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Inferring Land Values in Oslo

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Inferring Land Values in Oslo*

Anna Emilie Iden, Plamen Nenov and Sonja Plaku*

Abstract

Land is a major and rising component of the cost of new housing, yet land prices are rarely directly observed in Norway. Following the methodology of Davis and Heathcote (2007), we construct a quarterly land price series for residential housing in Oslo over the period 2003 – 2025. The land price is the difference between the price of a used home and the replacement cost of the structure. We find that real land prices rose to about three and a half times their 2003 level and the implied land share of new housing costs rose from about a third to just over half. Land prices are also more volatile than construction costs and account for much of the cyclical variation in house prices.

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1. Introduction

One salient development in the Norwegian housing market in recent years has been the sharp increase in construction costs following the Covid-19 pandemic. This has renewed the debate about the drivers of high and rising house prices, and specifically the relative importance of construction costs and land values. The debate is particularly relevant in the market for new homes, where list prices have risen relative to used-home prices since the housing-market peak in early 2017, while sales and construction activity have been weak in recent years (Iden, Nenov and Plaku, 2026). A central question in this discussion is to what extent high construction and regulatory costs make new projects difficult to realize, as opposed to developers being reluctant to lower list prices and accept lower land valuations. Yet land prices are not directly observed, making it difficult to assess their evolution. Constructing a consistent land value index can therefore provide evidence on how land-related values have evolved and help inform this debate.

The relative importance of land values and construction costs for house prices also matters for financial stability and macroprudential policy, since the two components of housing value may differ in their volatility and responsiveness to macroeconomic shocks. Tools aimed at strengthening the resilience of the financial system, such as capital requirements and borrower-based measures, are designed in part to protect against fluctuations in collateral values and household balance sheets. A housing market in which a growing share of property value consists of the more volatile land component may therefore be more exposed to housing-market corrections, potentially increasing the benefits of macroprudential policies. Moreover, borrower-based macroprudential measures, such as debt-to-income limits, can constrain households' borrowing capacity and thereby dampen housing demand. Since the replacement cost of a housing unit reflects factors determining housing production, such as productivity, material and labor costs, changes in housing demand may be reflected more strongly in land values than in replacement costs. The decomposition of house prices into land values and replacement costs may therefore provide additional information about the factors driving housing demand.

In this staff memo, we build on Davis and Heathcote (2007) to infer the evolution of land prices in Oslo over the period 2003-2025. Conceptually, the Davis and Heathcote methodology is straightforward and intuitive: a housing unit is a bundle of two assets – the structure, which can be reproduced, and the land parcel on which the building is constructed, whose supply is harder to adjust. In a competitive construction market, the value of the structure would be pinned down by its replacement cost, adjusted for depreciation. The residual obtained by subtracting the value of the structure from the value of the house would capture the value of the land.[1]

While Davis and Heathcote (2007) infer aggregate residential land values using estimates of the market value of the US housing stock and the replacement value of residential structures, Davis and Palumbo (2008) extend this approach to individual metropolitan areas, using property-level data to estimate depreciated replacement costs. Our approach is closer to the latter, but we apply the residual method to a representative apartment in Oslo rather than to individual properties. Specifically, we construct its market value using a quality-adjusted (SPAR) house-price index and estimate its depreciated

[1] Despite its simplicity, the residual approach, pioneered by Davis and Heathcote (2007) and Davis and Palumbo (2008), remains a standard method for inferring land values when representative land transactions are unavailable, which is the case in most relevant housing market contexts. Indeed, in developed urban areas, directly observed land transactions are sparse and highly selected, which leads to a skewed and highly uncertain picture of the evolution of land values. Recent work has attempted to develop alternative approaches based on vacant-land sales, teardowns, matching, and hybrid estimation to partially address these issues, with mixed success. For example, Gedal and Ellen (2018) show that teardown transactions can be more representative than vacant land sales, while McMillen and Singh (2022), Longhofer and Redfearn (2022), Albouy and Shin (2022), and Bourassa and Hoesli (2022) develop methods that combine information from vacant, teardown, and improved-property transactions.

replacement cost using construction-cost data and an age-related discount estimated from Norwegian property transactions. This allows us to construct a quarterly land value index without relying on aggregate capital-stock estimates or tracking changes in the quantity of residential housing.

Our results show that real land-related values in Oslo rose to about three and a half times their 2003 level, while their implied share of new housing costs increased from about one-third to just over one-half by 2025. Land-related values are also substantially more volatile than replacement costs and account for much of the cyclical variation in house prices. A larger land share also implies that housing values are increasingly exposed to fluctuations in the more volatile land component, all else equal. Land-related values have also remained broadly flat since 2017, a development that may reflect several factors, including changes in mortgage lending requirements and construction costs. A comparison with new-home list prices reveals differences in the adjustment of land-related values across the two markets, consistent with more sluggish price adjustment in the new-home market in response to changes in housing demand.

We are not the first to use the residual approach to infer land values in Norway. In a recent analysis, Samfunnsøkonomisk analyse (Benedictow et al., 2022) calculates residual land values from new-home prices over the period 2010-2020. They find that the residual values inferred by this method align closely with actual sale prices once a project is fully regulated, which supports the residual approach for larger developments as well. Our approach is related but differs in one important way – we use *used*-home prices rather than *new*-home prices. This requires an adjustment for age-related depreciation, which we propose and implement. Using used-home prices allows us to construct an index based on a larger and more liquid market, where transaction prices adjust more readily to changes in housing demand. Our approach therefore provides a consistent and representative series for the whole period 2003-2025 and can be easily extended going forward or applied to other housing markets.

The remainder of this memo is organized as follows. Section 2 describes the Norwegian residential construction market. Section 3 outlines our methodology for imputing land values. Section 4 presents and discusses the main results, and Section 5 concludes with policy implications.

2. The Norwegian residential construction market

Construction of residential real estate involves several cost components. Enterprise costs include direct expenses of physically building the units, including materials, such as concrete, insulation, and electrical installations and labor expenses, such as wages, pensions, and health and safety measures. To fund construction, developers typically draw on construction loans, which carry a financing cost over the building period. Banks usually require 50 to 60 per cent of units pre-sold before the loan is granted, which secures demand and reduces the lender's risk. The developer also incurs costs associated with planning, organizing and overseeing the project. This covers external consultants, project administration, sales and marketing, and overheads such as auditing and accounting. Finally, expected sales revenues must provide a margin for the developer after covering the cost of developable land, developer expenses, construction and financing. This margin compensates the developer for tying up capital and taking on risk. In a competitive market, developers tend to earn only the return required to undertake such projects, known as a normal return on capital.

