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Modelling of cycles in the residential real estate market

The residential real estate market, similarly to other markets, shows cyclical variations in prices and the number of constructed housing units. These changes are not random but driven by specific factors.

One of those factors, which distinguishes the housing market from other markets, is its different behaviour in the short run and long run. In the long run, demand is determined by fundamental factors and the supply side adjusts to the demand side. Supply adjustments take a long time and result from new construction or the depreciation of the housing stock. Demand shocks generate accelerator effects, because the current supply is only marginal as compared to the housing stock, while the demand shock concerns nearly the whole housing stock. Additionally, the financial system and consumer behaviour, including speculative behaviour, have a pro-cyclical effect. As supply substantially lags the price impulse and the supply elasticity generally exceeds the demand elasticity, there are short-term tendencies to generate lasting cycles. If additionally some factors accumulate, the cycles may turn into a real estate crisis.

Real estate market models are well described in the literature. One well known is the DiPasquale and Wheaton[10] model, yet it focuses on the housing market in the long run. Cycles in the real estate market and their occurrence are described by, among others, Wheaton[41], whereas the supply side is analysed by DiPasquale[11]. Further on, Hott and Jokipii[18] show that housing market bubbles are largely affected by the persistence of low interest rates. We present the related literature whenever it is appropriate in the remainder of the text.

Housing as a capital good generates housing services, which can directly meet the owner's needs, be the object of commercial activity or speculation. As a tangible fixed asset housing is subject to speculations based on expectations about its price growth in the future. According to Case and Shiller[8], during the last boom buyers in the US cherished too optimistic and unrealistic expectations about a further price growth. Yet, in historical terms, housing is also a consumer good which satisfies the owner's housing needs, provides housing security and additionally, ensures a relatively safe, long-term investment of savings. Thus, housing is not only the housing space but also an object, which is determined by the stream of utility that it generates. Housing space is one of its main features priced in the market and affecting the value of housing. It should also be added that housing is a heterogeneous good, not only from the point of view of the abovementioned functions it serves, but also in terms of its features, which are often differently evaluated in each of the analysed functions. Therefore, we adopt Rosen's[33] approach, defining housing as a heterogeneous good, whose

value is determined by the sum of the assessment of its features.

Already King[22], basing on Lancaster's[23] theory on heterogeneous goods, concluded that housing may be considered as a basket of goods generating a stream of services. In the case of housing, this stream depends mainly on its quality and location, which affects the consumers decision how much money should be spent on this basket. In order to find the analogy to the traditional consumer problem, we assume that the mortgage loan repayment is the price we pay for this stream of services. This is in line with Goodman[15], who presented an analysis of housing demand, accounting for the hedonic value of housing, which considers housing as a good that generates a stream of services. He also accounted for the relation of rents to housing value in consumer decisions.

In our study we consider housing primarily as an asset, generating a stream of services for the owner. We analyse the housing market from a macroeconomic perspective, basing our analysis on microeconomic foundations. Only an analysis which rests on correct, realistic assumptions, makes it possible to interpret the market processes and provide useful guidelines for the macroeconomic policy.

Despite housing heterogeneity, we can apply elements of the classical economic analysis that is used to analyse markets of homogenous goods (see Rosen[33], King[22] and Goodman[15]. The assumption that the hedonic function applies for example to the Polish housing market was confirmed by empirical studies by Tomczyk and Widłak[37]. This allows us to take the market value of each housing unit to the level of an average, one-size housing, characterized by its market value, which is the aggregate sum of the assessment of its features and the expectations of the seller or buyer. Under the implicit markets theory, a home buyer chooses not only between housing and other goods, but also between particular features of housing. Analysing the equilibrium from the microeconomic perspective, we have to deal with a multi-dimensional problem, which is reduced to the two-dimensional space in the macroeconomic analysis.

The value added of our article is a well-established demand model with sound microfoundations. Additionally, we present a simple model of housing market cycles which reflects the observed phenomena. We provide a detailed description of the relations between the primary and the secondary market and discuss how, via the multiplier and accelerator effects, even apparently minor demand shocks may generate strong cycles. We present a model that is applicable to many housing markets, and whenever useful, we give examples from the Polish housing market. Our analysis and detailed description of the mechanics of the market should help to improve existing macroeconomic models, i.e. make them more close to reality. This in turn will make their implications more useful for policymakers.

Microeconomic foundations of macroeconomic relationships used for the modelling of demand in the housing market

Models built on microeconomic foundations (see Heckman[16]) form the basis for a demand and supply analysis in the macroeconomic context, which allows economists to draw realistic, precise conclusions, which are an useful guide to monetary, fiscal and regulatory policies. The modelling of housing demand, which accounts for the shift from the microeconomic to the macroeconomic perspective, is presented, *inter alia*, by Westaway[40] and Pain and Westaway[30]. There is a debate going on whether structural models attempting to analyse all parts of the economy should be used, or whether the economy should be looked at from a bird's eye view, focusing only on those compo-

nents which are the object of the analysis (*reduced form model*). Heckman[16], summarizing the debate concludes that well developed, partial models should be used, which enable an in-depth analysis of the reaction of a part of the economy to particular shocks. We follow suit and present a simplified economy of the housing market, consisting of housing demand and supply. In the entire article we analyse the number of housing units, because the mismatch between housing units desired and housing units available in the market is the measure and determinant of tensions. Moreover, housing cycles are usually driven by the price of housing units and not that much by the increase of rents. For example Levin and Pryce[24] find that in England and Wales real rents between 1996 and 2007 increased by 9%, while at the same time the ratio of annual rent to the housing price fell from 6,4% to 3%. This basically means that the real housing price doubled and the price increase was much stronger than the increase in rents.

