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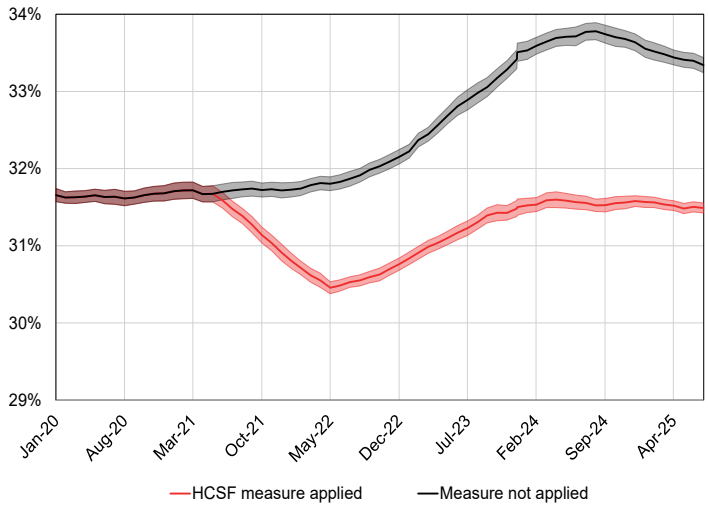
The Consequences of Regulating Mortgage Lending Conditions

Stéphane Frachot and Alisée Koch

- An increase in household mortgage debt was the catalyst for the decision made by the macroprudential authority – the High Council for Financial Stability (HCSF) – to regulate mortgage lending conditions for households in France. In 2019, the HCSF published a recommendation for credit institutions to limit the debt service to income (DSTI) ratio – the share of income allocated to monthly mortgage repayments – and the maturity of the mortgages approved. This recommendation became legally binding in 2022.
- The Primmo model was used to assess this regulation, taking into account the varying impact that government policies may have depending on actual observed interest rates. This assessment showed that the HCSF's measure had enabled the average DSTI ratio to be reduced while increasing the average mortgage maturity. However, the effect on property prices is limited amid rising interest rates. The findings are in line with the studies presented in the HCSF's 2024 Annual Report.
- When using the variation in the average income of buyers in the model as a proxy of the exclusion of households, the analysis reveals that lower-income households are "excluded" from the credit market due to high interest rates, but that this is not compounded by the HCSF measure.
- If the HCSF had not applied the measure, the average DSTI ratio would have risen while the average mortgage maturity would have decreased. However, this would not have had a major effect on transactions and property prices within one year, as short-term market momentum is primarily influenced by the interest rate environment.
- The model can also be used to examine the effect of exogenous shocks – relating to interest rates, as well as construction and rent – on the property market's momentum and the profile of borrowers.

Average DSTI ratio of borrowers



Sources: Primmo model, DG Trésor.
Note: The chart above covers a period under tight market conditions, with the trend being very similar to that under slacker market conditions.

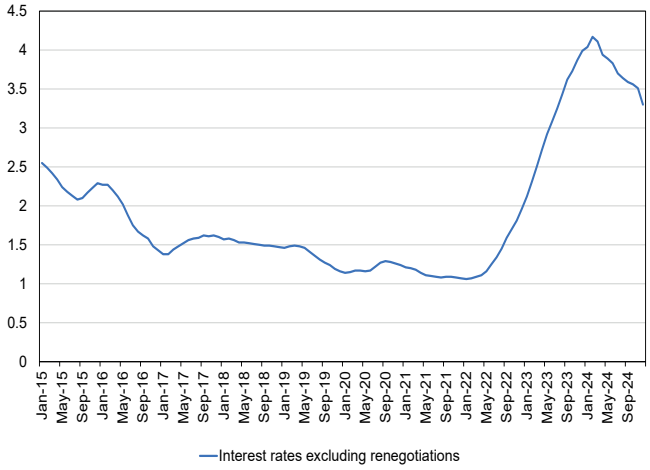
1. An agent-based model for assessing mortgage measures

