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TRANSITION AND INTEGRATION EFFECTS IN THE BALTIC HOUSING MARKETS: THE DIPASQUALE-WHEATON APPROACH

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Abstract. This paper analyses housing market developments in the Baltic States using a price-rent (PR) adjusted version of the DiPasquale-Wheaton (DPW) model as a frame of reference. Relating housing markets in Estonia, Latvia and Lithuania to the boom, the bust and the recovery after the financial crisis in 2007/2008, the paper discusses the interrelations between the different parts of the housing market system. Transition involves structural shifts, and the links between rental housing, owner-occupied housing and the housing construction industry might differ in the Baltics compared to mature economies, differences originating especially on the supply side of housing markets. As the Baltics are integrating their economies with the EU, housing markets may also be affected by the integration process, a process that includes factors both on the financial side and on the real side of the economy.

Keywords: *Baltic States, housing prices, transition, economic integration, DiPasquale-Wheaton.*

INTRODUCTION

In transition economies housing markets may carry somewhat different characteristics than in mature economies.[1] While macroeconomic developments and the availability of mortgage financing are key housing market drivers also in transition economies, the mixing of cyclical and structural factors set these countries apart. Cyclical factors are either shared (symmetric), or they are asymmetrically going their own country-specific way – albeit with a cost. Structural factors are key factors in the transition process and are typically not to be found in similar strength in mature economies, adding complexity to housing market analysis in transition economies.

In the Baltic states, housing markets are also affected by economic integration as the region ties closer links with the EU. While taking advantage of the increased opportunities from integration, both financially and in terms of improved market

[1] For housing markets in general see Agnello & Schuknecht (2011) or Goodhart & Hoffman (2008).

access internationally, in the years before the sub-prime crisis, the Baltics were violently hit during the crisis, and the region's boom-bust cycle showed amplitudes not seen in other countries (Staehr, 2013). The Baltic states, like others in Central and Eastern Europe (CEE), found themselves in a situation of simultaneously managing transition,[2] integration[3] and a dangerous financial crisis that led to a deep recession. It is the simultaneity of transition and integration effects, shared with CEE economies, that sets these countries apart from, for example, Central Asian economies. While Central Asian economies have a transition effect due to a shared Soviet history, they typically lack the integration effect.[4] It is the interplay of the two effects that provides the backdrop for this article while both the high rate of economic growth before the crisis, the boom-bust cycle and the period after the crisis have shaped Baltic housing markets.

This article aims to contribute to the literature in the following way: with the help of an adaptation[5] of the DiPasquale-Wheaton (DPW) model, we provide a frame of reference for housing market development in the Baltic states in the period between 2006 and 2023. The aim of the paper is partly pedagogical, providing a stylised frame of reference for future extensions. We focus, in a novel way, on the supply side effect of transition and, in particular, on the role of depreciation of the housing stock. In addition, we sketch the effects of economic integration, including both the effect of high rates of economic growth and a boom-bust scenario – using the reasoning of Borgersen & Emblem (2022, 2023). We relate transition to the structural shifts residing on the supply side of an economy, in our framework, the supply side of the housing market, and in part also to the higher economic growth such supply side shocks may produce. Integration is related to closer links to international financial markets, which in our framework means being exposed to the global financial boom-bust cycle surrounding the US subprime crisis.

Our focus is on the direct and indirect effects of different types of shocks to the Baltic housing market stemming from either the transition process or the implications of economic integration. We focus on how these processes influence the housing market as given by the PR ratio (Price-to-Rent ratio). We rely on shocks originating in the real side of the economy, the financial side, and in the housing market itself. When analysing the effect of internal housing market features, we focus on a particular feature of the transition process that has its origin in the shared history of having been part of the Soviet Union: an old housing stock in a dire state of disrepair. This means that the supply side figures prominently. Depreciation takes on a special role for key housing market indicators, here exemplified by the PR ratio.

[2] Transition from a centrally directed system to a decentralized market economy.

[3] Integration into the European Union and NATO.

[4] The opponents of joining the European Union in Latvia were heard saying: "We just successfully escaped one economic union. Now you want us to immediately join another one?" The Eurasian Economic Union does not include many countries and operates on a significantly lower level of intensity than the European Union. See, for example, Chatham House 2022 or GIS 2021.

[5] The adaptation refers to Borgersen & Emblem (2022, 2023) which extends the original focus on the commercial real estate market to the housing market.

The DPW model illustrates how the PR ratio may first rise and then fall during a boom-bust cycle, while a higher rate of economic growth lifts both house prices and rent producing by itself an ambiguous effect on the PR ratio. When considering a higher rate of depreciation, the model predicts a reduction in the short-run PR ratio, while the long-run effect on the PR ratio is ambiguous, related to, amongst other factors, the degree of competition in rental markets. The speed at which such shocks are transmitted across the housing market system and the strength of the corresponding direct and indirect effects are important for the housing market cycle and how the PR ratio evolves during the transition process.

The paper is structured as follows. Section 1 reflects briefly on the macroeconomic development and the financial situation in the Baltics over the period 2000–2019, focusing on characteristics important for housing markets and presenting, in graphical form, housing market statistics. The third section presents the DPW model. The fourth section discusses macroeconomic developments, financial sector developments and internal housing market issues impacting housing supply across the Baltics using the DPW framework. The last section concludes after discussing some transition aspects not captured by the DPW model analysis.

