the apartment, being aware of the legal prohibition of any further rent increases before the reference rent has caught up. We assume that $w(c)$ has the following properties: $w(0) > m(0)$ due to the tenant's specific investments into the dwelling, $w'(c) > 0$, $w''(c) < 0$ for all c and $\lim_{c \to \infty} w(c) = \bar{w} < \infty$.

The extraordinary rent increase following the modernization Δm is also limited by legal restriction to $\Delta m \leq f \cdot c$ where f is the limiting percentage in Section 559 I BGB.

The landlord's profit from investing into modernization is thus given by $\Pi(c) = R(\Delta m(c)) - c$ where $\Delta m(c) = \min(fc, w(c) - m(0))$. If f is sufficiently large to make the legal constraint to the one-time rent increase non-binding, the landlord's profit reduces to $\Pi_w(c) = R(w(c) - m(0)) - c$ with the derivatives

$$\Pi_w'(c) = \overline{t}(w(c) - m(0))w'(c) - 1 \qquad \text{and}$$

$$\Pi_w''(c) = \overline{t}'(w(c) - m(0))(w'(c))^2 + \overline{t}(w(c) - m(0))w''(c).$$

This leaves the possibility for multiple maxima but we assume for simplicity that the maximum is unique and at $c = c^*$. The assumptions on $w(c)$ imply that $\lim_{c \to \infty} \Pi_w'(c) = -1$ so that uniqueness of the profit maximum implies that $\Pi_w'(c) < 0$ for all $c > c^*$. In addition, uniqueness of the profit maximum also implies that if profits are positive for some values of c, then $\overline{c}$ defined by $\Pi_w(\overline{c}) = 0$ is unique and satisfies $\overline{c} > c^*$.

Now assume to the contrary that the tenant's willingness to pay is large enough to make the legal constraint to the onetime extraordinary rent increase binding. Then the landlord's profit function reduces to $\Pi_\ell(c) = R(fc) - c$, the first derivative of which is $\Pi_\ell'(c) = \overline{t}(fc)f - 1$ and the second derivative of which is $\Pi_\ell''(c) = \overline{t}'(fc)f^2 > 0$. For the extreme values of c, namely 0 and ∞, we note that by L'Hôpital's rule we get $\lim_{c \to 0} \frac{R(fc)}{c} = \lim_{c \to 0} \frac{\overline{t}(fc)}{1} = 0$ and $\lim_{c \to \infty} \frac{R(fc)}{c} = \lim_{c \to \infty} \frac{\overline{t}(fc)}{1} = \infty$ so that $\Pi_\ell(c) < 0$ for c sufficiently close to zero and $\Pi_\ell(c) > 0$ for sufficiently large c. Recalling that the second derivative is strictly positive, $\Pi_\ell(c)$ is thus a slanted-J-shaped function that starts at the origin, is strictly negative for all $c \in (0, \underline{c})$, where $\underline{c} > 0$ is defined by $\Pi_\ell(\underline{c}) = 0$, and strictly positive and increasing in c at an increasing rate for $c > \underline{c}$ (see the upper part of Figure 2 for a graphical visualization).

Combining the arguments of the previous paragraphs it is obvious that the landlord will invest $c = c^*$ if he is allowed to do so, i.e. if $w(c^*) - m(0) \leq fc^*$ which is equivalent to $\Pi_w(c^*) \leq \Pi_\ell(c^*)$. If he is not, he will choose the modernization costs for which both the legal constraint and the market constraint are binding, i.e. $\hat{c} > 0$ defined by $\Pi_\ell(\hat{c}) = \Pi_w(\hat{c})$. We note that $\hat{c}$ is unique due to the fact that $\Pi_\ell(c) = \Pi_w(c)$ reduces to $w(c) - m(0) = fc$ of which the left-hand side is increasing in c from

$w(0) - m(0) > 0$ at a decreasing rate and the right-hand side increases from 0 at a constant rate (see the lower part of Figure 2), which implies that the graphs of the left-hand side and of the right-hand side may intersect only once.

In order to study the effect of lowering the fraction f of the modernization costs by which the landlord is allowed to increase the annual rent (or of introducing a legal constraint to the onetime extraordinary rent increase which is the same as reducing f from infinity to a sufficiently small finite level) we note that $\Pi_\ell(c)$ increases in f due to $\frac{\partial \Pi_\ell(c)}{\partial f} = R'(fc) \cdot c > 0$ and thus $\hat{c}$ decreases in f.

This allows us to distinguish three cases of the effect of a reductions of f:

Case 1: $\hat{c} \leq c^*$ before and after the reduction of f. In this case, the landlord will choose modernization costs of $c = c^*$ both before and after the reduction of f. The latter thus has no effect on the landlord's choice.