1.1 Background: a progressive implementation of macroprudential measures

Property accounts for a significant proportion of household assets in France (62% of gross wealth) and most owners purchase their property by taking out a mortgage for an amount that is often equivalent to several years of income. At aggregate level, excessive debt borne by households relative to their disposable income can pose a risk to financial stability.[1] Heavily indebted households are more vulnerable to economic shocks, are less able to save money and are more exposed to interest rate fluctuations – albeit the latter is a limited risk in France, where loans are primarily granted on a fixed-rate basis.[2]

The High Council for Financial Stability (HCSF) is the macroprudential authority responsible for supervising France's financial system. In line with this assignment, in 2019 it began to roll out policies to regulate household debt dynamics, limit the exposure of banks, and thereby keep the risk of a crisis at bay.[3] It introduced a DSTI ratio cap of 35% and a maximum limit for mortgages of 25 years, in place since 2022.[4] The measure became binding at a time when interest rates were rising, making it more difficult to assess the measure in a broadly unique interest rate environment (see Chart 1).

Chart 1: Average interest rate for new mortgages granted to French households (excluding renegotiations, as a %)



Source: Banque de France.

1.2 The Primmo model used in the study

The assessment of the effects of the HCSF measure examined both borrowers and their profile, and the property market. The effect of scrapping the measure was also evaluated on a prospective basis.

The Primmo model used is an agent-based model (ABM), the principle of which is to reconstruct, in a stylised manner, the main stages of the purchase/sale process for a property on the market.[5] In doing so the model can provide insight into the emergence and dynamics of complex phenomena based on interactions between a diverse range of agents[6, 7] by means of simple decision-making rules. ABMs' ability to provide a macroeconomic analysis – based on microfoundations – for a given policy removes the limitations that generally affect the analysis of complex phenomena.[8,9] Agent-based models have been widely used in the literature to examine the effect of prudential measures on the property market, particularly on loan-to-value (LTV) ratios, the mortgage rate and the DSTI ratio.[10,11,12]

The model's initial population and its profile (e.g. income, assets, age, housing occupancy status) are

(1) A. Alter, A. Feng, N. Valckx (2018), "Understanding the Macro-Financial Effects of Household Debt: A Global Perspective", *IMF Working Paper* No. 18/76.
(2) Chris Hunt (2015), "Economic implications of high and rising household indebtedness", *RBNZ Bulletin.*
(3) These policies were the subject of an ex-ante analysis of the various possible measures to implement to regulate household indebtedness in *Trésor Economics* No. 277, which uses the same model (*Primmo*).
(4) Recommendation R-HCSF-2019-1 of December 2019 introduces a maximum DSTI ratio of 33% and a maximum loan maturity of 25 years, in keeping with market practices. The maximum DSTI ratio was raised to 35% in January 2021, and became legally binding in January 2022 (D-HCSF-2021-7, in French only).
(5) A description of the model's methodology is provided in the Appendix to the 2024 HSCF Annual Report.
(6) C. Macal and M. North (2005), "Tutorial on agent-based modeling and simulation", Proceedings of the Winter Simulation Conference.
(7) S. Railsback and V. Grimm (2011), "Agent-Based and Individual-Based Modeling: A Practical Introduction".
(8) G. Fadiran et al. (2020), "Macroeconomic Policy effects on development transition – Views from Agent based model".
(9) S. Poledna et al. (2020), "Economic Forecasting with an Agent-Based Model", *Social Science Research Network*.
(10) T.S. Yun and I.C. Moon (2020), "Housing Market Agent-Based Simulation with Loan-To-Value and Debt-To-Income", *Journal of Artificial Societies and Social Simulation*.
(11) Baptista et al. (2016), "Macroprudential policy in an agent-based model of the UK housing market", *Staff Working Paper* No. 619, Bank of England.
(12) Catapano (2021), "Macroprudential Policy Analysis via an Agent Based Model of the Real Estate Sector", *Social Science Research Network*.

taken from the 2020 French Household Finance and Consumption Survey: 14,490 individuals representing France's population, comprising both tenants and property owners. On the supply side,[13] the absorption rate is used to estimate the number of owners selling their properties each month (for each interval of the model).[14] On the demand side, surveys on households' intention to buy property[15] are used to randomly select tenants who, for each period (one month in duration) consider whether to buy a property or to continue renting. If the discounted cost of rent is greater than the purchase price, they are deemed "active" on the property market and look to purchase property.[16] The results of the model are provided for two contrasting cases of tight property market conditions and slack market conditions correlating, in a stylised manner, to the Paris market and the rest of France.