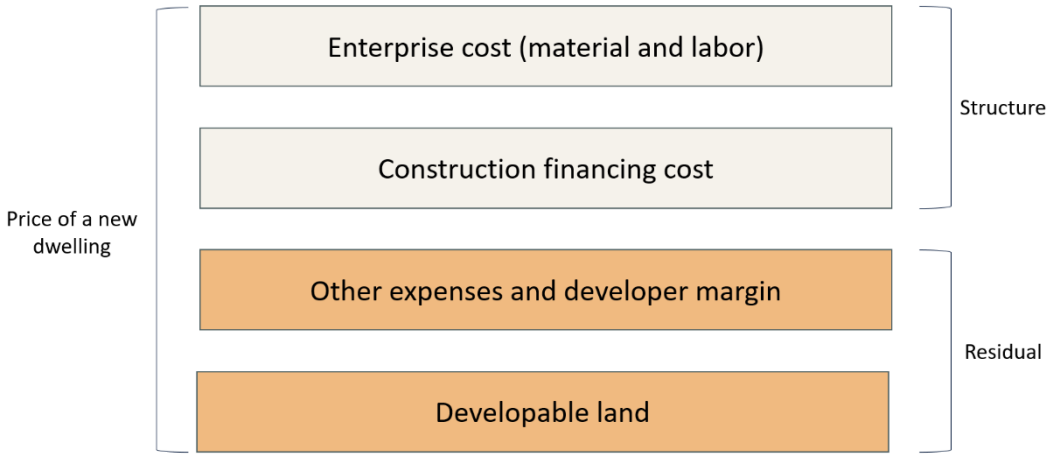
The developer must also acquire the land itself. Some plots are already regulated for housing and cleared of physical obstructions, so building can start without further planning. Others are unregulated

raw land that must first go through municipal planning and approval.[2] Bringing raw land to that point involves municipal fees, surveyors, and the preparation of plans, and may also involve sequencing provisions, requirements in the zoning plan that put infrastructure in place before an area can be occupied.[3] Still other land plots may require clearing of old structures, which leads to additional costs. Given the time-consuming nature of this process, developers often hold on to an inventory of land in different stages of readiness, while at the same time incurring financing and other inventory costs. When a construction project commences, all these land-related costs may be passed through into the final sales price.[4]

In this memo we do not aim to isolate the different costs associated with bringing raw land to a developable phase from the value of raw land itself and instead refer to the combination of these as *developable land*. Therefore, the value of developable land includes both the true economic value of raw land due to limited land supply in a city as well as the costs, regulatory, financial, and physical, associated with bringing that raw land to a developable phase.

Figure 1 shows the cost decomposition described above. The sale price of a new dwelling is a combination of the enterprise and construction financing costs, a developer margin, other development costs, as well as the value of the developable land. In the Appendix, we formalize this decomposition in a simple equilibrium model of the housing market and housing development.

Figure 1 Decomposition of the price of a new dwelling



Note: The structure, comprising enterprise costs and construction financing costs, is what we measure as the replacement cost. The residual, other expenses, developer margin and developable land, is what our land value residual captures. Source: Norges Bank

[2] See Municipal planning functions - regjeringen.no.

[3] See Byggordboka - Rekkefølgebestemmelser.

[4] Note that the value/cost of developable land may or may not be directly incurred by the developer in an accounting sense. For example, if the developer already owns the land, the value of land will be part of the developer's accounting profits when new dwelling units are sold in the market. In our memo, we treat the land cost as being incurred directly by the developer and passed through fully into the final sale price.

3. Methodology

This section briefly describes our methodology, with additional technical details included in the Appendix. Following Davis and Heathcote (2007), we consider a dwelling with market price P^H to be a bundle of two assets, structure with market price P^S and developable land with market price P^L, so

$$P^H = P^S + P^L.$$

In a perfectly competitive market the price of the structure, P^S, would equal the replacement cost, namely, what it would cost to rebuild the dwelling at current prices, adjusting for the depreciation of the dwelling since it was built, net of any renovations that may have taken place since then. The value of developable land, P^L, would then be the difference, or residual, between the market price of the dwelling, P^H, and the replacement cost of the structure, P^S.

Since the replacement cost of the structure is not observed, we infer it in two steps. First, we build a series for the cost of constructing a new dwelling. Second, we scale this series down by a depreciation factor. Following the discussion from the previous section, we infer the dwelling construction cost as the sum of the enterprise cost and financing cost. Specifically, we use Norsk Prisbok's 2025 construction cost per square meter for an apartment building.[5] To make construction costs comparable to housing prices, we need to account for differences in how floor area is measured. Norsk Prisbok reports costs per square meter of gross floor area (bruttoareal, BTA), whereas the housing price data are measured per square meter of internal floor area (BRA-i)[6], which excludes external walls, stairwells, technical rooms and other common spaces. We therefore apply a floor-area conversion factor to the 2025 Norsk Prisbok benchmark.[7] We roll the level backward with Statistics Norway's construction cost index and adjust for changes in value added per hour in construction.[8] In addition to this construction cost we impute financing costs, using a procedure described in the Appendix.

To compute the depreciation factor, we proceed in two steps, which we detail in the Appendix. First, using transaction data from the Norwegian Land Register, we estimate a hedonic regression of log transaction prices on property-age indicators, controlling for property characteristics and granular location-time fixed effects. Figure 2 plots the resulting age-price gradient for apartments in Oslo and in all of Norway, together with 95 per cent confidence intervals. Transaction prices decline with the age of the dwelling, stabilizing after age 40. This flattening of the age-price gradient may reflect renovations and maintenance, which offset some of the physical depreciation of older structures, as well as the presence of a non-depreciating land component.[9] Our second step, therefore, involves accounting for the non-depreciating share of land in the dwellings used to estimate the age gradients. Specifically, we assume that land accounts for 30 per cent of the initial value of a dwelling, which is close to the initial land share we estimate for the first year in our sample (see Figure 4 below).[10]

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[5] Throughout, we focus on apartments in Oslo for our land value imputation.

[6] According to Eiendomsverdi, floor area is measured using BRA-i where available and P-ROM otherwise. The differences between these measures are expected to be small for apartments.