The classical micro- and macroeconomic analysis focuses usually on a representative consumer who spends some of its income on a consumer goods basket. When analysing housing consumption we adopt a similar approach, which is as follows. A single household takes a decision to purchase housing, which may be considered as a basket of goods and services (referred to as H) and spends a part of its income on it. The home purchase decision can be explained using a decision tree model, as proposed by Kim[21], where the home buyer's decision is affected subsequently by the price of housing, its location and other features. Limitations of the human brain's ability to process simultaneously a large set of information leads to taking of hierarchical decisions (Kahn, Moore and Glazer[20]). It should be further emphasised that the decision to purchase a particular dwelling is influenced by both the social standing of the surrounding dwellings and its quality (Phe and Wakely[31]). Moreover, the home purchase probability depends on the household's income (Carter[7]).

Housing demand

We present a simple micro-founded housing demand model in which a household has to allocate its income between housing consumption and consumption of other goods. An important and empirically justified assumption is that a household finances the home purchase through a mortgage. We assume that under fixed instalments, the annual cost borne by a household is the size of housing H times its price per square meter p, multiplied by the interest rate r, thus rpH. This cost plays a dominant role in the decision to buy housing. The household utility results from housing consumption H and consumption of other goods C and additionally, from the excepted wealth growth as measured by the housing appreciation. The utility function takes the form of the CES function, whereas the parameter θ is the weight that a consumer attaches to the consumption of other goods and the parameter μ is used to set the elasticity of housing substitution with other goods.

$$U(C,H) = (\theta C^{\mu} + (1-\theta)A^{\gamma}H^{\mu})^{\frac{1}{\mu}}$$

The substitution elasticity is calculated as $\epsilon = \frac{1}{1-\mu}$. Further on, the parameter γ determines how strong the future appreciation or depreciation of housing affects the consumer's decision. The appreciation is calculated as the ratio of the next year's expected price to the current price $A = \frac{p_{t+1}}{p_t}$. Housing appreciation was included in the utility function by, *inter alia*, Dunsky and Folla[12] and Sommervoll, Borgensen and Wennemo[35]. An expected price increase has a positive impact on the house purchase decision, whereas housing depreciation has an adverse effect. The consumer has to obey the following budget constraint:

$$b = rpH + C$$

Solving the household's problem with the Lagrange equation, we obtain the demand function for housing and other goods under a given income, interest rate and housing price.

$$C^* = \frac{b}{1 + rp\left(\frac{1-\theta}{\theta} rp \frac{1}{A^\gamma}\right)^{\frac{1}{\mu-1}}}$$

$$H^* = \frac{b}{rp + \left(\frac{1-\theta}{\theta} rpA^\gamma\right)^{\frac{1}{1-\mu}}}$$

Optimal housing choice with a kinked budget constraint

In the model presented above we assumed that a household may take out any loan, provided it meets its budget constraints. Yet, as due to prudential regulations banks impose certain restrictions on the borrower, the amount of available loan may be considerably reduced. This situation concerns practically all countries, in particular fast developing emerging economies where the housing stock is rather small with respect to income and there is a strong need for mortgage-financed homeownership. Given prudential regulations, a household may spend only a part of its income on the loan repayment: $b_H = kb \leq b, k \in (0,1)$. Thus the budget constraint is kinked and two cases of consumer decisions on housing expenditure should be considered:

$$H = \begin{cases} H^*, & rpH^* \leq kb \\ \frac{kb}{rp}, & rpH^* > kb \end{cases}$$

The kinked budget line has also an evident impact on the optimal demand for other goods, which takes the following form:

$$C = \begin{cases} C^*, & rpH^* \leq kb \\ (1-k)b, & rpH^* > kb \end{cases}$$

Provided the optimal point is unavailable due to lending restrictions, the household will have to adjust its consumption accordingly – it will consume less housing and more other goods than it would like to. This, in turn, leads to very strong demand shocks. Should interest rates fall considerably, the mortgage-financed loan availability would rise and boost housing demand.

The impact of the credit channel on the real estate market

The home purchase decision, if financed with a mortgage, is affected by interest rates, prudential regulations and the required down-payment. Already in the beginning of the 1970's Burnham[6] quotes the findings of the Fed's analysis, which demonstrated that mortgage supply is one of the most important, if not the key factor affecting home construction. This relationship still holds (see Aoki, Proudman and Vlieghe[4] and Levin and Pryce[24]) and we can assume that it will hold in the future, too.

Prudential regulations and quantitative limits routinely applied by banks as well as limits used additionally in the situation of growing risk reduce mortgage availability significantly. These factors lead to a kinked budget line and shift the equilibrium point, reducing housing consumption (Figure 1a). It should be noted that amidst strong housing needs (when the utility function is strongly inclined towards housing consumption) and banks' prudential restrictions preventing consumers from reaching their optimum, housing demand will rise along with loan availability (Figure 1b). With the normal budget constraint, rising income translates proportionally into housing demand (from A to A'). Yet, with a kinked budget constraint, the consumer has a suboptimal allocation of consumption and a rise in income leads to a nonlinear increase in loan availability and generates a demand shock. The consumer does not only spend

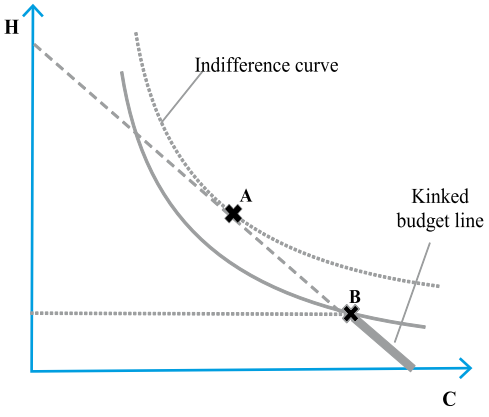
this additional income on housing, but moreover can give up some consumption of other goods to spend even more on housing (housing consumption moves from B to B'' instead only to B').