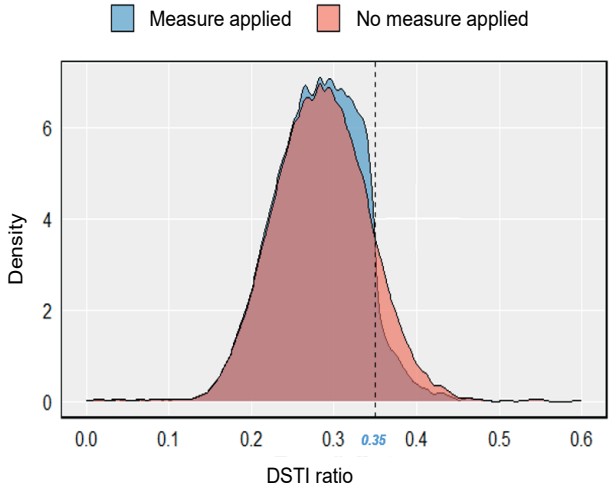
Buyers determine their spending limit based on their maximum borrowing capacity and their financial and property assets. On the other hand, sellers determine their asking price based on the quality and surface area of the property, the average market price, historical price trends and market tension which depends on the buyer-to-seller ratio. Buyers and sellers are then matched, in the presence of matching frictions, based on spending limit and asking price. If a sale is not made, buyers may raise their offer and sellers may lower their price during the next interval. Buyers who successfully find a seller take out a mortgage, and trade off the mortgage's maturity against the debt service. With this model, two property market scenarios can be established: one in which the macroprudential measure is applied and a counterfactual scenario. As the model does not enable banks to take account of a recommendation, the measure is modelled as immediately binding and applied in early Q3 2021, when banks complied with the measure across the board.[17, 18]

2. Assessment of the implementation of the HCSF measure: direct effects on mortgage terms and limited effects on the property market amid interest rate hikes

2.1 Borrowers cap their DSTI ratio and extend the maturity of their mortgage

The average DSTI ratio, defined as the share of income allocated to monthly mortgage repayments, is considerably lower in the scenario in which the HCSF measure is introduced (1.6-2.2 percentage points lower than the counterfactual scenario). Between 2022 and 2024, the DSTI ratio rises in both scenarios given interest rate increases, but this increase is preceded by a sharp drop when the measure is introduced (see chart on cover page). This result confirms that the DSTI ratio cap was binding, considerably more so than the maturity limit.[19] More specifically, the model factors in households having to raise their DSTI ratios to just below the 35% limit as a result of the measure (see Chart 2).

Chart 2: Distribution of the DSTI ratios of borrowers, 50 months following the measure



Source: Primmo model, DG Trésor.

(13) House Prices in France : Property Price Index, French Real Estate Market Trends in the Long Run | Inspectorate General for the Environment and Sustainable Development (IGEDD) (developpement-durable.gouv.fr). The country-level absorption rate is published, so it is assumed that the rate is uniform, particularly because supply plays a significantly smaller role than demand in property market dynamics within the model.
(14) The number of owners who have sold property is used as an approximation for the number of owners intending to sell property.
(15) The results are obtained from the May 2024 study conducted by Harris Interactive and IFOP for Optimhome. The figures differ depending on the geographic location and the interval under examination, but they are in line with INSEE's Camme survey of July 2024.
(16) The model does not factor in the possibility of owning a second home nor of buying to let.
(17) In January 2021, the HCSF reported that the measure would become legally binding in Q3 2021 (press release).
(18) The HCSF measure allows for a degree of flexibility, but this has not been factored into the model.
(19) The share of mortgages failing to meet the DSTI ratio criteria was 14.1% on average for 2023, compared to 0.6% for the share of mortgages failing to meet the maturity criteria (the French Prudential Supervisory and Resolution Authority – ACPR), demonstrating that the DSTI cap is more binding than the maturity limit.