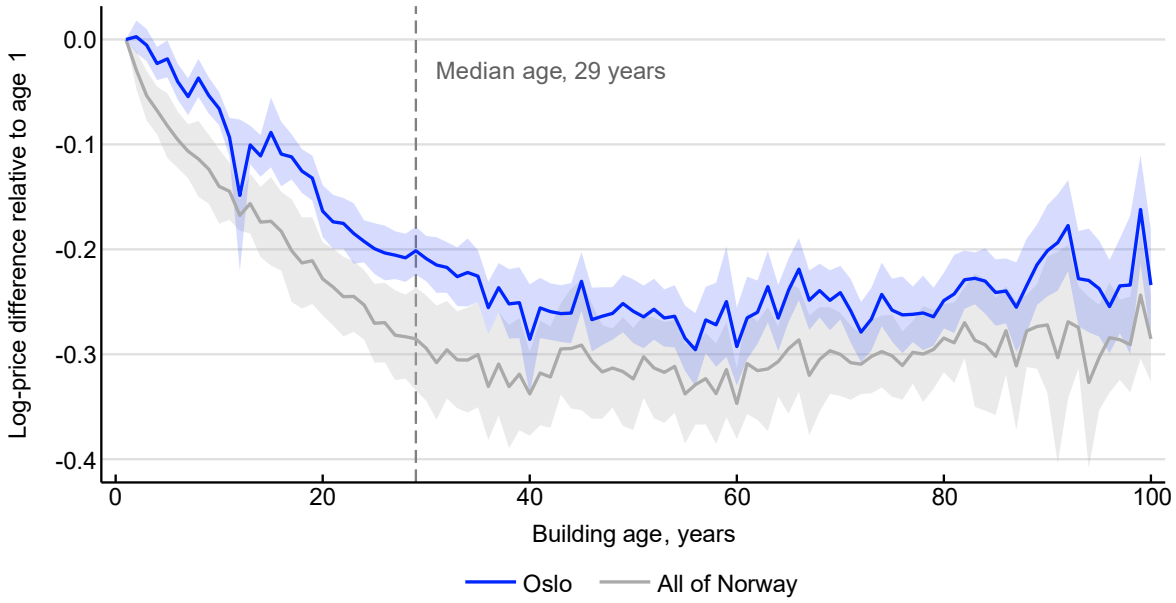
[7] We use a conversion factor of 1.30. This factor is based on typical Norwegian conversion ratios for apartment buildings (see UNION, 2025b; Dovre Group and Transportøkonomisk institutt, 2016; and the area-measurement standard NS 3940, Standard Norge, 2022). These ratios are based on saleable floor area (BRA-s), which we assume to be approximately comparable to the floor-area measures used by Eiendomsverdi for apartments. The Appendix reports the ratios and the sensitivity of our results to the factor.

[8] This productivity adjustment matters, since the construction cost index measures input prices, not output per unit of labor.

[9] The difference between the age discount in Oslo compared with all of Norway shown in the figure likely reflects a combination of both factors – more frequent renovations in Oslo than in the rest of Norway and a higher share of land in Oslo housing.

[10] We evaluate the land-share adjusted age gradient at the median age for apartments transacted in Oslo in 2021, which is 29 years.

Figure 2 Age-price gradient for apartments, Oslo and all of Norway.



Note: Estimated log-price difference by building age, relative to a one-year-old apartment, with 95 per cent confidence intervals based on standard errors double clustered by month and municipality for all of Norway and by month for Oslo.
Sources: Norwegian Land Register and Norges Bank.

To compute the market price of the dwelling, P^H, we use Eiendomsverdi's average price per square meter for Oslo apartments in 2025 as the level in 2025 Q4. We then extend the series backwards using Eiendomsverdi's quarterly real price index for used homes in Oslo. The index covers all dwelling types and is seasonally adjusted and quality-adjusted using the SPAR method.

The land value residual P^L is then the difference between P^H and P^S. Given data availability for the house price index, we conduct our analysis for Oslo apartments from 2003 Q4 to 2025 Q4.

3.1 How to interpret the land value residual?

It is important to emphasize the limitations of the residual approach to land value imputation. First, any errors in the calculation of the replacement cost, P^S, or the house price, P^H, would be included in the land residual. If these errors are non-systematic, then that would just be reflected in measurement error around the true land price. Second, as Section 2 and the formal model in the Appendix emphasize, there are cost components and a developer profit margin that cannot be recovered with the imputation of the replacement cost. These factors would have a systematic effect on the land residual. To the extent that these omitted components vary relatively little over time, they would mainly affect the level of the imputed land value rather than the evolution of the land series.[11] Nevertheless, the land value we impute will have to be interpreted with these unobserved systematic factors in mind.

[11] Illustrative project budgets we have seen from a Norwegian real estate developer suggest that development costs, such as project management, sales and marketing, and fees, are relatively small, each accounting for less than 2 per cent of expected sales revenues. Other components, including additional land-related costs and developer profit margins, may be more substantial.

4. Results and discussion

4.1 Developments in land prices

Figure 3 plots the imputed real replacement cost and land value residual from applying the methodology described in Section 3. The series are normalized as indices, for easier comparison with the real used house price index for Oslo, which is also shown in the figure. We can draw several conclusions. First, land prices are substantially more volatile than house prices. Specifically, the standard deviation of the Hodrick-Prescott filtered cyclical component of real land prices is 9.1 per cent, about twice that of real used-home prices (4.5 per cent) and almost six times that of the replacement cost (1.6 per cent). This is not surprising since house prices are a combination of the volatile land component and much less volatile replacement cost. Land price volatility may also come from higher interest rate sensitivity, as suggested by the period around the Covid-19 pandemic, with a strong monetary loosening in 2020, followed by a persistent tightening from late 2021.[12]

Second, land prices increased substantially more than house prices during 2003-2017. Since 2017, however, there is a notable break in this growth trend, with land prices remaining broadly flat through 2025. Among other factors, the nearly flat land values since 2017 may also partly reflect the effects of debt-to-income restrictions introduced in early 2017 on housing demand. Higher construction costs, which are not passed through fully into house prices and instead push down the value of land, may also have contributed.[13] Nevertheless, at the end of 2025 land prices in Oslo are still about three and a half times their level at the end of 2003.

In addition to the scarcity of land, these high values may partly reflect regulatory and other costs associated with developing residential land. Indeed, according to Statistics Norway, the average time from the initial planning meeting to final approval of privately initiated detailed zoning plans in Oslo increased by approximately 35 per cent, from around 1,400 days in 2016 to 1,900 days in 2025.[14] Such delays can increase financing and other inventory costs for developers. Since our land value residual does not separately account for the costs of bringing raw land to a developable stage, part of the estimated residual may reflect these costs rather than the scarcity value of land alone (see also Section 3.1).