This phenomenon accounts for the fact that lending follows aggregate loan availability and mortgage-financed housing availability, a process observed for example for many years in the Polish housing market (see Łaszek, Augustyniak and Widłak[27] and NBP[32]). Households in Central and Eastern European countries easily substituted domestic loans bearing high interest with foreign currency denominated loans bearing a lower interest rate, however failing to account for the high FX risk (Brzoza-Brzezina, Chmielewski and Niedźwiedzińska[5]), which boosted housing demand. A rising demand brings mainly price effects as housing supply is rigid in the short-term. If along with rising home prices, banks ease their loan restrictions, housing demand may remain stable or even grow until it reaches the consumer's equilibrium point (the consumer will choose the allocation B' rather than B, Figure 1c).

The described relations concern buyers of new housing who will be affected by

Figure 1a **Loan amount and demand for housing amidst banks' prudential regulations**

Figure 1b **Consumer expansion path amidst banks' prudential restrictions**



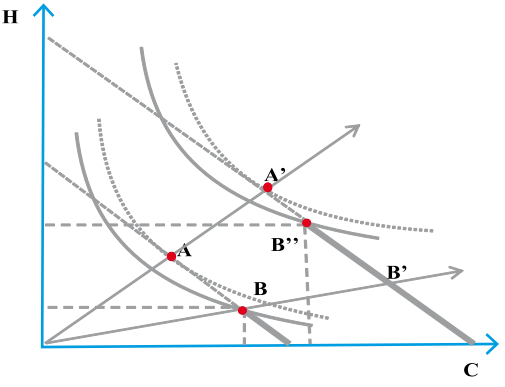
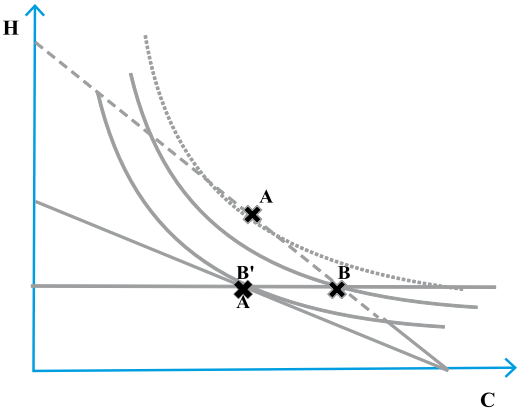
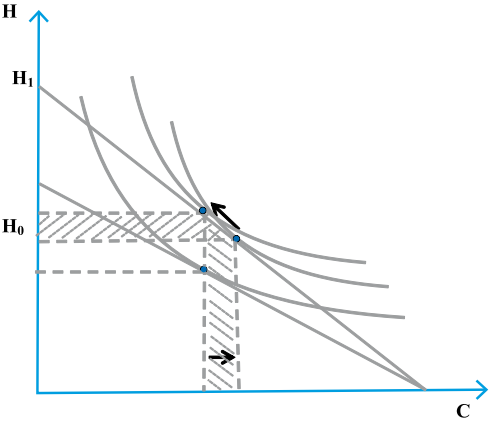


Figure 1c **Mortgage loans and housing demand amidst growing housing prices and easing of banks' prudential restrictions**

Figure 1d **Mortgage loans and housing demand amidst growing home prices and impact of the wealth effect**





home price increases through the rise in the amount of cash and lending necessary to finance housing. In the case of home owners, a further price growth should urge them, through the substitution effect, to attempt to capitalize on growth in value and replace their housing with a smaller, lower-priced housing. Consequently, a growing supply should improve the situation in the market. However, high transactions costs in this market and consumer habits are factors curbing this phenomenon. The home owner usually agrees to the change, if the additional profit or utility of new housing significantly exceeds the above mentioned costs.

Yet, even very high price increases do not always lead to massive home sales. A change in the value of housing means also a perceived change in the consumption of housing. Under such conditions the consumer will shift its preferences towards housing. Consequently, housing demand will be maintained at the current level (the home owner will not sell the higher-priced housing). The owner's preferences should change in such a way, that the substitution effect of the rising home price (reduction of housing consumption and boosting consumption of other goods) is offset with the income effect (income growth results in consumption of higher-priced housing, Figure 1d). In Poland for example, the boom period brought a rise in the volume of transactions in the secondary market, thus we may have observed both types of behaviour in the market.

Moving from individual demand to aggregate demand

The next step in our analysis is to move from decisions taken by a single household to the whole population of prospective home buyers and the number of housing units actually sold. The household's decision to purchase a particular housing unit, in a particular location may be treated as a discrete decision (see Anas[1, 2]). We assume that one household can buy a large dwelling, another one a small one, and another one will not decide to purchase housing at all or will buy more than one housing unit. As there are many prospective buyers we can use the law of large numbers to move from the individual purchase probabilities to proportions in the whole population. Each household is assigned a vector of purchase probability of housing at a given price, by which we get the average home purchase probability of the whole population. Multiplying the housing demand of an individual household H_t^* by the number of households in the economy N and dividing this value by the size of an average housing unit in square meters $\overline{H_t}$, we obtain the aggregate demand for the number of housing units: $D_t = H_t^* N_t / \overline{H_t}$.

The supply side and price adjustments

After having examined the demand side, we analyse the supply and price reactions to demand changes. The stock S_t of housing units consists of the depreciated stock from the previous period (d is the depreciation rate), which is restored through new housing construction I_t (Sommervoll, Borgensen and Wennemo[35]):

$$S_t = S_{t-1}(1 - d) + I_t$$

In the long-run equilibrium, the production of new housing units equals their depreciation, thus the housing stock remains constant. This is a simplifying assumption, which does not take population growth into account, under which the housing stock has to grow in equilibrium. Moreover, the stock S_t equals demand for housing D_t in the long run. If, on the other hand, for reasons mentioned above, demand for housing increases to exceed housing supply, prices start to rise. The price adjustment, which results from

the demand and supply mismatch, can be described by the following formula (see Tse, Ho and Ganesan[38]):

$$\Delta P_t = \rho\left(\frac{D_t - S_t}{S_t}\right),$$

where the parameter ρ determines the price response elasticity to the mismatch (it may be asymmetrical downwards and upwards). As a result of the price growth, real estate developers increase the housing production. A very important fact for the price adjustment is that the demand shock concerns a large part of the whole housing stock, while new housing production concerns its marginal part only. The relationship between new housing construction and the housing stock may be denoted as $f=I_t/S_t$, a parameter which usually has a value of several percentage points. The inverse of this parameter, which we call the fundamental multiplier, causes that even a minor change in housing stock demand generates a shock to the demand for new housing production. This results in a huge jump in prices and urges developers to increase production.