Case 2: $c^* < \hat{c} \leq \overline{c}$ after the reduction of f. In this case, the landlord's choice of c was smaller before the reduction of f than it is afterwards. Figure 2 shows the reason: Suppose the chosen modernization cost is $\hat{c}_2$ after the reduction of f. Then (re-)increasing f will result in a lower $\hat{c}$, say $\hat{c}_0$, and thus before the reduction of f the landlord's optimum was either $\hat{c}_0 < \hat{c}_2$ or $c^* < \hat{c}_2$.

Case 3: $\hat{c} > \overline{c}$ after the reduction of f. In this case, the legal restriction does not allow the landlord to make a positive profit or break even. Thus the landlord will abstain from any investment in modernizing his property.

Hence, reducing the fraction of the modernization costs which landlords are allowed to add to the annual rent either has no effect at all, or it increases the extent and cost of the modernization, or it stops any modernization outright. What does this imply for the resulting extraordinary rent increase? In the first case, the landlord increases the rent by $w(c^*) - m(0)$ before and after the change to the legal restriction. In the second case, the rent after modernization will increase from $w(c^*)$ or $w(\hat{c}_0)$ to $w(\hat{c}_2) > \max(w(c^*), w(\hat{c}_0))$, where the strict inequality results from $w'(\cdot) > 0$ and $\hat{c}_2 > \max(c^*, \hat{c}_0)$. In the third case, the landlord may have chosen to modernize before the legal change but will abstain from doing so afterwards, hence no rent increase is possible.

For our simple version of the model, we thus get a very clear

Result 1: Any reduction of the proportion of modernization costs by which the landlord may legally increase the annual rent will (1) either have no effect, or (2) lead to higher extraordinary rent increases for tenants in properties undergoing modernization, or (3) prevent a modernization that would have been undertaken without the legal change.

We draw the reader's attention to the fact that due to the construction of our model, only the third case alters the tenant's utility, and it does so to the tenant's advantage. In the first two cases, the modernization allows the landlord to extract the tenant's quasi-rent by capturing his complete willingness to pay for keeping the apartment. Only in the third case, modernization and thus extraction of the tenant's quasi-rent becomes unattractive to the landlord as a result of the legal change. As a consequence, lowering the fraction of modernization costs by which the landlord may legally increase the annual rent may have a positive effect on the tenant's utility, though not by curbing increases in the rent but only by preventing modernization and preserving his quasi-rent.

Looking at many residential rental contracts with variations of the parameters of the specific cases, we conclude that after a reduction of the fraction of modernization costs by which the landlord may legally increase the annual rent, we will observe fewer but more extensive (and more expensive) modernizations.

Variations of the Model

a. Allowing for rent increases that aim at driving the tenant out of the contract

We so far assumed that the landlord will only capture the sitting tenant's complete willingness to pay for keeping the (modernized) apartment. Local newspapers and files of courts abound with reports of cases in which landlords (plan to) modernize their properties to an extent and with resulting extraordinary rent increases that drive out incumbent tenants and thus allow landlords to offer their properties to parties with an even higher willingness to pay for the modernized apartment. We leave it open, whether this should be taken as a more efficient use of resources or as a destruction of much needed cheap residential rental space, but we follow the political argument in calling the incumbent tenant the "weaker" tenant. We show in the following paragraphs that reducing the fraction of modernization costs which may legally be added to the annual rent accelerates the transformation of affordable into "luxury" residential space. Thus any hope the German legislator may have had that by reducing the fraction said transformation could be slowed must be disappointed.