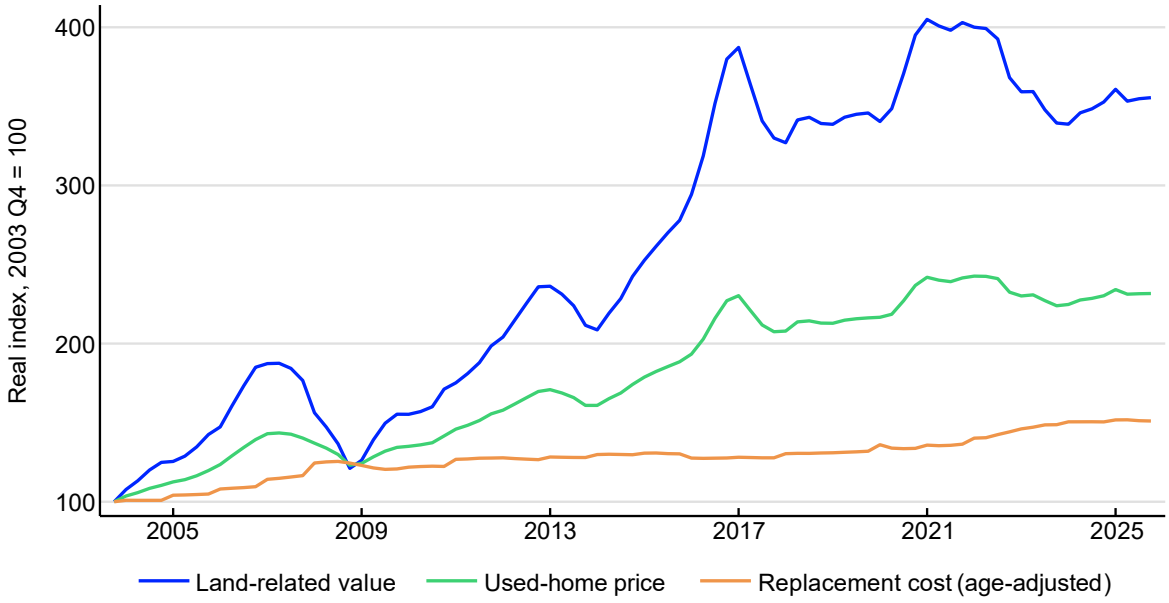
It is noteworthy that replacement costs have also increased during the period, and particularly after the Covid-19 pandemic. The increase of around 50 per cent is not as pronounced as for land prices but shows that construction costs have also contributed to the increase in housing costs in Oslo.

[12] Interest rates would also tend to influence land values through at least two channels. On the one hand, lower interest rates would tend to increase the demand for land. On the other hand, lower interest rates would also raise the supply of developable land by reducing the inventory costs of developers. See the Appendix for the condition under which the demand channel dominates.

[13] See the model in the Appendix for a formalization of this argument.

[14] Statistics Norway (2026), StatBank Table 12671. The figures measure total calendar days from the initial planning meeting to final decision, including time spent by the municipality, the proposer and other actors. They cover all privately initiated detailed zoning plans, not exclusively residential developments. The planning stage is not included in our imputed financing costs, which cover only the assumed two-year construction period.

Figure 3 Developments in real land-related values, replacement costs and used home prices in Oslo, 2003–2025. Quarterly real indices, 2003 Q4 = 100.



Sources: Eiendom Norge, Eiendomsverdi, Finn.no, Norsk Prisbok, Norwegian Land Register, Statistics Norway and Norges Bank.

4.2 Land share

We can use our decomposition of house prices into land value residual and replacement cost to compute a measure of the land share of (new) housing, which we define as the land value residual divided by the sum of the land value residual and the construction cost of a new structure. Figure 4 shows the implied land share in the cost of building new housing. The land share has risen from about a third (32 per cent) in 2003 to just over half (53 per cent) at the end of our sample. The share is strongly procyclical with the housing market cycle, falling to about 32 per cent around the financial crisis, and peaking near 59 per cent in 2017 Q1.

Figure 4 Implied land-related share of new housing costs in Oslo, 2003–2025. Per cent.



Sources: Eiendom Norge, Eiendomsverdi, Finn.no, Norsk Prisbok, Norwegian Land Register, Statistics Norway and Norges Bank.

The fact that the land share has been increasing has important financial stability implications. Housing debt is secured against property, and our results suggest that the value of that property increasingly reflects the value of land. Furthermore, our estimates imply that land prices are substantially more volatile than construction costs. As land accounts for a larger share of housing value, a larger share of the collateral behind mortgage lending is tied to the component that fluctuates most. Therefore, holding the volatility of the individual components fixed, a rising land share implies greater volatility in aggregate house prices. To illustrate this more clearly, consider the following example: If land accounts for just over half of the value of a new dwelling, corresponding approximately to our estimated land-related share in Oslo at the end of 2025, a 30 per cent fall in land prices, holding the value of the structure fixed, would translate into a roughly 16 per cent fall in the value of the property. If land instead accounted for only a third of the property value, as at the end of 2003, the same decline in land prices would reduce the house price by only around 10 per cent.[15]

4.3 Land values for used and new housing

As an alternative to our baseline land value residual based on used-home transaction prices, we construct a residual using a list-price index for new housing developed in Iden, Nenov and Plaku (2026). In this calculation, we match the listed price of a new dwelling in each quarter to the imputed construction cost four quarters later, reflecting the typical lag between the initial listing and completion of a housing project. The two residuals are constructed using different housing units and land parcels and are therefore normalized separately. Consequently, our comparison focuses on their dynamics over time rather than their levels, and the two series should not be interpreted as alternative estimates of the value of the same underlying land.

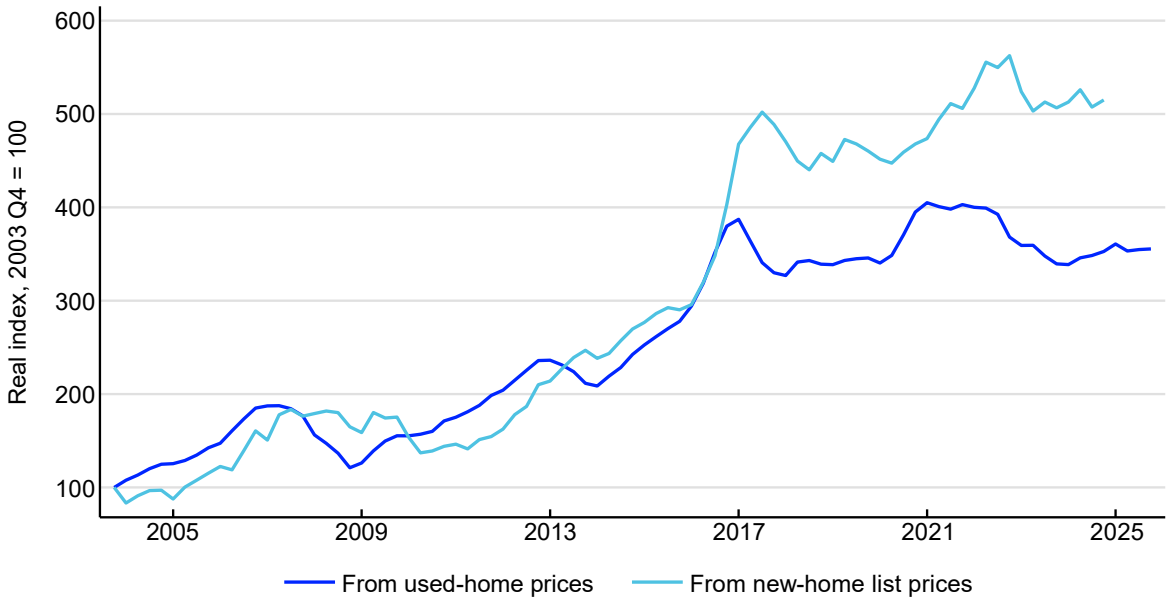
Figure 5 shows that the two residuals exhibit broadly similar cyclical movements, but with important differences in the timing and magnitude of their adjustment. In particular, the residual based on new home list prices tends to decline more slowly during housing market downturns. This pattern is visible

[15] Note that the share of land in the value of a used home is somewhat higher, since the structure has depreciated.

around the global financial crisis, when the used-home land value residual declined more rapidly, and following the housing market expansion leading up to 2017, when the new-home residual increased further and only partially corrected later. These differences are consistent with sluggish adjustment of developers' list prices relative to transaction prices in the used-home market in response to housing demand shocks, in line with the evidence on price rigidities documented in Iden, Nenov and Plaku (2026). As we argue in that paper, such price rigidities may cause adjustment in the new-housing market during cyclical downturns to occur disproportionately through lower sales volumes and construction activity rather than reductions in posted prices.