Real estate developers often extrapolate the historical price increase, assuming that if prices are on the rise this year they will also increase in the future. Their production function depends on the previously observed rises in prices and surges in production costs. A more detailed analysis of the developer's construction process and its financing can be found in Augustyniak *et al.*[3], here we make the construction process and related decisions as simple as possible. The real estate developer in Poland usually puts a pre-sale contract on sale when the construction process has been started, and the completion of the real estate is scheduled in approximately two years. At times of very high demand and strong price increases, even contracts for newly commenced investment projects, the so-called holes in the ground get sold. We modify the housing production function proposed by Tse, Ho and Ganesan[38], adjusting it to empirical observations. The real estate developer's production consists of its autonomous production and production that depends on the lagged price change Δp_t and lagged changes in construction costs ΔC_t:

$$I_t = \alpha_0 + \alpha_1 \Delta p_{t-2} + \alpha_2 \Delta p_{t-1} - \alpha_3 \Delta C_{t-2}$$

Substituting the number of housing units newly built by developers into the previously discussed housing stock equation, we obtain the motion of the housing stock:

$$S_t = S_0 + \alpha_1 \Delta p_{t-2} + \alpha_2 \Delta p_{t-1} - \alpha_3 \Delta C_{t-2}$$

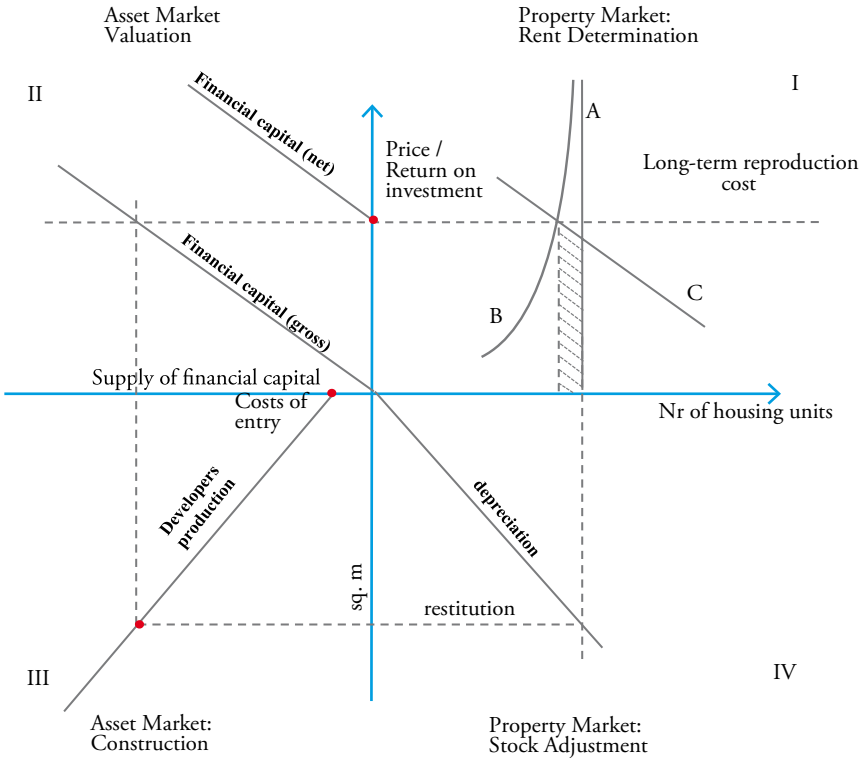
We use this simple model to explain the occurrence of cycles in the housing market in the next section.

Introduction to the modelling of housing market cycles

Basing on the previously presented microeconomic foundations of the demand and supply side behaviour, we now present the interactions at the macroeconomic scale. We first sketch the fundamentals of the housing market and then show how to move from a long run equilibrium housing model to one that is able to explain cycles in the short and medium term.

In the case of residential real estate the creation of supply in the short term is generally very limited and any changes in demand translate into demand for new construction. It should be mentioned that when discussing supply adjustments, namely adjustments of the size of the housing stock, given the relatively small annual stock increases (1-3%), we mean a perspective of several years or even decades and a similar length of supply cycles. As demand is cyclical and volatile, supply does not match demand. Yet, there have been cases when, especially with the government's intervention, long-term economic growth has been accompanied by

Figure 2 **The OOH market model, which bases on the DiPasquale-Wheaton (1992) model**



a large, long-run supply of new housing investment projects. Taking the considerably high volatility of demand into consideration, it may be concluded that the market will only seek to reach the equilibrium, usually failing to achieve it. Downward adjustments are much more difficult as they result from stock depreciation, which is usually inferior to the size of new construction. In the case of major structural mismatches, the downward adjustment may take a long time.

Basic models of the real estate market base on the DiPasquale and Wheaton[10] model (DPW, hereafter) and usually deal with real estate for rental. However, the DPW model and its adaptations constitute equilibrium models in the housing space market rather than short-term speculation and imbalance models in the market for housing units. In order to analyse the disequilibrium in the market, we propose a housing model, which is focused on owner occupied housing units and a short period of time.

The owner occupied housing model

When analysing short- and medium-run housing cycles, we need to focus on owner occupied housing units. The household's need to buy a dwelling can be only satisfied with a dwelling from the existing stock or a newly constructed dwelling. While adjustments in the rental market are relatively smoother and faster, rising demand for owner occupied housing leads very quickly to price surges, construction booms and housing cycles.

The DPW model can be relatively easily augmented from the rental model to the owner occupied housing model (OOH), which we propose and explain in more detail. It is enough to apply the imputed rent instead of the usual rent. Although the DPW model did not account for the credit channel, it can be easily im-

plemented. The capital market provides capital to households that is transformed into housing, and further on, through the interest rate, it transforms the cost of housing into a stream of payments borne by the home owner.