1. HOUSING, BANKING, AND MACROECONOMICS IN THE BALTICS

Gaining independence from the Soviet Union in 1991, the Baltic states experienced a period of high economic growth throughout the 1990s, only set back by the Russian economic crisis in 1998.[6] During the eight years from 1998, the Baltics averaged economic growth rates of about 8 percent (Staehr, 2013) and earned the name “the Baltic Tigers”. High rates of growth were accompanied by societal changes, and both consumption and investments increased significantly, fuelled by loose credit supply and low interest rates (see also Martin (2010) for a discussion). Naturally, the housing market was affected by higher household income, low interest rates and a changing housing consumption structure.

Favourable international financing conditions allowed the Baltics, especially Latvia, to run significant current account deficits in the years leading up to the crisis. The international savings glut and the entry of the Nordic banks into the Baltic states contributed to the supply side, while increased optimism in households on future income increased the demand for credit. Higher economic growth and increased household income had a positive impact on the demand for housing both by itself and also as the availability of credit rose.[7]

[6] The first years after independence were tough for the Baltics, entering a transformational recession (see, e.g., Balcerovicz (2002)).

[7] At the same time there were local conditions that tended to work against a credit expansion. Particularly in the case of Latvia, the habit persists (even among respectable employers) that officially, and visibly, the minimum wage is paid, which is topped up (invisibly) by ‘money in an envelope’. While this leads to paying a low amount of taxes (the principal reason for this arrangement), it makes bankers say that the income flow is not sufficient to support mortgage payments. This normally restricts access to mortgage financed housing unless a ‘workaround’ is found (See OECD Economic Surveys Latvia, May 2019).

The Baltic states were, therefore, in a vulnerable position when the international financial crisis erupted in 2008. During the build-up of the crisis, there were shortcomings in the macroeconomic policies and in the policy mix, as well as in financial supervision (Grønn & Fredholm, 2013). Credit growth and capital inflows (as a share of GDP) to the Baltics exceeded those to most other Central Eastern European (CEE) countries and, reflecting the role of parent bank funding, led to a sharp rise in loan-to-deposit ratios (Purfield & Rosenberg, 2010). Another important characteristic of Baltic banking was that many of these banks were exposed to a large share of unhedged borrowers, with income in domestic currency and loans in foreign currency (Grønn & Fredholm, 2013).[8]

The crisis hit the Latvian housing market especially hard, but house prices fell significantly across the Baltics both in nominal and in real terms.[9] Figure 1 shows the severity of the Baltic house price cycle. After some years of sluggish house price growth, in part due to the credit-less recovery, house price growth picked up in 2015/2016 in all the Baltic states.

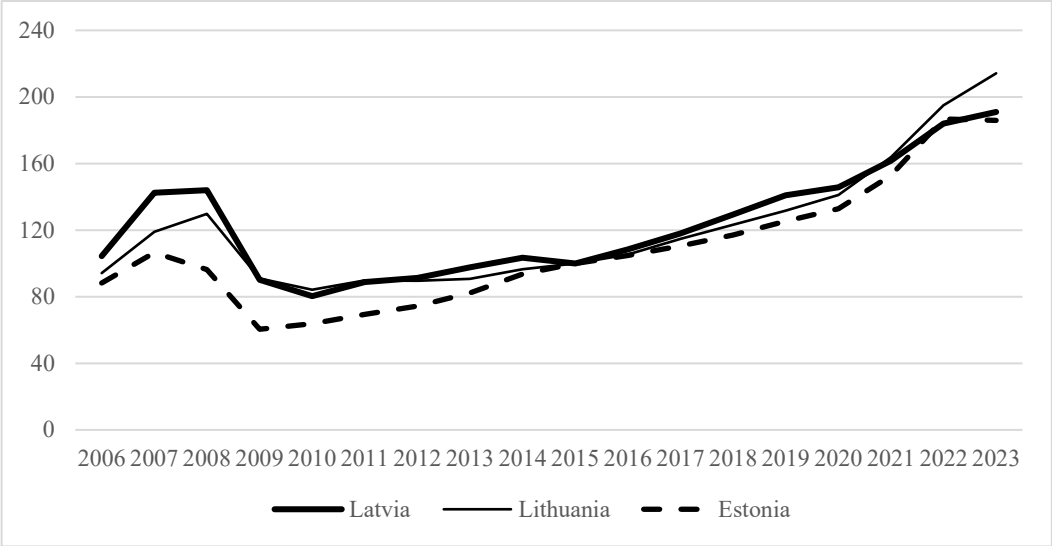

Fig. 1. Nominal house price indices in the Baltics, 2006–2023 (Index, 2015=100).

Source: OECD

Rental markets have also shown tendencies for boom-bust characteristics, as illustrated in Fig. 2. While rental prices in the three Baltic states rose relatively parallel in the years leading up to the crisis and fell simultaneously after the crisis, more recent years have shown asymmetric developments across the Baltics.

[8] Here one should remember that while the three Baltic states joined the EU simultaneously in 2004 (i.e., before the financial crisis) the same cannot be said about joining the eurozone; all three countries joined the eurozone after the financial crisis. Estonia adopted the euro on January 1, 2011, Latvia on January 1, 2014, and Lithuania in 2015.