The persistent divergence since 2017 is also consistent with this mechanism. The tightening of mortgage lending requirements in Oslo in 2017 may have contributed to a persistent downward shift in housing demand. While prices in the used-housing market adjusted relatively quickly, developers may have been reluctant to reduce list prices, since lowering prices could lead them to realize losses on existing projects, weakening their balance sheets, and complicating access to financing. Nevertheless, differences in the composition and geographic coverage of the new- and used-housing markets may also contribute to the persistent divergence between the two residuals.

Figure 5 Imputed land-related values in the used- and new-home markets in Oslo, 2003–2025. Real indices, 2003 Q4 = 100.



Note: The series based on new-home list prices ends in 2024 Q4, while the series based on used-home prices extends through 2025 Q4.
Sources: Eiendom Norge, Eiendomsverdi, ECON Nye boliger, Finn.no, Norsk Prisbok, Norwegian Land Register, Statistics Norway, Iden, Nenov and Plaku (2026) and Norges Bank.

5. Concluding remarks and policy implications

Our analysis of the Oslo housing market over the period 2003–2025 shows that land-related values have increased substantially more than replacement costs and account for much of the cyclical variation in house prices. Land accounts for a growing and cyclically sensitive share of the price of housing, making land values one of several factors shaping housing affordability, as well as an important consideration for financial stability.

Regarding the housing affordability implications, if the pressure on the cost of new housing comes mainly from land rather than construction, measures aimed primarily at reducing building costs may only have a minor impact on affordability, since part of the reduced building cost would go into higher land values. What has driven the increase in land prices during our sample period is an open question. One possibility is that demand for housing in attractive locations has grown faster than the supply of land available for development. Regulatory constraints may contribute to this by limiting the amount of land zoned for housing or slowing the process through which land can be transformed into sites ready for immediate development. But the effective supply of land may also depend on the timing decisions of landowners and developers. Because land is durable and development is largely irreversible, owners may have an incentive to delay development when the expected (real-options) value of waiting is high (Titman, 1985; Cunningham, 2006; Bulan, Mayer and Somerville, 2009).

The second implication, as already alluded to in the introduction, directly concerns financial stability. Housing debt is secured against property, and based on our estimates, the value of that property seems to increasingly reflect the value of land. Since the land value is much more volatile than the replacement cost of the structure, macroprudential policy has reason to pay attention to this development. Therefore, directly assessing developments in land values may be more informative about housing market and financial stability risks than looking only at house prices.

Two extensions of our work would be particularly useful. First, new housing construction costs could be reconstructed directly year by year, rather than by rolling a single benchmark backwards. Second, the imputed series could be compared with an independent transaction-based land price index. Constructing such an index, however, is not straightforward because land transactions are subject to substantial selection and composition effects. Any future innovations in urban land valuation would provide a useful independent benchmark for the residual estimates presented here.

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Appendix

Data details

We use a number of data sets for our imputation. We describe each in turn:

Construction cost. The construction cost level is from Norsk Prisbok, a reference work for the Norwegian building industry compiled by Norconsult Digital and AS Bygganalyse. It gives experience-based costs per square meter of gross floor area by building type, updated twice a year, and we use the average of the two figures. We use apartment blocks of three to four floors as our reference building type and average across the variants Norsk Prisbok reports for this category. This provides a consistent benchmark for estimating construction costs over time. The costs cover design work up to the contracting of a builder, but not site works, infrastructure up to the plot, or regulatory work. We apply a factor of 1.30 to convert the BTA-based construction cost to a floor-area basis comparable with the housing price data, as described in Section 3 and in the robustness analysis below.[16]

Construction cost and productivity index. We use Statistics Norway's construction cost index for residential blocks. We use the aggregate index rather than the labor component alone, since the Norsk Prisbok level already combines materials and labor. We adjust the construction cost for productivity using national accounts figures for the construction sector, measured as value added at basic prices per hour worked.

Consumer prices. All series are in real terms, deflated by the headline consumer price index from Statistics Norway as an annual average, with 2025 as the base year.

Used apartment prices. Used prices are average square-meter prices for Oslo apartments from Eiendomsverdi's EV Insight statistics, unadjusted for dwelling characteristics.

New apartment prices. New prices are for Oslo apartments from ECON Nye boliger, a database of new housing projects that records all dwellings on the market in each two-month period, sold and unsold, with history back to 2001.

Used house price index. The used price index for Oslo comes from Eiendomsverdi and is seasonally adjusted. It covers all dwelling types in Oslo. It uses a quality-adjusted SPAR method (Eiendom Norge, n.d.).

New listed house price index. The new listed house price index comes from Iden, Nenov and Plaku (2026), who use project-level data from ECON Nye boliger to construct a hedonic list price index for new housing. See that paper for details on the construction.

Methodology details

Imputing financing costs. We impute the financing cost in period t as

$$Financing\ cost_t = LTC * Construction\ cost_t * Interest\ rate_t * T,$$

where LTC is the loan-to-cost ratio, $Construction\ cost_t$ is the cost of building new per square meter, $Interest\ rate_t$ is the annual interest rate, T is the construction period in years. We assume a construction

[16] For the UNION comparison, we use the average of UNION's spring and autumn 2025 surveys, 56,150 NOK per square meter of BRA-s (UNION, 2025a).

period of 2 years, and we let financing cost accrue only over this period. For the loan-to-cost ratio we use 0.7. The interest rate is the three-month NIBOR plus a constant surcharge of 2.1 percentage points.

The construction period is consistent with UNION (2025a) and Prognosesenteret (2025), both of which use this value as the typical construction time for apartment buildings. Industry sources such as UNION (2025a) assume a loan-to-cost ratio around 0.5, while development-focused banks advertise financing of up to 100 per cent of construction costs. As a robustness check we also report results for loan-to-cost ratios of 0.5 and 0.9. The interest rate surcharge is guided by the average margin on new floating-rate loans to non-financial corporations, around 1.9 percentage points; margins on construction lending are plausibly somewhat higher, consistent with figures reported by market participants. We assume the share outstanding of the loan over the period is one, which gives an upper bound on the financing cost.