The starting point for our model is the fact, that the housing market is in disequilibrium and the equilibrium state is more an exception rather than a rule. This is the result of a quite inelastic short-term housing supply which becomes flexible with a time lag, the volatile demand, its relationship with the financial market and finally, speculations. First, we present the long-run behaviour of the market and subsequently explain how it changes as the time period becomes shorter.

Our OOH model bases on the DPW model and, as an equilibrium model, it focuses on the long-term perspective. Its four parts can be illustrated with a system of coordinates presented in Figure 2. The first quarter is the housing market, represented by the housing units stock that is used to generate a stream of utility. The second quarter is the market of financial capital which flows to the housing sector if the rate of return is sufficiently high. The gross capital inflow is used for the replacement of depreciated housing stock, whereas the net capital flow adds new housing units to the stock. The third quarter is the real estate development and construction market which transforms financial capital into real capital, i.e. housing. The fourth quarter represents the stock depreciation and reconstruction, finally affecting the stock level in the first quarter.

The real capital market, i.e. the housing units market, is in its long-term equilibrium when the current, commercial and available supply intersects its alternative uses, setting the price per unit of capital, its rental cost and the number of vacancies at such a level, that the related real estate development production offsets the stock depreciation. In this situation, enterprises are no longer motivated to enter the real estate development sector. However, in the short run a demand shock boosts prices as supply is almost rigid. The price growth leads, through the financial market, to a lagged supply growth.

In the subsequent part we explain the supply in the primary and secondary market at various time horizons, which helps us to explain the occurrence of cycles in the OOH market.

Supply in the primary and secondary market in relation to time

In the short term, the supply in the primary market consists of still unsold newly constructed housing units and a relatively inelastic new construction that was planned in the past. In the medium term, the supply of housing units will increase, as developers may plan in advance larger production volumes. In the long term, new capital may flow into the construction sector, boosting its production capacity and setting costs at the average cost level. The housing supply gets flexible with time, provided that new housing construction offsets depreciation, namely if prices offset long-run production costs. The longer the period, the larger becomes the aggregate supply of new housing stock and the higher is its elasticity, thus the supply curve is getting flatter and flatter. In the very long period housing supply will get flexible through the aggregation of annual construction effects. The entire economy will undergo structural adjustments aimed to match housing supply with the sector's needs. The market will trigger mechanisms that will offset the supply and demand mismatch in the local markets through new construction and housing stock depreciation. As annual supply changes represent insignificant percentage points of the housing stock, whereas demand changes are considerably

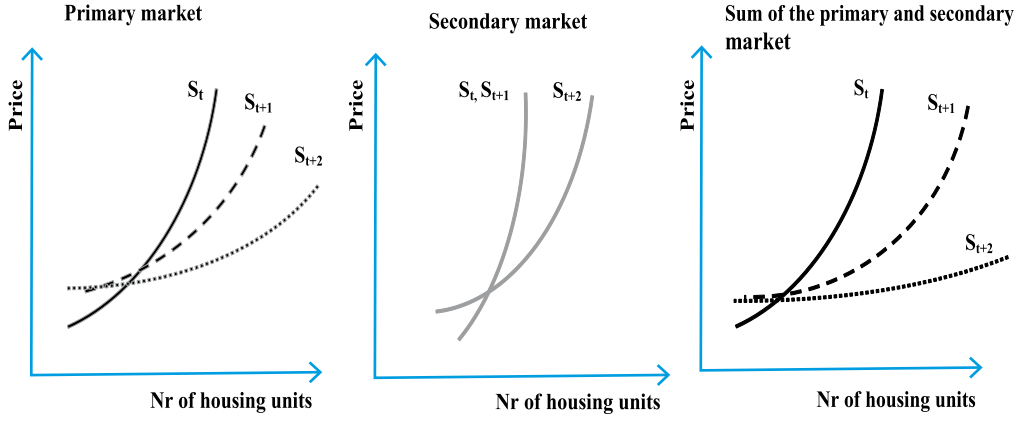
larger, these adjustments may take decades and are generally unlikely to result in an equilibrium. To a certain extent, we also have to do with adjustments through the competition of local submarkets attempting to solicit investors and attract demand. As a result, local submarkets in terms of new supply and current changes in demand will always be somewhat unbalanced.

The supply in the secondary housing units market is rather inelastic in the short term, however it may be increased as a result of growing real estate prices. Growing housing prices should urge households to change their existing dwelling into a smaller one or hasten their decision to sell the dwelling, should the substitution effect outweigh the income effect. Yet, transaction costs or the fact of housing being considered a consumer good will be strong enough to finally put an end to this trend, as empirical evidence shows. Supply will get flexible in the long run only through changes in the use of housing units, large-scale migration as well as owners' deaths.

The total housing supply is the sum of supply of new constructed housing, presale development contracts and supply from the secondary market. The supply in the primary, secondary and the total market in the short term (t), medium term (t+1) and long term (t+2) is shown in Figure 3. The longer the time period, the more flexible will be total housing supply.

Due to the non-arbitrage condition between the primary and secondary housing market, dwellings of similar quality and technical conditions should be priced similarly. Yet, the non-arbitrage condition is usually disturbed by fiscal policy (taxes, subsidies) and regulations. In addition, housing offered in the primary and secondary market generally differs in terms of dwelling characteristics and ownership status. Also, developers are more price flexible than sellers in the secondary market, and can often encourage homebuyers to purchase homes above their market value. However, in case of oversupply, developers are willing to sell dwellings below secondary market prices, if they sold previously enough housing units at higher prices. Due to the imperfect non-arbitrage condition, the primary market price in most local markets in Poland is usually slightly higher than the equilibrium price, and the secondary market price is a little bit lower (see NBP[32]). This results from real estate developer's marketing opportunities to convince the client of the higher value of a particular dwelling. The empiri-

Figure 3 **Supply of housing in the short term t, medium term t+1 and long term t+2 in the OOH market**



cal analysis of transaction prices in 17 regional cities in Poland indicates moreover, that the price impulse comes from the secondary market and affects the primary market subsequently (see Leszczyński and Olszewski[25]).