[9] See Aus et al. (2016) for Estonian house prices, and Krusinskas (2012) for the Baltics in general.

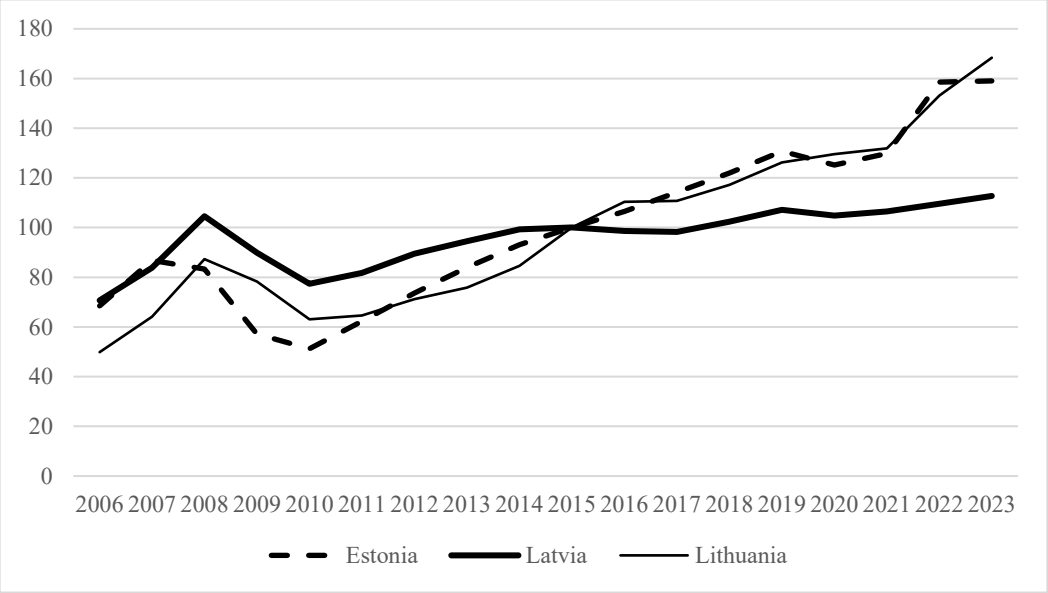

Fig. 2. Rent indices in the Baltics, 2006–2023 (Index, 2015=100).

Source: OECD

In the latter part of the period Latvian rental prices[10] have evolved differently than rental prices in the two neighbouring countries. A few factors may be at play, both on the supply and demand side of rental markets. High rates of Latvian emigration impact rental demand (OECD, 2019a). Latvia's pre-eminent position in attracting speculative buying of real estate in the boom years might impact the supply side. Speculative real estate purchases are reported to be the highest in Latvia.[11] This points to real estate purchases without owner-occupancy in search of rental tenure in amounts large enough to offset Latvia relative to its Baltic neighbours, contributing to Latvia's lower rental prices relative to Estonia and Lithuania.[12] In addition, since July 1, 2010, temporary residence permits[13] for Latvia have been available to foreigners through the purchase of expensive apartments and villas in Latvia. Free movement within the Schengen area and access to visa-free travel to many countries is an important attractor. Latvia's "golden visa" scheme has been targeted toward wealthy people from the east. The

[10] The OECD Affordable Housing Database addresses the Latvian residential rental market and lists the following challenges: "Ensuring the availability of high quality and affordable housing. The current situation in rental housing market can be characterized by the following main challenges: rapidly growing demand for housing in regions restricts job creation; low purchasing power of inhabitants, which leads to low interest among investors to construct rental housing in regions; and, labor shortage, declining population of working age, ageing population, emigration of young workers".

[11] See The Baltic Times (2005) and/or Global Property Guide Latvia 2016.

[12] See the Global Property Guide: Latvia, Lithuania, Estonia (2022).

[13] Official News Portal of Latvian Radio and Latvian Television. Eng.lsn.lv. (nd)
Also see: Office of Citizenship and Migration Affairs. Republic of Latvia (2022) as well as Mercury Group Estate Latvia (2023), OBERHAUS Real Estate Advisors (2016), and Global Property Guide Latvia (2022).

scheme has recently been restricted and reduced. However, The Global Property Guide Latvia (2022) reports that foreigners still figure prominently in the Latvian housing market, accounting for about 70 % of all property transactions in the country. The Property Guide also reports that roughly two-thirds of the rental market in Latvia consists of housing built in Soviet times. Some of these housing investments may have been "buy-to-let" investments, stimulating the supply side of the rental market and producing a volume effect that constrains rental price growth.

Many people in the Baltic states object to being associated with transition, a process which they consider completed. The housing market, however, is a relatively sheltered market, stemming from the fact that houses are non-tradable goods without established world prices or direct international competition, making the transition relevant. The Soviet overhang might be seen as a transition effect impacting both the market for rental housing and the market for owner-occupied housing. Analysing house prices in emerging European economies, Egert & Mihaljek (2007), Huynh-Olesen et al. (2013), and Ciarlone (2015) all find transition factors to be significant house price drivers.[14] Addressing the role of transition, Anderson (2000), Snieska et al. (2011), and Tsenkova & Polanska (2014) discuss housing market transformations in the process from socialist to market economies. In the early transition, the legal framework for private housing markets is especially important. For instance, analysing rental markets in Riga, Balode & Kamols (2019) highlight the current lack of rental market data but also the possibility that a new rental housing regulation act will help to overcome the data problem, attract more investment, facilitate legal proceedings, decrease the grey economy, and ultimately stimulate rental market developments. Swedbank Research (2019), page 3, reports that "… transactions involving Soviet-era apartments still dominate the market, accounting for around two-thirds of total deals. These Soviet-era apartments are still more affordable due to lower prices (the average price of a Soviet-era apartment is 55 % lower than the average price of a newly built apartment in a sleeping district). Moreover, the price growth of Soviet-era apartments has slowed or even, in some cases, stopped. On the other hand, the condition of these houses is poor."