Estimating age discounts. To estimate the relationship between housing age and transaction prices, we estimate a hedonic regression using property transaction data from the Norwegian Land Register for the period 2000–2021. Our sample is restricted to arm's-length residential property transactions with a living area of at least 10 square meters. We exclude housing cooperatives (borettslag), for which transaction prices do not fully reflect outstanding common debt, as well as newly constructed units (age zero) and properties older than 100 years. We regress the logarithm of the transaction price on a flexible set of property-age indicators, with each year of age entering separately and one-year-old properties serving as the reference category. The specification controls for the number of rooms and building type, and allows the relationship between floor area and prices to vary across three-digit postal codes. We additionally include building-type-by-postal-code fixed effects, quarter-by-postal-code fixed effects, and calendar-quarter-by-postal-code fixed effects, as well as month fixed effects. These controls account for differences in property characteristics, local housing market conditions, and seasonal variation in transaction prices. We estimate the specification separately for apartments and houses, both for the full sample and for Oslo. Standard errors are two-way clustered by municipality and transaction month in the full sample and clustered by transaction month for Oslo. The estimated coefficients on the age indicators trace out the hedonic age-price gradient, measuring the conditional log-price difference between properties of a given age and otherwise comparable one-year-old properties. We use the age gradient evaluated at the median age of transacted apartments in Oslo in 2021, the last year of the transaction data, which is 29 years.

Adjusting for non-depreciation of land. Our age gradient combines the depreciated physical structure plus the undepreciated land that the housing unit contains. To recover the depreciation of the structure alone, we must account for the share of the dwelling's value that is land. A higher land share implies a smaller effective discount on total property value. We assume a land share of λ = 0.3 at the time of construction, which is close to the land share we estimate at the start of our sample (about one third). We also consider robustness exercises with other values of λ.

Applying the discount to the structure alone, the depreciation factor is therefore

$$\psi = \left(1 + \frac{\exp(\beta_{29}) - 1}{1 - \lambda}\right),$$

where β_{29} is the age coefficient at 29 years. Finally, we arrive at

$$P_t^S = \psi ReplacementValue_t^{New}.$$

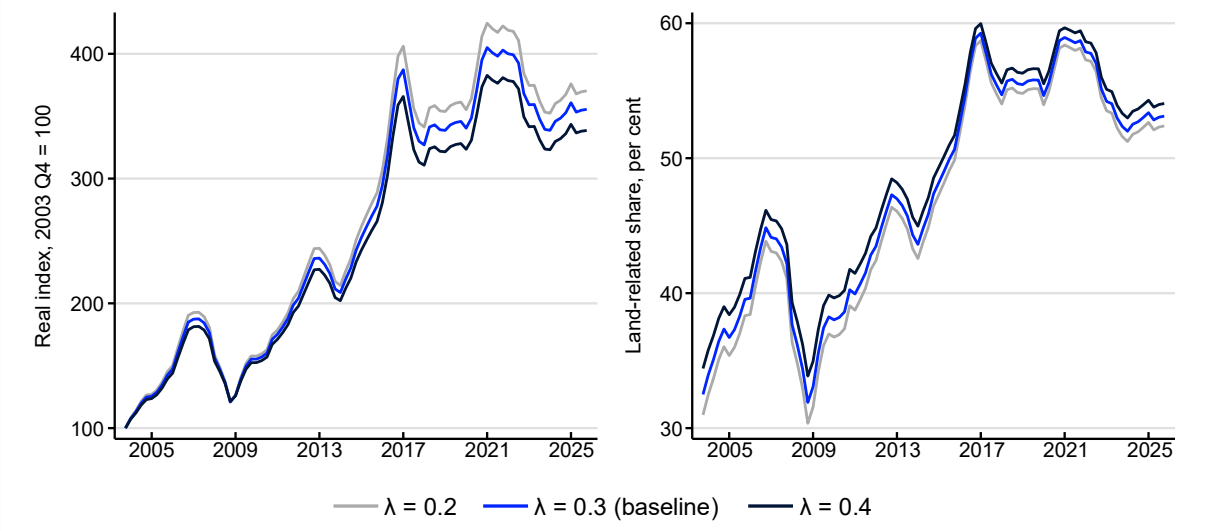
Robustness and sensitivity analysis

We perform a number of robustness checks. None of them overturns the broad pattern, though some shift the level of the land price series mildly. We check the land share used in the depreciation

adjustment, the loan-to-cost ratio used for the financing cost, the source of the construction cost and the BTA-to-BRA-s conversion factor.

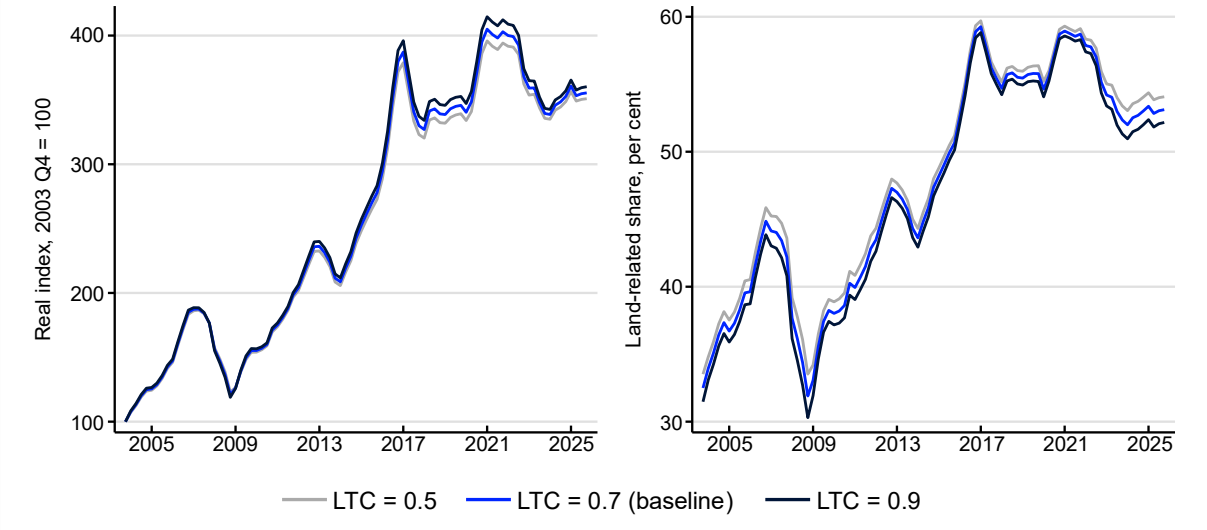
Different values of the land share used in the construction of the depreciation factor. The land share λ used to separate land from structure in the age gradient is set to 0.3 in our baseline computations. A higher λ makes the age discount fall more heavily on the structure, which lowers the replacement cost we subtract and so raises the land residual. The choice therefore affects the level of the land price and the land share. We re-run the imputation with λ at 0.2 and 0.4. Figure 6 shows the resulting land value index and land share. The effect of changing λ is small, affecting mostly the level, with the time series pattern largely maintained. Our results therefore do not appear to be very sensitive to this assumption.