Table 1: Effect of the HCSF measure on various outputs of the model in August 2024

In August 2024	Counterfactual scenario	Effect of measure on slack market	Effect of measure on tight market
Mortgage loan in years of income, average	4.3	–3.66% i.e. –0.15 years (***)	–4.62% i.e. –0.20 years (***)
Average DSTI ratio	32.9%	–1.6 pts (***)	–2.2 pts (***)
Average maturity (months)	211	+2.33% i.e. +5 months (***)	+3.10% i.e. +6.75 months (***)
Loan-to-value ratio	1.008	–0.4 pts (negligible).	–1.0 pts (**)
Annual loan production (% of revenue)	6%	–0.3 pts (***)	0.5 pts (***)
Average debt (€)	135,868	–3.7% (***)	–3.0% (***)
Average income of buyers	37,017	+0.75% (negligible)	+0.43% (negligible)
Percentage of first-time buyers	72%	–3.5 pts (negligible)	–5.5 pts (negligible)
Financial assets of buyers	63,642	+4.60% (*)	+4.63% (negligible)

Source: Primmo model, DG Trésor.

Note: Each box illustrates the effect of the HCSF measure, determined by calculating the difference between the scenario in which the HCSF measure is implemented and the counterfactual scenario in August 2024.

How to read this table: Under (relatively) slack market conditions, the HCSF measure implemented in early Q3 2021 cut the average DSTI ratio by 1.6 percentage points in August 2024.

Significance thresholds: 1% = (***), 5% = (**), 10% = (*).

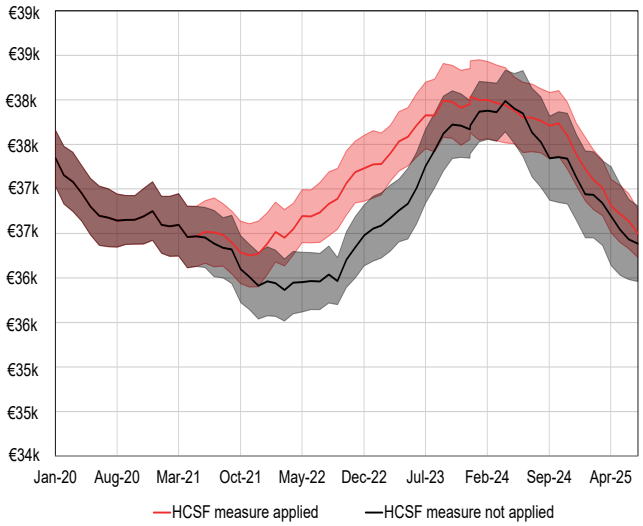
To confirm whether the measure has a significant effect on each variable, we performed a Welch test for each interval, with the null hypothesis being $\mu_0 = \mu_1$, with μ_0 being the average of simulations with the HCSF measure and μ_1 being the average of simulations not involving the HCSF measure. We deem the measure to be statistically significant in cases where the hypothesis is rejected for at least 12 periods, including necessarily the interval under examination (August 2024).

To secure their desired property, some households make a trade-off and extend the repayment period of their loan: the average mortgage maturity was 5 to 6.75 months longer in August 2024 as a result of the HCSF measure's implementation. This does not preclude a fall in the average maturity due to interest rate hikes driving up borrowing costs. The impact of interest rates on average maturity therefore dwarves the effect of the DSTI ratio cap.

2.2 The measure reduces household debt but has little selection effect

The total mortgage loan (interest and principal) to annual income ratio (the loan-to-income ratio)[20] is reduced by 0.15 years under slack market conditions and 0.2 years under tight market conditions as a result of the HCSF measure. The measure has significantly reduced the average debt of borrowers, falling by 3.71% under slack market conditions. However, the average income of buyers is not materially affected by the measure at the end of the modelled interval. Starting from late 2021, the average income of buyers rises in both scenarios but this is primarily the result of interest rate increases, which excludes lower-income buyers. Indeed, lower-income buyers are "excluded" by the interest rate environment, and this exclusion is not compounded by the HCSF measure's implementation (see Chart 3). The measure therefore has little selection effect in a relatively high interest rate environment.

Chart 3: Average annual income of buyers in the property market



Source: Primmo model, DG Trésor.

Note: The data is presented here under tight market conditions, with a similar trend observed under slacker market conditions.