To demonstrate this point we introduce a new potential tenant, we assume that this new tenant's willingness to pay for the apartment $\tilde{w}(c)$ is lower than the incumbent tenant's willingness to pay when the quality of the property is below some threshold and higher for extensively modernized
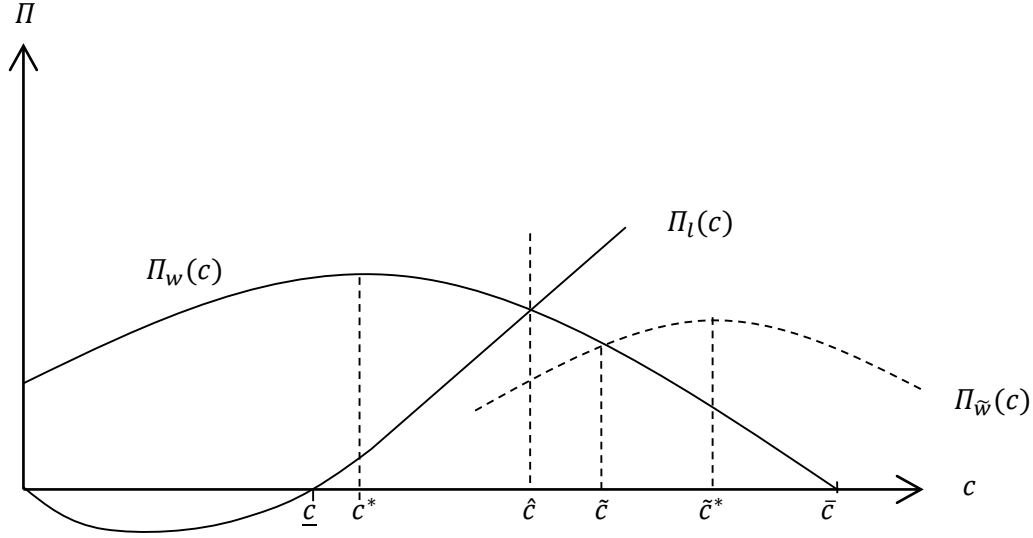
Fig. 3: Landlord's profits with two alternative tenants.

Note: The graph shows the landlord's profit from modernization as a function of modernization cost when bound by the legal restriction, $\Pi_l(c)$, and when bound by the willingness to pay of the incumbent and a new tenant, $\Pi_w(c)$ and $\Pi_{\tilde{w}}(c)$, respectively. Because the legal restriction is binding, the landlord chooses higher modernization costs than would be optimal without the legal restriction. Tightening the legal restriction further, thereby rotating $\Pi_l(c)$ clockwise, will result in the landlord trying to replace the current tenant with a new, more affluent one by increasing modernization cost to $\tilde{c}*$

properties, formally: $\tilde{w}(c) \gtreqqless w(c) \Leftrightarrow c \gtreqqless \tilde{c}$. At least for $c \geq \tilde{c}$, the function $\tilde{w}(\cdot)$ has the same properties as $w(\cdot)$, i.e. $\tilde{w}'(c) > 0$, $\tilde{w}''(c) < 0$ for all $c \geq \tilde{c}$ and $\lim_{c \to \infty} \tilde{w}(c) = \bar{\bar{w}} < \infty$. As a consequence, the landlord's profit from contracting with the new tenant is larger than from continuing the lease with the incumbent "weaker" tenant if $c \geq \tilde{c}$. The optimal cost of modernization for contracting with the new tenant, $\tilde{c}*$, is also finite. Figure 3 visualizes the argument.

Whether the landlord will aim only at extracting the incumbent tenant's quasi-rent or aim at displacing the weak incumbent tenant by a new tenant with a higher willingness to pay for an apartment in an extensively modernized property, depends on whether the maximum profit from contracting with the new tenant is larger or smaller than the maximum profit from merely exploiting the incumbent tenant's desire not to move. This in turn depends on the exact form of $\tilde{w}(c)$.

The most interesting case is the one in which $\tilde{c} > c*$ and the maximum profit from contracting with the new tenant $\Pi_{\tilde{w}}(\tilde{c}*)$ is smaller than the maximum profit from keeping the incumbent tenant $\Pi_w(c*)$, as depicted in Figure 3. Then the legal restriction f on the fraction of modernization costs which may be added to the annual rent may affect the landlord's choice between the incumbent and

the new tenant. If the limit is weak, i.e. if the extraordinary rent increase is permitted to be large enough, then the legal restriction is not binding and the landlord will choose to extract quasi-rent from the incumbent tenant and not increase the rent by an amount that would drive out the incumbent and allow a contract with a new tenant.

However, when the legal constraint becomes stricter, i.e. when f becomes smaller, $\Pi_\ell(c)$ also declines. Eventually, $\hat{c} \in (c^*, \tilde{c})$ so that $\Pi_\ell(c)$ intersects $\Pi_w(c)$ between the latter's maximum and the intersection of the latter with $\Pi_{\tilde{w}}(c)$. As discussed above, further decreasing f reduces the landlord's profits from modernizing the property with the incumbent tenant continuing the contract. If $\hat{c}$ is close enough to $\tilde{c}$, the profit $\Pi(\hat{c})$, which the landlord may earn from continuing with the incumbent tenant, is smaller than the profit $\Pi_{\tilde{w}}(\tilde{c}^*)$, which he earn from the new tenant. Hence, lowering f may induce the landlord to raise the modernization costs so much that the consequentially permitted extraordinary rent increase drives out the weaker incumbent tenant and thus allows a contract with the new tenant. This effect is the exact opposite to what the legislator had hoped for.