Figure 6 Sensitivity to the land share λ used in the depreciation adjustment. Land-related value index, 2003 Q4 = 100 (left) and land-related share, per cent (right), Oslo, 2003–2025.



Sources: Eiendom Norge, Eiendomsverdi, Finn.no, Norsk Prisbok, Norwegian Land Register, Statistics Norway and Norges Bank.

Figure 7 Sensitivity to the loan-to-cost ratio used in the financing cost. Land-related value index, 2003 Q4 = 100 (left) and land-related share, per cent (right), Oslo, 2003–2025.

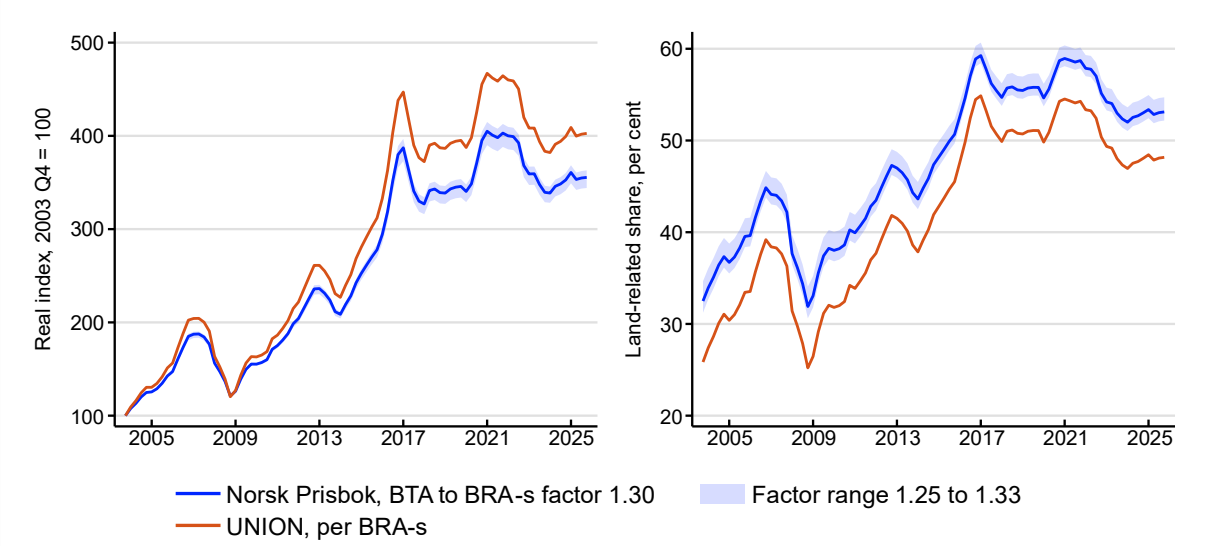


Sources: Eiendom Norge, Eiendomsverdi, Finn.no, Norsk Prisbok, Norwegian Land Register, Statistics Norway and Norges Bank.

Financing cost sensitivity. The financing cost depends on the loan-to-cost ratio, set to 0.7 in the baseline. Since financing costs are part of the replacement cost, a higher ratio implies a higher replacement cost and so a lower land value. We re-run the imputation with the ratio at 0.5 and 0.9 (Figure 7). The land value index is almost unchanged. The land share shifts by up to about 1.7 percentage points, mainly when interest rates are high, as around 2008 and after 2022. Because financing costs are a small part of the replacement cost, our results depend very little on this ratio.

Different construction cost sources. We also check whether the source of the construction cost matters by replacing Norsk Prisbok with UNION's survey-based figure (UNION, 2025a). UNION reports costs per square meter of BRA-s, so we use it without conversion. UNION's level is about 12 per cent higher than the converted Norsk Prisbok level, which likely reflects differences in the cost items and building types the two sources cover. The higher cost lowers the land share by 4 to 7 percentage points throughout the sample, placing it below the range implied by our conversion factors (Figure 8, right panel). The land value index has the same timing under both sources but fluctuates somewhat more with UNION, since a smaller residual responds more in percentage terms to a given change in house prices (Figure 8, left panel). The broad pattern, a strong rise to 2017 followed by a broadly flat profile, holds under both sources.

Figure 8 Construction cost from Norsk Prisbok and UNION. Land-related value index, 2003 Q4 = 100 (left) and land-related share, per cent (right), Oslo, 2003–2025. The shaded band shows Norsk Prisbok with conversion factors from 1.25 to 1.33. UNION reports costs per BRA-s and is not converted.

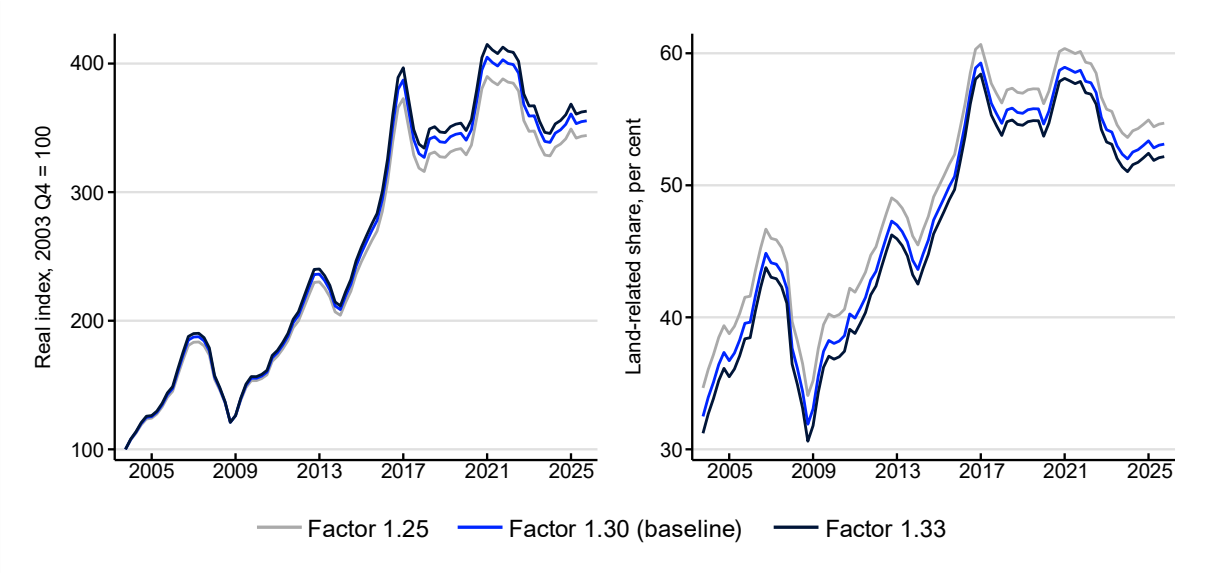


Sources: Eiendom Norge, Eiendomsverdi, Finn.no, Norsk Prisbok, Norwegian Land Register, Statistics Norway, UNION (2025a) and Norges Bank.