This Soviet overhang has several implications. A striking thing about the Baltic housing market, shared with other post-soviet economies, is the high share of owner-occupied housing without a link to the mortgage market, often referred to as "outright ownership". In 2019, in Estonia, 59.9 percent of households owned their home outright, in Latvia – 68.7 percent and in Lithuania – 81.2 percent (OECD, 2019b). The OECD average for 2019 is 43.1 percent, and the EU average is 51.7 percent. The share of owner-occupied housing with mortgages in 2019 is correspondingly low in the Baltic states: 17 percent in Estonia, 9 percent in Latvia, and 9 percent in Lithuania. This is to be seen against the backdrop of the 25 percent OECD average and 20 percent EU average. Kulikauskas (2016) relates this to the large privatization of housing markets that followed the break-up of the Soviet Union in the early phases of transition. This part of the Soviet overhang leaves the

[14] See also the contributions by An et al. (2021), Ionascu (2017), Posedel & Vizek (2009), and Hegedus et al. (1996).

housing market in a state of disrepair, a housing stock in need of repair and replacements. Hence, in addition to the volume effect increasing the supply of rental housing there might also be another transition effect on rental markets, the poor quality of rental housing. Naturally, poor housing quality constrains rental price growth. A housing stock in need of repair and a need for reinvestments increases the importance of depreciation costs for housing markets, impacting the net flow of housing and the cost of maintenance in general and the user cost of both owner-occupied and rental housing more specifically.

The policy response to the financial crisis was driven by considerations of integration. It was based on the Baltic states maintaining their fixed exchange rates towards the euro (Purfield and Rosenberg, 2010). There were both political and economic reasons for maintaining the fixed exchange rate (Staehr, 2013). A credit-fuelled domestic demand boom prior to the crisis was accompanied by a credit-less recovery (IMF, 2014; European Commission, 2017). Despite a strong turnaround beginning in 2010, credit growth did not bounce back, and as late as 2014, the IMF raised concerns that the dormant credit market curtailed the recovery. The credit-less recovery constrained housing market developments. Historically, a credit-less recovery is not uncommon due to either excess capacity or tighter lending standards (see, e.g., Abiad et al., 2014). Both supply and demand factors seem to be at play across the Baltics but to different degrees in different countries (IMF, 2014). IMF (2014) suggests that the Baltics' credit expansion during the boom was demand side driven, but the contraction during the recession was mainly related to worsening bank asset quality. It is natural to relate the poor quality of housing, weak house price growth and bank collateral in housing markets to this worsening asset quality. This did not provide the housing market with any stimulus from the funding side during this period. Analysing the link between bank specifics and macroeconomic determinants of non-performing loans Kjosevski & Petkovski (2016) argue strong macro-financial links in the Baltic region. Knowing that these are the two main sources for housing market developments, the housing market should be analysed in relation to macro-financial linkages.

Housing market equilibrium is often analysed using the price-to-rent (PR) ratio (see, e.g., Himmelberg et al., 2005, Hill & Syed, 2015). Naturally, both house price and rental price developments, as well as households' choice between rental and owner-occupied housing might contain transition effects. Still, both the PR ratio (Kulikauskas, 2016) and the user cost (Kulikauskas, 2017) from which the PR ratio is derived – are analysed for Baltic housing markets, bringing potential equilibrium implications to the table. The two papers find that while Baltic housing markets were in line with fundamentals before 2006/2007, they then started to diverge. The papers find especially large misalignments in Latvia. Knowing the long-run nature of housing investments, the portfolio share of housing may be sub-optimal in the short run, both during periods of house price growth and during periods of liquidity constraints (Yao & Zhang, 2005). In addition, knowing how uncertainty matters for housing demand (Han, 2010), the global financial crisis might have had a significant impact on Baltic housing markets, including the choice between owning and renting in general and the PR ratio more specifically.