(20) The loan-to-income (LTI) ratio is the number of years required to repay a loan if the entirety of the borrower's income – assumed to be fixed – is used to do so.

2.3 The measure has a significant yet limited effect on the property market

In a HCSF measure scenario, the average price per square metre in August 2024 is between 0.5% and 0.75% less than in the counterfactual scenario (see Table 2), particularly because market tension[21] is lessened by a drop in buyers. However, the measure does not have a significant effect on the number of transactions under tight market conditions, since the number of prospective buyers continues to be high enough to maintain supply. Lastly, the model does not show any selection effect on the quality and surface area of property bought and sold on the market as a result of the measure.[22]

Table 2: The measure's effect on the property market in August 2024

	Effect of the HCSF measure under slack market conditions	Effect of the HCSF measure under tight market conditions
Price	–0.56% i.e. –€16/m² (***)	–0.73% i.e. –€22/m² (***)
Market tension	–8.0% i.e. –0.09 (***)	–8.4% i.e. –0.18 (***)
Number of transactions	–7.3% (***)	–0.7% (negligible)
Quality	–4.0% (negligible)	–0.0% (negligible)
Surface area	+2.5% (negligible)	–1.3% (negligible)

Source: Primmo model, DG Trésor.
Significance thresholds: 1% = (***), 5% = (**), 10% = (*).

3. When interest rates drop, it is thought that market momentum is dictated by monetary policy

Table 3: Effect in August 2025 of the scrapping of the HCSF measure as from August 2024

	Low interest-rate scenario		High interest-rate scenario	
	August 2025	August 2027	August 2025	August 2027
Volume of transactions	+9.6% (negligible)	+3.6% (negligible)	+2.8% (***)	+6.3% (negligible)
Average price per m²	+0.21% (negligible)	+1.25%(***)	+0.07% (***)	+0.63% (***)
Loan-to-income (LTI) ratio	+0.19 years (***)	+0.24 years (***)	+0.22 years (***)	+0.25 years (***)
Average maturity	–7.0 months (***)	–6.0 months (negligible)	–3.7 months (***)	–0.62 months (***)
Average debt	+3.4% (**)	+2.2% (**)	+1.93% (***)	+1.87% (***)
DSTI ratio	+2.1 pts (***)	+2.3 pts (***)	+2.0 pts (***)	+1.6 pts (***)
LTV ratio	+0.7 pts (*)	+0.8 pts (negligible)	+1.0 pts (negligible)	–0.27 pts (negligible)
Average income of buyers	–2.3% (***)	–0.9% (negligible)	–4.3% (**)	+0.4% (negligible)
Average financial assets	–4.3% (**)	–2.0% (negligible)	–11.9% (negligible)	+0.4% (negligible)
Percentage of first-time buyers	+1.1 pts (negligible)	–4.3 pts (negligible)	+5.0 pts (negligible)	–1.7% (negligible)
Market tension	+3.3 pts (negligible)	+12.6 pts (negligible)	+4.6 pts (***)	+2.9% (***)
Property quality	+11.0% (negligible)	–2.4% (negligible)	–0.0% (negligible)	+6.0% (negligible)
Average surface area	+0.5% (negligible)	+1.5% (negligible)	+1.9% (negligible)	+1.6% (negligible)

Source: Primmo model, DG Trésor.
Note: If the HCSF measure had been scrapped in August 2024, the average mortgage maturity would have been seven months shorter by August 2025 compared to a scenario in which the measure is not scrapped.

In this section, the Primmo model is used to analyse the effect of a hypothetical scrapping of the measure, in a new interest-rate environment, after one and five years. The interest-rate environment has a key role in shaping the effect of the measure, which is why two interest-rate forecasts are used (see Table 3). Mortgage interest rates refer to the rates observed until July 2024, and then from that point onwards two forecasts

(21) Market tension is the ratio of the number of prospective buyers for housing to the number of properties available for sale. It is an output of the model, and is calculated for every interval.
(22) In the model, surface area and quality are determined for each new property independently from the model, and our results simply show that there is no "selection" of smaller or lesser-quality housing as a result of various shocks. Another study examining the impact of these shocks when the property market situation determines the features of new properties would be an interesting avenue to explore.

are used: an “optimistic” forecast in which the rates fall to 1.5% in April 2026, and a “pessimistic” one in which the rates plateau at 3.5% until the interval end. In both cases, the market examined is tight but the results are similar to those obtained from a slack market.