A simple model of the housing cycle and policy implications

Basing on the previously described behaviour of households and developers in the residential real estate market, we analyse a demand shock driven housing cycle. Similarly to business cycles, housing cycles are driven by exogenous shocks. Due to the specific character of the residential real estate market its cycles are inevitable.

The major housing cycles generators are multipliers, which cause that even minor changes in certain macroeconomic factors result in strong fluctuations in the whole housing market. We should remember that the growth in demand concerns nearly the entire housing stock whereas the primary market supply is a mere fraction of the whole stock. Therefore, any demand shocks translate through the fundamental multiplier, presented in section 2.5, in even stronger supply shocks. Under the assumption of a rigid short-term supply, this multiplier is defined as the ratio of current demand for housing from the primary market to its current supply. On average and in annual terms, the supply from the primary market has a size of 1% of the whole housing stock and satisfies demand for new housing, as well as it replaces the depreciated housing stock. Around 2% of the housing stock are traded in the secondary market, thus if there are no demand shocks driven by growing income, migration or changes in the interest rate, around 3% of the housing stock are traded and the aggregate demand for housing is satisfied.

Let us now suppose that the economy is accelerating. As shown by numerous studies, with a low level of GDP *per capita* and, consequently, a low level of housing needs satisfaction, the income elasticity of demand for housing may approach 1 (see Lin and Lin[26]). With a 5-6% GDP growth, which corresponds to a 4-5% income growth, the aggregate demand for housing is likely to increase from 3% to 5% of the whole stock in year-on-year terms. As only around 2% can be satisfied from the secondary market, another 3% need to be delivered from the primary market. However, as the primary market constructed on average housing units that account for 1% of the stock, their production should triple, which is basically impossible in the short run. As supply is inflexible, prices go up quickly and can even double. Consequently, real estate developers embark on long-term investment projects, consumers strive for a better place in the waiting list for housing and pre-sale construction contracts and rights thereto are traded. To speed up the contract realization, developers start to purchase ready-made projects from competitors, thus trigger a boom in the sector.

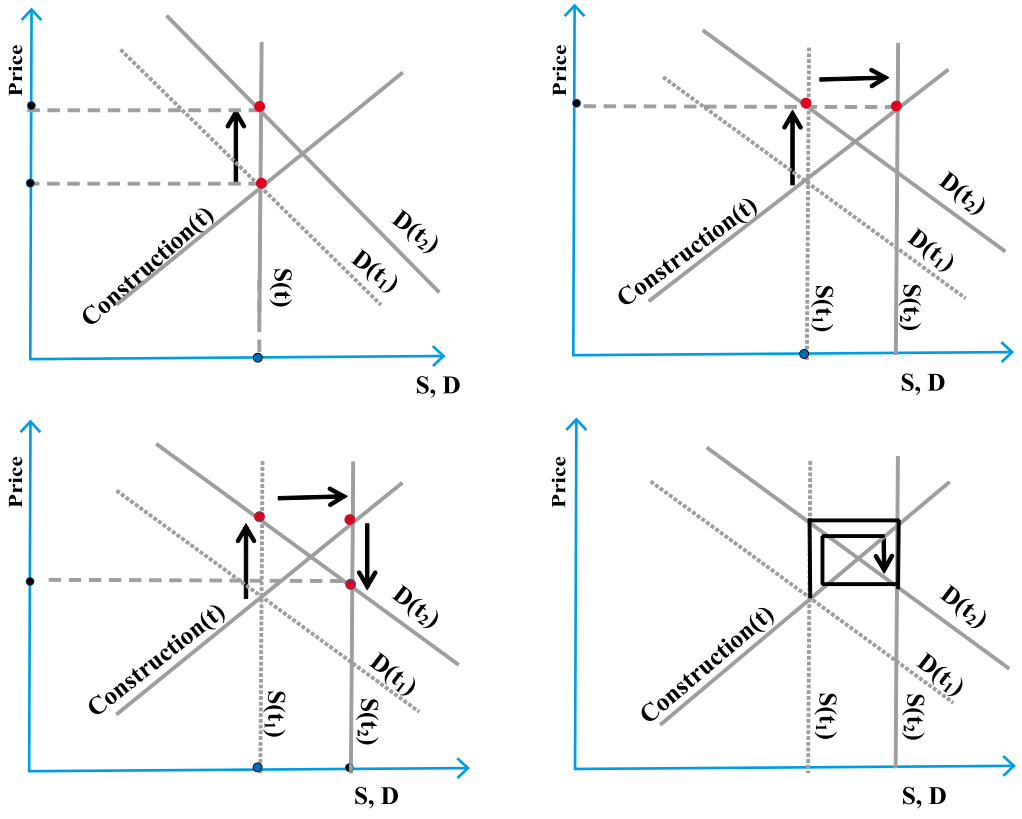
A demand shock can be also triggered by the reduction of interest rates. Even a small reduction of interest rates, as discussed earlier, leads to strong increases in loan availability and boosts demand for housing. A significant share of households, who previously were not able to afford housing but had a strong need to buy it, will now be able to buy it. Moreover, falling interest rates will boost capital flows from bank accounts to the owner occupied housing sector. We think that this effect has not yet been adequately accounted for in the central bank's monetary policy, yet its impact may be significant. We explain the effect of the accelerating impact of an interest rate reduction on housing demand growth, and the real estate development market with the following example. To achieve the objective of stimulating economic growth, the central bank cuts its interest rates over a

given period by 2 percentage points, i.e. from 4% to 2%. This effect translates not only into the aggregate demand in the economy, but also causes a nearly two-fold increase in the availability of mortgage loans, which, amidst given income also doubles the demand for the housing stock. Consequently, home prices will double and speculative price bubbles start to emerge in the market. The discussed example may be extended to include GDP growth-induced migration, or an additional shock caused by a marriage boom.