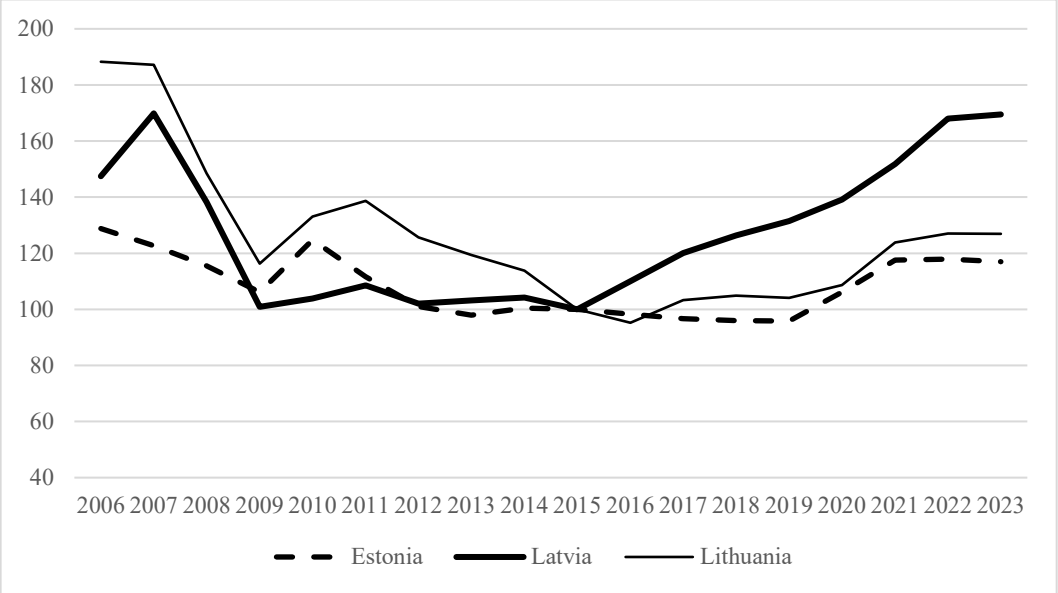

Fig. 3. Price-to-rent ratio in the Baltics, 2006–2023 (Index, 2015=100).

Source: OECD

Figure 3 shows the PR ratio for the Baltics over the period 2006–2023. While the ratio has circled around equilibrium, there are both periods of convergence and periods of divergence. Naturally, both supply and demand side features impact market prices and macroeconomic developments; shocks from the financial side of the economy and internal housing market features all impact the PR ratio. In addition, shocks to the PR ratio may be initiated in either rental markets or in the market for owner-occupied housing. For instance, the asymmetric rental market development in Latvia is important for its diverging PR ratio in the latter part of the period.

2. AN AUGMENTED DIPASQALE-WHEATON MODEL

The DiPasquale & Wheaton (1992) model links the different parts of the real estate system and is extended by Achour-Fischer (1999), Colwell (2002), De Salvo (2017), and Borgersen & Emblem (2022, 2023). Here, only a minimalistic version of Borgersen & Emblem (2022, 2023) is presented, relating the DPW model to a housing market context.

The housing market version of the DPW model links the rental housing market, the market for owner-occupied housing and the activity in the housing construction industry. As the relation between housing starts and housing depreciation determines the housing stock, shocks to the flow of housing also impact the housing stock. Figure 4 illustrates the model graphically.

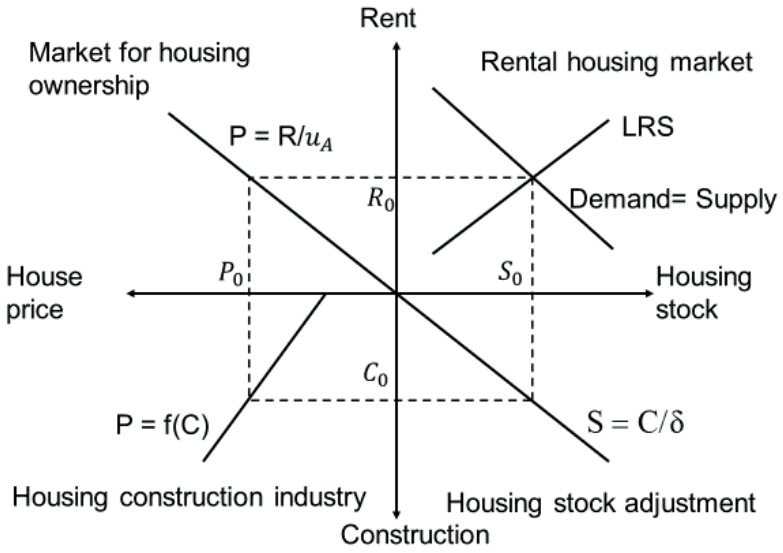

Fig. 4. The DiPasquale-Wheaton model and the PR ratio.

In the four-quadrant model, the first quadrant determines the price of rental housing *R* by the intersection between rental housing demand *D* and a given rental housing supply S_0. Rental demand is related to household income α and the price of rentals, as $D = \alpha - \beta R$. The rental market equilibrium, where supply equals demand, is represented by the rental price

$$R_0 = \frac{\alpha - S_0}{\beta}. \tag{1}$$

As the model is recursive, the price of owner-occupied housing P follows directly in the second quadrant using the price-to-rent (PR) ratio as an equilibrium condition for the housing market in the relation between an exogenous user cost, u, and the rental price derived above.

$$P_0 = \frac{R_0}{u} \tag{2}$$

An after-tax expression for the user cost, along the lines of Himmelberg et al. (2005), is

$$u = (1-\theta) r^{RF} + \gamma + \delta + \theta r^{M} (1 - t_m) - g + t_p. \tag{3}$$

The parameter θ represents the loan-to-value (LTV) ratio, the risk-free interest rate is r^{RF}, and r^{M} is the mortgage rate, while *g* equals house price growth. The rate of depreciation is δ, and γ is the risk premium of owner-occupied housing over renting. Two tax parameters are included in the user cost expression, tax-deductibility of mortgage rates t_m and tax on housing equity t_p. While the former reduces the user cost, the latter has the opposite effect. We see how the user cost is

related to a few factors, both financially founded, e.g., the interest rate, internal housing market features like the rate of depreciation or a tax on housing equity, and factors originating on the real side of the economy.