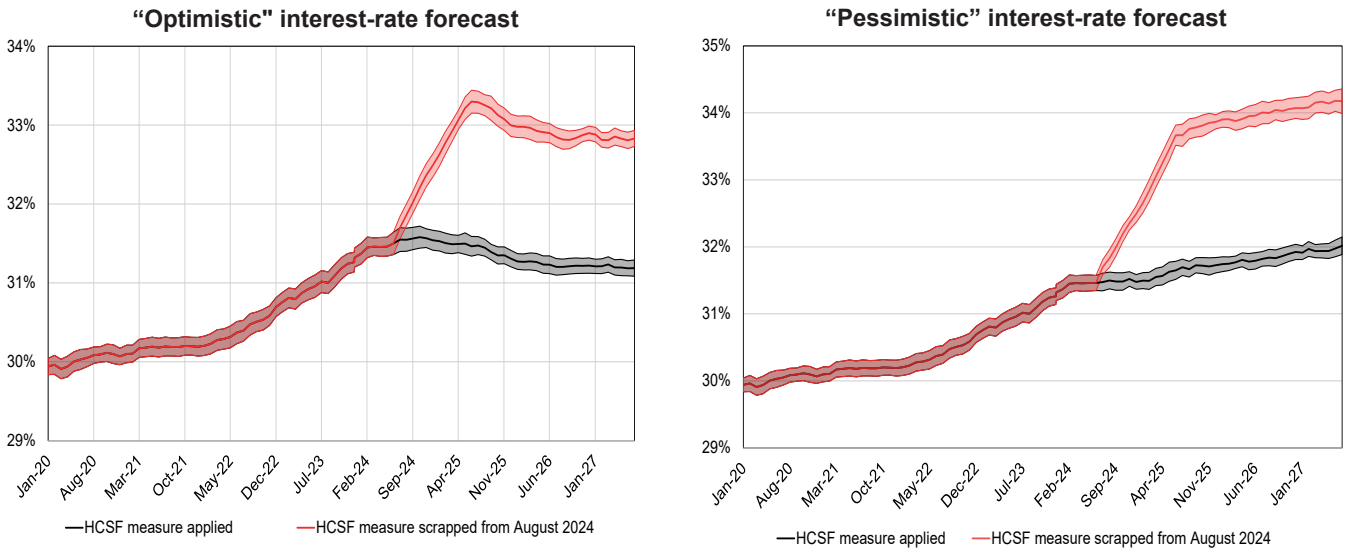
3.1 Borrowers are raising their DSTI ratios while shortening their mortgage maturity

With no HCSF measure in place, the agents in the model would no longer need to trade off their DSTI ratio against the mortgage maturity at the time of borrowing. In this case, they would raise their DSTI ratio and shorten the maturity of their loan to keep down the total cost of borrowing (see Chart 4). In addition, the average debt would increase from 1.9% to 3.4% after one year depending on the interest-rate environment, primarily because of agents with a smaller cash flow who may re-enter the property market, with their average loan amount being greater. The entry of lower-income buyers into the market results in a drop in the average income of buyers too, triggering a 0.19 to 0.22 increase in the LTI ratio one year on from scrapping the HCSF measure (see Chart 5).