Further reducing f will not reverse the effect. Only when f becomes small enough to prevent any positive profits from modernization will the incumbent tenant benefit from the legislation as he keeps his apartment without any extraordinary rent increase, but all modernization will be retarded.

We now turn to the case in which maximum profit from contracting with the new tenant $\Pi_{\tilde{w}}(\tilde{c}^*)$ is larger than the maximum profit from keeping the incumbent tenant $\Pi_w(c^*)$, which includes the case of $\tilde{c} \le c^*$. In this case the landlord will always choose to displace the weaker incumbent tenant by modernizing and increasing the rent by an amount to exceed the incumbent's willingness to pay. No restriction of the rent increase to any proportion of the modernization costs will change this choice, except for restrictions which effectively ban any modernization.

We thus get the following

> **Result 2:** Any reduction of the fraction of modernization costs by which the landlord may legally increase the annual rent will (1) either have no effect on the landlord's choice between the weaker incumbent and a new tenant, or (2) induce the landlord to choose the more extensive (and more expensive) modernization which only the new tenant is willing to pay for, or (3) prevent a modernization that would have been undertaken without the legal change.

b. Time Preference and Positive Interest Rates

Our model abstracted from time preferences and interest rates. Allowing for them would not substantially alter the argument. In the decision of the landlord, the future income stream would be depreciated. As a consequence, present rent increases have to be larger to finance the modernization costs. However, the present value of the entire income stream from the increased rent would still grow in a super-linear way in the initial rent increase. Consequently, the argument of our model would persist.

c. Limits to the Time of Rent Increase

We also assumed that the extraordinarily increased rent remains constant until the reference rent has caught up with it. We can relax this assumption, for example by considering current modernizations as the basis for future modernization, or as a result of a smoother realignment and return to the reference rent. If we do, the effects described in the model remain unchanged in substance, as long as the present value of the additional rent grows in the initial, regulated rent increase in a super-linear way, i.e. as long as $R''(\Delta m) > 0$.

But even if we assume that the extraordinary rent increase is only temporary – some proponents of a reform have suggested a sunset for the extraordinary rent increases – the results do not change. Formally, the revenue function will then become $R(\Delta m) = \displaystyle\int_0^{\min(\bar{t}(\Delta m),\hat{t})} \left(m(0) + \Delta m - m(t)\right) dt$ where $\hat{t}$ is the point in time after which the extraordinary rent increase must be rescinded. The first and second derivatives of this function are: $R'(\Delta m) = \begin{cases} \bar{t}(\Delta m) & \text{if} \quad \bar{t}(\Delta m) < \hat{t} \\ \hat{t} & \text{if} \quad \bar{t}(\Delta m) \geq \hat{t} \end{cases}$ and

$R''(\Delta m) = \begin{cases} \bar{t}'(\Delta m) & \text{if} \quad \bar{t}(\Delta m) < \hat{t} \\ 0 & \text{if} \quad \bar{t}(\Delta m) \geq \hat{t} \end{cases}$.

If the legal constraint for the rent increase is binding, the first derivative of the profit function then becomes $\Pi_\ell'(c) = \begin{cases} \bar{t}(fc)f - 1 & \text{if} \quad \bar{t}(fc) < \hat{t} \\ \hat{t}f - 1 & \text{if} \quad \bar{t}(fc) \geq \hat{t} \end{cases}$. Nothing changes when c is small. When c becomes large enough to satisfy $\bar{t}(fc) \geq \hat{t}$, then the profit function ceases to be convex but becomes a straight line with the slope of the original profit function at the level of c for which $\bar{t}(fc) = \hat{t}$ holds true. This slope may be positive or negative. If it is positive, the analysis remains unchanged: The profit function has a breakeven point and profits grow in the costs of modernization, c, without bounds. If $\hat{t}f - 1 \leq 0$, the slope of the profit function never becomes positive and thus modernization can never result in a positive profit for the landlord. In this case, the time limit for the rent increase has the same effect as

a strong decrease of the fraction f: It effectively prevents all modernization. The possible effects of lowering f thus remain exactly the same as those listed in **Results 1** and **2**. As introducing or lowering the time limit for the higher rent $\hat{t}$ reduces the slope of the profit function $\Pi_\ell(\cdot)$ in the same way as a reduction of f, its effects are also the same which allows us to state

> **Result 3:** Any reduction of the time during which the extraordinary rent increase may be charged will (1) either have no effect, or (2) lead to higher extraordinary rent increases for tenants in properties undergoing modernization, or (3) prevent a modernization that would have been undertaken without the legal change. With regard to the problem of weaker incumbent tenants being replaced by a new tenants, such a policy will (1) either have no effect on the landlord's choice between the weaker incumbent and a new tenant, or (2) induce the landlord to choose the more extensive (and expensive) modernization which only the new tenant is willing to pay for, or (3) prevent a modernization that would have been undertaken without the legal change.