These phenomena show that in countries with a low level of development and strong housing needs, loan availability and availability of mortgage-financed housing can be a good measure of demand. Moreover, the previously discussed accelerator effects explain the occurrence of cycles, even without speculation or migrations and changes in demographic factors.

Once the housing market is put out of equilibrium, it replicates, and often deepens its cycles through a short-term rigid supply and flexible demand. The mechanism, presented in Figure 4, is as follows. A demand shock leads first to a price growth, as supply is fixed at $S(t_1)$. This in turn makes developers increase their production, but the result will be visible with a lag, and few years later the supply increases to $S(t_2)$. However, at some point the excess supply makes prices go down and the developers decrease their new production and the cycle continues. If the demand would be stable, the construction sector would slowly converge towards the equilibrium that lies somewhere between $S(t_1)$ and $S(t_2)$. But the pro-cyclical behaviour of market participants like speculations and often also public factors (like economic and supervisory policy) make the demand shift and are significantly destabilizing factors. Therefore, the equilibrium will change over time and the market will only converge towards it. The cycle mechanism is determined by the

Figure 4 **A simple model of the cycle**



shape of the demand and supply curves, in particular by the angle between them, which makes fluctuations more expansive or gradually dampened.

A similar mechanism of nonlinear interactions, yet this time negatively affecting business conditions in the sector, will be observed amidst a downward price rigidity that is commonly observed in this market. Should prices stiffen at a level ensuring that real estate developers generate decent financial results, they will embark on new investments and build housing on stock, waiting for better times to come. Due to a large margin they will be able to reduce the price and sell the supply surplus at a profitable price. Considerable possibilities of financing the unsold housing stock at high margins constitute factors favouring such practices. For example, if their rate of return on equity stands at around 20%, which is not an extraordinary result in this industry (see NBP[32]), real estate developers may finance with current housing sales a three-year stock of unsold housing and even more unfinished housing units (pre-sale construction contracts). However, in reality, amidst a relatively low price elasticity of demand at high prices, the possibility of price reductions and a profitable sale of the housing surplus are limited. The cumulating unsold housing stock adds to the developer's risk. In the subsequent period, price declines may be abrupt and construction may collapse. The supply elasticity may also change, modifying the size of construction in response to the price shock.

This model shows that even relatively minor changes in fundamental factors trigger demand shocks. Those, in turn, first generate oversupply and then trigger downward adjustments, which consequently leads to strong cycles. Additional disturbances in the market may be seen in the form of speculative behaviour as well as the impact of regulatory factors. Those additional factors affect the shape of the cycle, providing it with a stochastic character actually observed in the housing market.

In theory, housing cycles could be avoided should companies conduct market research and were able, in reliance thereon, to determine the equilibrium supply and synchronize their supply. Yet, basing on practical knowledge on the real estate market this task may be considered as infeasible. The basic difficulty is a 2-4 years long time lag between the investment start and its effects, in which the equilibrium conditions change. Another problem is the fact, that it is practically impossible to coordinate the production in a free and competitive market; what is more, such actions could be viewed as cartel practices.

The only way to smooth the housing market cycle is to smooth demand. This can be done either with prudential regulations that curb the loan availability or with fiscal policies which, through higher taxes or lower subsidies, make housing less affordable. Another stabilizing factor are housing policies which help to satisfy the need for housing. For example a well-functioning rental market will make households less willing to buy owner occupied housing, thus it will smooth demand shocks.

Conclusions

Cycles are a permanent feature of the residential real estate market. Although they are inevitable, a well-matched demand steering policy can smooth them. The investigation of housing market cycles must be based on the analysis of the number of housing units, as it is the mismatch between the number of desired and affordable housing units in the short term that boosts prices and, consequently triggers cycles.

Our analysis of the impact of interest rates or income growth on demand

shocks confirms, that macroeconomic housing models must rely on sound microeconomic foundations. Minor changes in interest rates, which at the macroeconomic level appear insignificant, on the account of their strong influence at the microeconomic level, translate into housing market shocks being felt throughout the entire economy. Those shocks, depending on the elasticity of supply and demand, can either fade away or explode. The only way to smooth housing cycles is to smooth housing demand, which in turn will enable the supply side to adjust slowly and the housing market can then converge towards an equilibrium.

References:

1. Anas A., *Residential Location Markets and Urban Transportation*, Academic Press, New York, 1982.
2. Anas A., *Taste Heterogeneity and Urban Spatial Structure: The Logit Model and Monocentric Theory Reconciled,* "Journal of Urban Economics", 1990, 28(3), pp. 318-335.
3. Augustyniak H., Gajewski K., Łaszek J., Żochowski G., *Real estate development enterprises in the Polish market and issues related to its analysis*, [in:] *Report on the situation in the Polish residential and commercial real estate market in 2011*, National Bank of Poland, Warsaw 2012.
4. Aoki K., Proudman J., Vlieghe G., *House prices, consumption, and monetary policy: a financial accelerator approach,* Bank of England Working Paper, No. 169, 2002.
5. Brzoza-Brzezina M., Chmielewski T., Niedźwiedzińska J., *Substitution between domestic and foreign currency loans in Central Europe: do central banks matter?,* ECB Working Paper, No. 1187, 2010.
6. Burnham J.B., *Private Financial Institutions and the Residential Mortgage Cycle, with Particular Reference to the Savings and Loan Industry*, [in:] *Board of Governors of the Federal Reserve System, Ways To Moderate Fluctuations in Housing Construction,* Central Bank of Ireland, 1972.
7. Carter S., *Housing Tenure Choice and the Dual Income Household,* "Journal of Housing Economics", 2011, 20(3), pp. 159-170.
8. Case K.E., Shiller R.J., *Is There a Bubble in the Housing Market?,* "Brookings Papers on Economic Activity", 2003, 34(2), pp. 299-362.
9. Chang C.-O., Ward C.W.R., *Forward pricing and the housing market: the pre-sales housing system in Taiwan*, "Journal of Property", 1993, No. 10, pp. 217-227.
10. DiPasquale D., Wheaton W.C., *The Markets for Real Estate Assets and Space: A Conceptual Framework*, "Journal of the American Real Estate and Urban Economics Association", 1992, No. 20(1), pp. 181-197.
11. DiPasquale D., *Why Don't We Know More About Housing Supply?,* "The Journal of Real Estate Finance and Economics", 1999, No. 1, pp. 9-23.
12. Dunsky R.M., Folla J.R., *The demand for mortgage debt and the income tax,* "Journal of Housing Research", 1997, No. 8, pp. 155-199.
13. Fotheringham A.S., *Consumer Store Choice and Choice Set Definition*, "Marketing Science", 1988, 7(3), pp. 299-310.
14. Glaeser E.L., Gyourko J., *Arbitrage in Housing Markets*, NBER Working Papers, 2007, 13704.
15. Goodman A.C., *An Econometric Model of Housing Price, Permanent Income, Tenure Choice and Housing Demand,* "Journal of Urban Economics", 1988, No. 23, pp. 327-353.
16. Heckman J., *Building Bridges between Structural and Program Evaluation Approaches to Evaluating Policy,* "Journal of Economic Literature", 2010, No. 48(2), pp. 356–398.
17. Hott C., *The influence of herding behaviour on house prices,* "Journal of European Real Estate Research", 2012, No. 5(3), 177-198.