3.2 Scrapping the measure would barely support prices in the long term

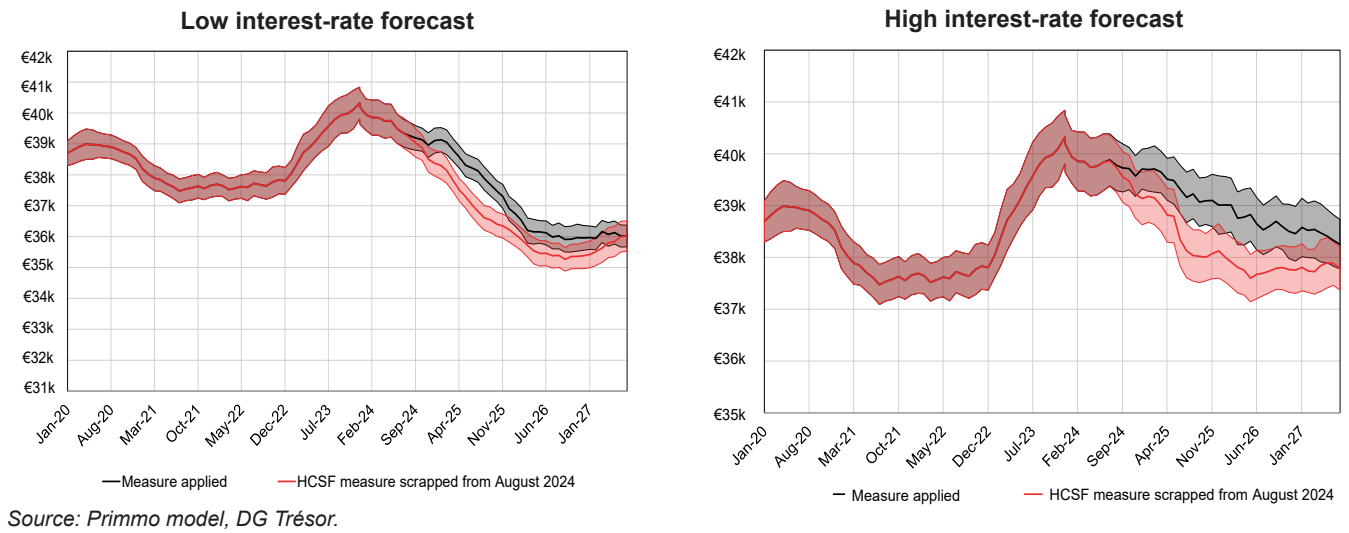
Scrapping the HCSF measure would not have an effect on the volume of transactions in the long term, and would only have an effect in the short term if the interest rates remained high. In this scenario, scrapping the measure offsets the weak demand caused by high interest rates. This is corroborated by the fact that market tension is only significantly affected in the scenario in which interest rates remain high. As for property prices, scrapping the measure would have almost no short-term effect, but in the long term would raise the average price per square metre by 0.63% to 1.25%.

Chart 4: Average DSTI ratio for mortgages



Source: Primmo model, DG Trésor.

Chart 5: Average annual income of buyers



Source: Primmo model, DG Trésor.

4. The effect of external shocks on the property market: an examination using the model

The findings from the assessment point to the interest-rate environment being key in determining the trends relating to the characteristics of loans, buyers and the property market, as well as considerably restricting the effect of the HCSF measure – even if it is significant – on the DSTI ratio and mortgage maturity. For a deeper insight into these mechanisms, the model has been used to examine the effect of external shocks on the property market:

1) Interest-rate shock: the 20-year mortgage interest rate increases from 1.5% to 2.5% (+100 basis points, but this effect is nonlinear), corresponding to a shock in 2022.

2) Construction shock: a temporary 1% increase in new housing stock.

3) Rent shock: a temporary 5% increase in rents with property prices remaining unchanged.

4.1 Interest-rate shocks significantly influence the profile of borrowers and favour higher-income buyers

The findings confirm that positive interest-rate shocks have a material effect in the model. The average LTI ratio falls by 0.63 years after five years given the drop in property prices triggered by dwindling demand, but also as a result of the foreclosure of lower-income buyers. Following a positive interest-rate shock, the average annual income and average financial assets of buyers increase by 2.41% and 12.3% respectively after one year. Increases in the borrowing cost of the mortgage exclude lower-income households from home ownership. Increases in the average income are therefore the result of a restructuring of the buyer household population into one that is wealthier.