The housing construction industry is positioned in the third quadrant. Carrying both fixed and variable costs, industry profitability relates the number of housing starts to house prices. Having determined house prices in the second quadrant, the number of housing starts equals

$$C = c_0 + c_1 P \ . \tag{4}$$

The higher the house price, the larger is housing construction. Finally, the fourth quadrant relates the housing stock to the flow of housing. Changes in housing supply ΔS are determined by the interaction between the rate of depreciation, δ, and supply of new houses, $\Delta S = C - \delta S$. In equilibrium, depreciation is assumed to equal the number of housing starts C making $\Delta S = 0$, making the equilibrium housing stock equal to

$$S_0 = \frac{C_0}{\delta} \ . \tag{5}$$

Colwell (2002) introduced a long-run supply curve (LRS) which, using the user cost and the PR ratio, as given in Expression (2), equals $S_0 = \frac{c_0}{\delta} + \frac{c_1 R_0}{\delta u}$ and is positioned in the first quadrant. The LRS curve determines long-run housing equilibrium when it intersects with the short-run housing supply, S_0 and the demand for rental housing, $S_0 = \frac{c_0}{\delta} + \frac{c_1 R_0}{\delta u_A}$. The DPW model determines long-run equilibrium in the rental market, in the market for owner-occupied housing, in housing construction and the housing stock R_0, P_0, C_0, S_0 simultaneously.[15]

3. SHOCKS TO THE HOUSING MARKET SYSTEM

We consider three types of shocks and their impact on the housing market system and the PR ratio as given by the DPW model. We differentiate between shocks to the real side of the economy, shocks originating in the financial side of the economy and internal housing market shocks, i.e., shocks to the supply side of housing markets. While the latter is a transition effect, the second is more related to economic integration, and a shock to the real side of the economy may be seen as a combination of integration and transition. The three shocks might be interrelated, but our approach considers them partially.

[15] The original DPW model is a long run model and does not specify short-run dynamics. Colwell (2002) reflects on short-run adjustments, which may be lengthy and characterised by overshooting. Short-run market dynamics may resemble a cobweb and be either convergent or divergent. In the following we focus on long-run outcomes and assume convergent dynamics including overshooting along the lines of Borgersen & Emblem (2022a).

3.1. Transition Effects on Housing Supply

This section highlights aspects related to the supply side of housing markets relevant to the transition. Transition economies may be described by the same type of characteristics as mature economies, but at different intensities, as well as characteristics differing from mature economies. For instance, when analysing Western housing markets, a long-standing puzzle is the inelastic supply side. For a few reasons, the volume of new housing construction is only weakly responsive to higher prices (see e.g., Caldera & Johansson, 2013). Also, when analysing Baltic housing markets, much has been said about the sluggishness of approval processes for new housing construction and the unprotected (by appropriate laws) landlords when it comes to rentals, which makes the supply side more than usually unresponsive to favourable price signals (European Commission, 2019).

When allowing for different market segments, housing of different quality or different forms of tenure, more puzzles come into play. Empirically, the depreciation of rental housing is found to exceed that of owner-occupied housing (Harding et al., 2000). Differences in the rate of depreciation between rental and owner-occupied housing might impact the housing market equilibrium, as expressed by the PR ratio, as a higher rate of depreciation of rental housing might influence the rental price set by a landlord and, hence, a household's choice of tenure. The rate of depreciation figures prominently in the Baltic housing markets on the strength of the ambitious renovation plans for old Soviet-era housing in all three Baltic States, which are bound to lift depreciation rates. Unless a higher rate of depreciation is accompanied by a more expansive construction sector where the number of housings starts responds more strongly to house prices, the structural shift will impact the housing market equilibrium.

In a DPW framework, the effect of a higher depreciation rate is shown in Fig. 5, where the initial housing market equilibrium is given by R_0, P_0, C_0, S_0. A higher rate of depreciation shifts the equilibrium condition in the fourth quadrant to the left, reducing the housing stock at all levels of construction. In addition, as a higher rate of depreciation increases the user cost of owner-occupied housing, the equilibrium condition for owner-occupied housing in the second quadrant shifts to the right, as house prices are reduced for all levels of rent as user cost increases. Hence, the higher rate of depreciation that follows the transition process has both supply- and demand-side effects across the housing market system.

In the DPW model, the short-run effect of a higher rate of depreciation is a reduction in the PR ratio. This demand-driven effect on the PR ratio stems from the assumption of perfect substitutability between rental and owner-occupied housing and the recursive model structure. While this demand side effect is immediate, there is a supply-side effect that comes into play over time, and while the PR ratio falls in the short run, the long-run model-based PR response is ambiguous.