BTA-to-BRA-s conversion factor. Norsk Prisbok reports construction costs per square meter of gross floor area (BTA), while house prices are measured using BRA-i where available and P-ROM otherwise. In the baseline we scale the Norsk Prisbok level by 1.30, which corresponds to a saleable area share of about 77 per cent. Norwegian sources document ratios of BRA-s to BTA for apartment buildings of about 0.75 to 0.80, that is, multipliers of about 1.25 to 1.33. UNION (2025b) specifies a reference apartment building of 9,000 m² BTA and 6,750 m² BRA-s, a ratio of 0.75 (multiplier 1.33). A 2016 Akershus Eiendom valuation reported in Dovre Group and Transportøkonomisk institutt (2016, Appendix 7) assumes a ratio of about 0.80 (multiplier 1.25). The area-measurement standard NS 3940 defines this ratio as the BRA-s factor (Standard Norge, 2022). Figure 9 shows the results with factors of 1.25 and 1.33. The land share shifts by up to about 2 percentage points, and the land value index by up to

about 4 per cent. The conversion assumes that these floor-area measures are sufficiently comparable to BRA-s for apartments.

Figure 9 Sensitivity to the BTA-to-BRA-s conversion factor. Land-related value index, 2003 Q4 = 100 (left) and land-related share, per cent (right), Oslo, 2003–2025.



Sources: Eiendom Norge, Eiendomsverdi, Finn.no, Norsk Prisbok, Norwegian Land Register, Statistics Norway and Norges Bank.

A simple model of land prices and housing development

This section presents a simple static model that illustrates the main arguments in the memo. The model features a representative household that demands housing, a representative developer firm that sells housing to households by combining structures and developable land, which are produced by structures entrepreneurs and land entrepreneurs. Structures entrepreneurs combine labor and materials to produce structures. Land entrepreneurs convert raw land, owned by land owners, into developable land subject to regulatory and inventory costs. All markets are competitive.

Housing demand. Aggregate housing demand is given by the reduced form function

$$H = D(P^H, Y, N, r), \tag{1}$$

which is decreasing in the house price P^H and the interest rate r and increasing in income Y and population N. It can be derived from a standard setting in which N households with income Y choose between housing and other consumption, and owning a unit of housing entails a user cost $(r+\delta)P^H$, where δ is the depreciation rate (Poterba, 1984). With Cobb-Douglas preferences, for example, $D = \gamma NY/[(r+\delta)P^H]$, where γ is the expenditure share of housing.

Developer. The representative developer firm combines structures S and developable land L in fixed proportions, $H = \min\{S, L\}$, with units normalized so that one unit of housing requires one unit of each. It also incurs other development costs c per unit of housing, such as overheads and the developer margin (Figure 1). Zero profits imply

$$P^H = P^S + P^L + c. \tag{2}$$

Structures entrepreneur. The structures entrepreneur produces structures using labor ℓ and materials m with a Cobb-Douglas production technology $S = A\ell^{\alpha}m^{1-\alpha}$, where A denotes the productivity of the production technology. Cost minimization and a zero profit condition pin down the equilibrium price of structures at

$$P^S = \kappa(W, P^M, A) = \frac{1}{A}\left(\frac{W}{\alpha}\right)^{\alpha}\left(\frac{P^M}{1-\alpha}\right)^{1-\alpha}, \quad (3)$$

where W is the wage and P^M is the price of materials. Construction financing costs, which we include in the replacement cost in the main text, can be added as a proportional markup on κ. This makes P^S depend on r, but not on housing demand.

Land entrepreneur. The land entrepreneur buys raw land RL from landowners at price P^{RL} and converts it one-for-one into developable land. Before development can begin, however, the land must be held in inventory for τ years while it goes through planning and approval, where we interpret τ as the regulatory burden that the land entrepreneur is subject to. Financing the land over this period gives an inventory cost of $r\tau P^{RL}$ per unit, so that the price of developable land is

$$P^L = (1 + r\tau)P^{RL}. \quad (4)$$

Landowners. Landowners supply raw land RL at the quadratic cost $\theta(RL)^2/2$, where θ captures the scarcity of land due to geography, zoning or alternative uses. The supply curve for raw land is therefore given by

$$P^{RL} = \theta RL. \quad (5)$$

Equilibrium. Market clearing requires $H = S = L = RL$. Combining conditions (2)-(5) above with the market clearing conditions gives the equilibrium housing supply curve

$$P^H = \kappa(W, P^M, A) + c + (1 + r\tau)\theta H. \quad (6)$$

The equilibrium price and quantity of housing are given by the intersection of this supply curve and the demand curve from Equation (1).

Discussion. Our simple model delivers several insights that support claims made in the body of the memo.

1. Given an observed structure price, the land residual from Section 3 is

$$\hat{P}^L = P^H - P^S = P^{RL} + r\tau P^{RL} + c.$$

Therefore, it captures the scarcity value of raw land, P^{RL}, the inventory cost of bringing it to a developable stage, $r\tau P^{RL}$, and other development costs, c.

2. Since structures are supplied perfectly elastically, $P^S = \kappa$ depends only on construction costs, while the price of developable land $P^L = (1 + r\tau)\theta H$ absorbs all demand-driven variation in house prices.
3. A longer approval process (higher τ) lowers the quantity of housing and the price of raw land, but raises developable land values and house prices, so part of the measured land value may reflect regulatory costs rather than land scarcity (Section 4.1).
4. Higher construction costs (higher W or P^M, or lower A) raise house prices less than one-for-one,

$$\frac{dP^H}{d\kappa} = \frac{1}{1 + (1 + r\tau)\theta|\partial D/\partial P^H|} \in (0,1),$$

and lower land values, since $dP^L/d\kappa = dP^H/d\kappa - 1 < 0$.

5. A higher interest rate lowers housing demand D but raises the inventory cost. The quantity of housing and the price of raw land fall unambiguously, while house prices and developable land values fall if and only if

$$-\frac{\partial \ln D}{\partial r} > \frac{\tau}{1 + r\tau},$$

that is, if the semi-elasticity of housing demand with respect to the interest rate exceeds, roughly, the time it takes to bring land to a developable stage. In the example with Cobb-Douglas preferences, this condition reduces to $\tau < 1/\delta$, which holds for any plausible approval time, so the demand channel dominates, consistent with the interest-rate sensitivity of land values since 2020 (Section 4.1).