18. Hott C., Jokipii T., *Housing Bubbles and Interest Rates*, Swiss National Bank Working Papers, 2012, No. 07.
19. Jaffee D.M., Rosen K.T., *Mortgage Credit Availability and Residential Construction,* Brookings Papers on Economic Activity, 2012, No. 10(2), pp. 333-386.
20. Kahn B., Moore W.L, Glazer R., *Experiments in Constrained Choice*, "Journal of Consumer Research", 1987, No. 14(1), pp. 96-113.
21. Kim M.-J., *Residential Location Decisions: Heterogeneity and the Trade-off between Location and Housing Quality,* PhD dissertation at The Ohio State University, 2010.
22. King A.T., *The Demand for Housing: Integrating the Roles of Journey-to-Work, Neighborhood Quality, and Prices,* NBER Books, 1976, Chapter 3968.
23. Lancaster K.J., *A new approach to Consumer Theory*, "Journal of Political Economy", 1966, No. 74(2), pp. 132-157.
24. Levin E.J., Pryce G., *What Determines the Responsiveness of Housing Supply? The Role of Real Interest Rates and Cyclical Asymmetries,* "Housing Studies", 2009, No. 24(6), pp. 713-736.
25. Leszczyński R., Olszewski K., *Panel analysis of home prices in the primary and secondary market in 17 regional cities in Poland*, Narodowy Bank Polski, Working Paper, 2014.
26. Lin C., Lin S., *An Estimation of Elasticities of Consumption Demand and Investment Demand for Owner-Occupied Housing in Taiwan: A Two-Period Model*, "International Real Estate Review", 1999, No. 2(1), pp. 110-125.
27. Łaszek J., Augustyniak H., Widłak M., *Euro a ryzyko bąbli na rynku nieruchomości mieszkaniowych*, Materiały i Studia, NBP, 2009, Nr 218.
28. Oikarinen E., *Empirical application of the housing-market no-arbitrage condition: problems, solutions and a Finnish case study*, "Nordic Journal of Surveying and Real Estate Research", 2008, No. 7(2), pp. 7-33.
29. Ortola-Magne F., Rady S., *Housing Market Dynamics: On the Contribution of Income Shocks and Credit Constraints*, "Review of Economic Studies", 2006, No. 73, pp. 459-485.
30. Pain N., Westaway P.F., *Modelling structural change in the UK housing market: A comparison of alternative house price models,* "Economic Modelling", 1997, No. 14, pp. 587-610.
31. Phe H.H., Wakely P., *Status, Quality and the Other Trade-off: Towards a New Theory of Urban Residential Location*, "Urban Studies", 2000, No. 37(1), pp. 7-35.
32. *Report on the residential and commercial real estate market in Poland in 2011*, Narodowy Bank Polski, Warszawa 2012.
33. Rosen S., *Hedonic prices and implicit markets: product differentiation in pure competition*, "Journal of Political Economy", 1974, No. 82(1), pp. 34-55.
34. Rubaszek M., *Mortgage down-payment and welfare in a life-cycle model*, "Bank and Credit", 2012, No. 43(4), pp. 5-28.
35. Sommervoll D.E., Borgensen T.-A., Wennemo T., *Endogenous housing market cycles,* "Journal of Banking & Finance", 2010, No. 34, pp. 557-567.
36. Stein J., *Prices and trading volume in the housing market: a model with downpayment constraints*, 1995, "Quarterly Journal of Economics", No. 110(2), pp. 379-406.
37. Tomczyk E., Widłak M., *Konstrukcja i własności hedonicznego indeksu cen mieszkań dla Warszawy,* „Bank and Credit", 2010, No. 41(1), 99-128.
38. Tse R.Y.C., Ho C.W., Ganesan S., *Matching housing supply and demand: an empirical study of Hong Kong's market,* "Construction Management and Economics", 1999, No. 17, pp. 625-633.
39. Waldron M., Zampolli F., *Household debt, house prices and consumption in the United Kingdom: a quantitative theoretical analysis*, Bank of England Working Paper, No. 379, 2010.
40. Westaway P.F., *A simulation model of consumer spending and housing demand*, NIESR Discussion Paper, No. 15, 1992.
41. Wheaton W.C., *Real Estate "Cycles": Some Fundamentals,* "Real Estate Economics", 1999, No. 27(2), pp. 209-230.

This paper presents the personal opinions of the authors and does not necessarily reflect the official position of the National Bank of Poland or the Warsaw School of Economics.

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