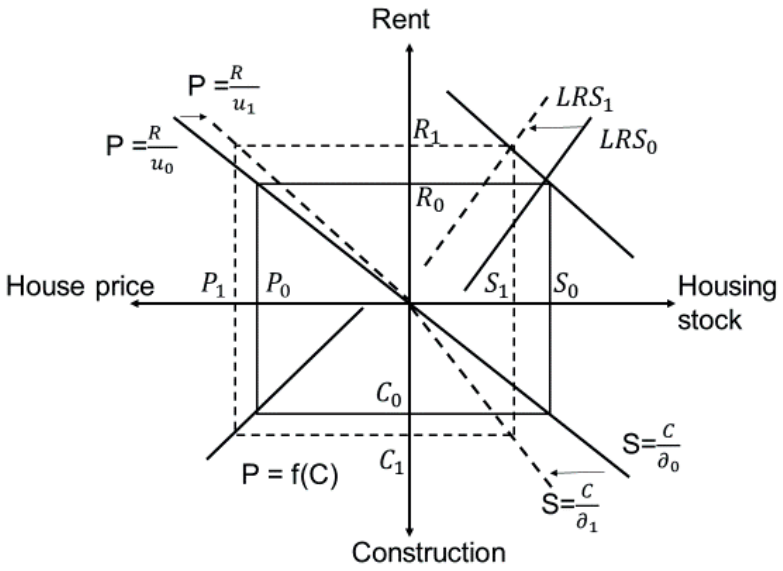

Fig. 5. Housing market effects of a higher rate of depreciation.

The model response to a higher rate of depreciation starts from the equilibrium house price $P_0 = \frac{R_0}{u}$ which relates the house price to the rental price and the user cost of owner-occupied housing. From Expression (3), we see that a higher rate of depreciation increases the user cost: $\frac{\partial u}{\partial \delta} = 1$. The effect on house prices of a higher rate of depreciation is thus $\frac{\partial P}{\partial \delta} = \frac{\partial P_0}{\partial u}\frac{\partial u}{\partial \delta} = \frac{-R_0}{u^2} < 0$ *ceteris paribus*. Hence, for a given rental price, the short-run DPW effect of a higher rate of depreciation on the PR ratio is negative.

Over time, these short-run predictions may be nuanced. We see from Expression (5) that a higher rate of depreciation reduces the housing stock: $\frac{\partial S_0}{\partial \delta} = \frac{-C_0}{\delta^2} < 0$ *ceteris paribus*. The reduction in housing supply will, over time, impact the prices of both rental and owner-occupied housing. Inserting for housing supply $S_0 = \frac{C_0}{\delta}$ we find the effect on rental prices as

$$\frac{\partial R_0}{\partial \delta} = \frac{\partial R_0}{\partial u}\frac{\partial u}{\partial \delta} = \frac{1}{\beta}\frac{c_0}{\delta^2} > 0, \tag{6}$$

as we know that $\frac{\partial S_0}{\partial \partial} = \frac{-c_0}{\partial^2}$.

The total derivative of house prices, with respect to depreciation, equals

$$\frac{\partial P_0}{\partial \delta} = \frac{1}{u^2}\left(u\frac{\partial R_0}{\partial u}\frac{\partial u}{\partial \delta} - R_0\frac{\partial u}{\partial \delta}\right). \quad (7)$$

As $\frac{\partial u}{\partial \delta} = 1,$ this expression reduces to $\frac{\partial P_0}{\partial \delta} = \frac{1}{u^2}\left(u\frac{\partial R_0}{\partial u} - R_0\right)$. The total effect on house prices includes the short-run effect of a higher rate of depreciation that comes from the perfect substitutability assumption underlying the equilibrium interpretation of the PR ratio, $\frac{-R_0}{u^2} < 0$ (i.e., the demand-side effect) and a supply-side effect (i.e., $\frac{1}{u}\frac{\partial R_0}{\partial u} > 0$) that comes from a reduction in the housing stock. The total effect on house prices is initially ambiguous.

Having already partially derived the demand-side effect of a higher rate of depreciation we may, as a discourse to the long-run effect, consider the supply-side effect of a higher rate of depreciation partially, i.e., using $\frac{\partial P_0}{\partial \delta} = \frac{1}{u^2}\left(u\frac{\partial R_0}{\partial u}\frac{\delta u}{\partial \delta} - R\frac{\partial u}{\partial \delta}\right)$, but abstract away from the demand-side effect. Hence, we only consider the supply-side effect, i.e., $\frac{\partial P_0}{\partial \delta} = \frac{1}{u}\frac{\partial R_0}{\partial u}\frac{\partial u}{\partial \delta}.$

This expression relates the supply-side effect to the user cost of owner-occupied housing and the rental price response to depreciation. Let us first assume $\frac{\partial R_0}{\partial u} = 1$ and $\frac{\partial u}{\partial \delta} = 1,$ making $\frac{\partial R_0}{\partial \delta} = \frac{\partial R_0}{\partial u}\frac{\partial u}{\partial \delta} = 1,$ which relates the price effects from changes in housing supply exclusively to user costs. When we consider the case where $u > 1,$ the effect on house prices falls short of the rental price effect: $\frac{\partial P_0}{\partial \delta} < \frac{\partial R_0}{\partial \delta} = 1$. Now the supply side effect contributes to a reduction in the PR ratio. When $u < 1,$ the opposite situation emerges, and the supply-side effect contributes to a higher PR ratio.