Again, the policy aimed at protecting the tenant will result in fewer but more extensive and more expensive modernizations and higher extraordinary rent increases for tenants in properties undergoing modernization.

The intuition of this result is simple: If the increase in the extraordinary rent increase due to modernization is small, the reference rent will catch up before the point in time after which the extraordinary rent increase would have to be rescinded. As a consequence, for low cost, small scale modernizations the analysis remains unchanged. In particular, such modernizations will continue to be unprofitable for the landlord. Only high modernization costs and rent increases make modernization profitable. However, if modernization costs and thus the rent increase are so high that the reference rent fails to catch up with the increased rent before the extraordinary rent increase must be rescinded, then after $\overline{t}(fc) \geq \hat{t}$ revenue will continue to increase only linearly in the extraordinary rent increase because the time effect does not apply any more. If revenue increases faster than the modernization costs, profits will also increase and thus we get exactly the same result as without a sunset on the rent increase. If revenue increases slower than costs, modernization never becomes profitable for the landlord and additional costs only increase the losses. As a consequence, no modernization will take place.

d. Allowing for different schemes of rent control after modernization

We have so far restricted our analysis to extraordinary rent increases that after modernization only temporarily exceed the reference rent. However, modernization typically improves the energy

efficiency and quality of the property giving landlords the ability to permanently lift the level of rent for the property based on a higher, quality-adjusted reference rent. If the reference rent perfectly mirrored the market rent for the property, one could simply retire Section 559 I BGB and not allow any extraordinary rent increases after modernizations. A landlord would then choose efficient ways of modernization and extraction of quasi-rents from an incumbent tenant would be restricted to the amount by which the market rent of the modernized property exceeds the incumbent's hypothetical willingness to pay if he had not yet moved in and were to conclude a new rental contract for the modernized apartment. As a consequence, an incumbent tenant may still become exploited, but less so.

However, the reference rent is but a very imperfect mirror of the market rent of an apartment. Although in most cities about ten to twenty variables enter the calculation of the reference rent, it is far from precise because many of the variables are binary or ordinal variables with very few values (like "last bathroom modernization before or after the year 2002" or three values for location in a city with an area of almost 900 km²). As a consequence, abolishing extraordinary rent increases after modernizations according to Section 559 I BGB would cause landlords' decisions on modernization to not only be oriented towards the evaluation by incumbent or future tenants but also to be restricted by the variables entering the calculation of the reference rent. One may expect this additional restriction to result in inefficiently little modernization, an effect which could be compensated by allowing extraordinary rent increases. As long as these extraordinary rent increases are restricted to a fraction of the modernization costs, the effects of this restriction will remain the ones described before. However, not all of the modernization costs have to be recovered from the "triangle" depicted in Figure 1 but may also be recovered from higher rents in the more distant future due to the increased reference rent. As a consequence, the legal restriction will become binding only at lower levels of f. Apart from this variation in degrees, the effect of the restriction will remain the same.

Conclusions

In this paper we have discussed how rent control based on the so-called reference rent customary in the locality interacts with the landlord's right to demand extraordinary rent increases after a modernization that improves the energy efficiency and quality of a property. We have paid particular attention to the restriction of this right which is based on limiting the fraction of modernization costs that may be added to the annual rent. While the political goal of this restriction is to protect incumbent tenants from large rent increases, in particular from rent increases that cause them to be displaced, we prove that the restriction either has no effect, or the opposite effect of what was intended: Extraordinary rent increases for tenant in properties undergoing modernization will be higher and rent increases that are large enough to effectively terminate the rental contract will become more likely.

The only way in which incumbent tenants may benefit from the tightening of the restriction is that any modernization of the property may become unprofitable for the landlord and therefore is prevented.

We show that our results are robust for variations in the assumptions and that they even transfer to a similar policy, a limit to the time during which a higher rent may be charged after modernization.

We thus suggest that other policies, like a more sophisticated reference rent based on the energy performance certificates (based on the *calculated* annual energy that is consumed) as required by Article 12 of the EU Directive on the Energy Performance of Buildings (2010/31/EU of 19 May 2010, recast), will improve both the landlords incentives to modernize and the tenants' situation as compared to the status quo of the law and the proposed change.

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