Table 4: Effect of short-, medium- and long-term shocks versus a shock-free scenario

	Interest-rate shock (+100 bp)		Construction shock (+1 %)		Rent shock (+5 %)	
	After one year	After five years	After one year	After five years	After one year	After five years
Transactions	–14.5%(***)	–5.5% (***)	+12.7% (***)	+0.17% (negligible)	+7.2% (***)	+0.25% (negligible)
Price per m^2	–0.19% (**)	–2.17% (***)	–0.60% (***)	–0.48%(***)	+0.54% (negligible)	+2.48% (***)
LTI ratio	–0.55 years (***)	–0.63 years (***)	–0.05 years (negligible)	–0.03 years (negligible)	–0.002 years (negligible)	+0.003 years (negligible)
Average maturity	–12 months (***)	–16 months (***)	–1.5 months (negligible)	–1.8 months (negligible)	–0.18 months (negligible)	–0.11 months (negligible)
Average debt	–7.5% (***)	–8.0% (***)	–3.64% (***)	–0.40% (negligible)	–1.75% (***)	+0.43% (negligible)
DSTI ratio	+52 bp* (***)	+64 bp (***)	–8.8 bp (negligible)	+2.6 bp (negligible)	+1.9 bp (***)	–12 bp (negligible)
LTV ratio	–0.73% (*)	–1.14% (***)	+0.36% (negligible)	–0.50% (negligible)	+0.07% (negligible)	–0.55% (negligible)
Average income of buyers	+2.4% (***)	+3.0% (***)	–3.3% (**)	+0.14% (negligible)	–0.03% (negligible)	+0.90% (negligible)
Average financial assets of buyers	+12.3% (***)	+6.8% (**)	–6.3% (*)	+5.4% (negligible)	–2.6% (negligible)	+3.8% (negligible)
Percentage of first-time buyers	–3.1 pts (negligible)	–1.3 pts (negligible)	–0.6 pts (negligible)	–0.3 pts (negligible)	–0.3 pts (negligible)	–1.0 pts (negligible)
Market tension	–14% (***)	–12% (***)	–15% (***)	–3.4% (negligible)	+24% (***)	+9.5% (***)
Average property quality	+4.5% (negligible)	–0.25% (negligible)	+6.7% (negligible)	+3.2% (negligible)	+5.4% (negligible)	+0.9% (negligible)
Average surface area	–1.2% (negligible)	–6.6% (ns)	–6.9% (negligible)	+0.55% (negligible)	–0.30% (negligible)	–3.6% (negligible)

Source: Primmo model, DG Trésor.

* bp = basis point. 100 basis points equals 1 percentage point.

The average maturity for mortgages and the DSTI ratio are significantly affected by the interest-rate shock. Rising borrowing costs increase monthly repayments and thus the DSTI ratio (52 basis points after one year), while the average maturity shortens (by 12 months after one year) in order to reduce the total borrowing cost. The interest-rate shock also positively affects the down payment rate,[23] also triggering a decrease in average mortgage lending, which is compounded by falling prices.

Construction and rent shocks reduce the average debt by 3.74% and 1.75% respectively after one year, but their effect subsides over time to the extent that, five years following the shock, the average debt is not materially different from the shock-free scenario.

In cutting market prices, the construction shock triggers a drop in the average income and average financial assets of buyers after one year, but the effect is no longer felt five years after the shock. As for income, the financial assets indicator is not influenced by interest rates in the model, and so changes in financial assets are actually a reflection of changes in the composition of buyers.

4.2 The property market adjusts to shocks, first through volumes and then through prices

The rise in mortgage interest rates results in a 14.5% and 5.5% decrease compared to the shock-free scenario after one year and five years respectively. Meanwhile, the construction shock raises the volume of transactions through its effect on supply. The shocks affect average prices with a time lag: construction and rent shocks temporarily affect the volume of transactions and then prices with a certain lag. With a rent shock, the volume increases by 7.2% after one year since rent hikes raise the opportunity cost of not owning a property and thereby increase demand. A rent shock significantly affects prices after five years (2.48% increase). This delayed impact is partly due to the adaptive expectations of households in the model.[24] This also triggers a hysteresis effect in setting prices: the construction shock has a significant effect on the drop in prices after five years, even though the market tension has returned to the same level as in the counterfactual scenario.

(23) The down payment rate is the personal contribution of the buyer relative to the total value of the property without using any loans. The sum of the down payment rate and the loan-to-value ratio is equal to 100%.
(24) The sellers set their current pricing requirements based on the average of past changes in market prices in addition to other determining factors of the pricing requirements such as market tension.

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tresor-eco@dgtresor.gouv.fr

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