Relating the size of the user cost to, e.g., transition stages, the model reasoning allows the PR ratio to vary along the transition path. Early in transition, where one may see high(er) user cost (i.e., $u > 1$), as home-ownership is cost intensive due to the substantial structural shifts characterising the early phases of transition as a large part of the old housing stock is replaced by a more modern housing stock, the supply side may contribute to a reduction in the PR ratio. Over time, as older housing structures are gradually replaced by modern-type apartments and the structural supply-side shifts become smaller, and the user cost is reduced (i.e., $u < 1$), the supply-side effect contributes to a higher PR ratio.

Taking both the supply-side effect from an adjusting housing stock and the demand-side effect from perfect substitutability between different forms of tenure

into account, the total effect on house prices is as given by Expression (7) (which we reproduce for convenience):

$$\frac{\partial P_0}{\partial \delta} = \frac{1}{u^2}\left(u\frac{\partial R_0}{\partial u}\frac{\partial u}{\partial \delta} - R_0\frac{\partial u}{\partial \delta}\right). \tag{7}$$

To simplify terminology, we again use the expression $\frac{\partial R_0}{\partial \delta} = \frac{\partial R_0}{\partial u}\frac{\partial u}{\partial \delta}$ and consider

$$\frac{\frac{\partial P_0}{\partial \delta}}{\frac{\partial R_0}{\partial \delta}} = \frac{1}{u} - \frac{R_0}{u^2}\frac{\frac{\partial u}{\partial \delta}}{\frac{\partial R_0}{\partial \delta}} \text{ or alternatively } \frac{\frac{\partial P_0}{\partial \delta}}{\frac{\partial R_0}{\partial \delta}} = \frac{1}{u}\left(1 - \frac{R}{u}\frac{1}{\frac{\partial R_0}{\partial u}}\right). \tag{8}$$

We define two elasticities. Let $El_R = \frac{\delta}{R_0}\frac{\partial R_0}{\partial \delta}$ represent the elasticity which reflects the degree to which rental prices respond to a change in the rate of depreciation. Likewise, we define $El_u = \frac{\delta}{u}\frac{\partial u}{\partial \delta}$ as the elasticity to which user costs react to depreciation. The effect on the PR ratio of a higher rate of depreciation may be expressed as

$$\frac{\frac{\partial P_0}{\partial \delta}}{\frac{\partial R_0}{\partial \delta}} = \frac{1}{u}\left(1 - \frac{El_u}{El_R}\right). \tag{9}$$

The long-run effect on the PR ratio of a higher rate of depreciation is related to the level of user cost and the two elasticities defined above. As the user cost effect is addressed earlier, we focus on the two elasticities. We see that $El_R > El_u$ makes the PR ratio increase, while $El_R < El_u$ produces a reduction in the PR ratio as a response to a higher rate of depreciation. When the user cost reacts stronger to depreciation than the rental price, house prices increase less than rental prices, reducing the PR ratio. When the user cost reacts less than the rental price, the house price increase exceeds the increase in rental prices, and the PR ratio increases, i.e.,

$$El_R > El_u \text{ makes } \left(1 - \frac{El_u}{El_R}\right) > 0 \text{ and } \frac{\frac{\partial P_0}{\partial \delta}}{\frac{\partial R_0}{\partial \delta}} > 0; \tag{10}$$

$$El_R < El_u \text{ makes } \left(1 - \frac{El_u}{El_R}\right) < 0 \text{ and } \frac{\frac{\partial P_0}{\partial \delta}}{\frac{\partial R_0}{\partial \delta}} < 0. \tag{11}$$

We may reflect on the two elasticities to give our model reasoning some purchase in a transition context, for instance, by considering El_R. In our linearized user cost expression $El_u = 1$ and the condition for whether the PR ratio rises or falls as the rate of depreciation increases is related to $El_R \gtrless 1$. An $El_R = 1$ would imply a competitive rental market, where landlords do not possess market power, and costs are passed through to rental prices in a "one-to-one" relation. When $El_R = 1,$ the PR ratio is unaffected in the long run as the supply side effect of a higher rate of depreciation completely balances the demand side effect. When, on the other hand, $El_R > 1,$ a landlord passes on more than the increase in depreciation cost to rental prices, as the landlord possesses some market power. This creates a reduction in the PR ratio. When $El_R < 1,$ the cost increase is only partially passed through to rental prices, making rent increase less than user costs as depreciation increases, lifting the PR ratio.

Hence, the long-run effect on the PR ratio of a higher rate of depreciation is, in addition to the user cost, also related to the two elasticities. While the user cost may vary along the transition path, the elasticities are context-specific and, e.g., related to the degree of rental market competition. This makes the contribution to the PR ratio from the structural shifts inherent in the transition process highly context-specific, a contribution that may vary both across countries and over time.

Figure 5 pictures a case where the PR ratio falls (as $\Delta P < \Delta R),$, even though both house prices and rental prices increase as the rate of depreciation increases. The net effect of the supply- and the demand-side effect of a higher rate of depreciation is in Fig. 5 a reduction in housing stock, which goes together with a higher level of rent, $R_0 \rightarrow R_1$ and higher house prices, $P_0 \rightarrow P_1$. Even though the number of housing starts has increased, $C_0 \rightarrow C_1,$ the increase in construction is not large enough to compensate for the higher rate of depreciation, which reduces the housing stock in the aggregate. The new equilibrium is R_1, P_1, C_1, S_1. [16]

3.2. Financial Shocks and the Boom-Bust Cycle

Turning to housing market shocks originating in the financial side of the economy our discussion is related to the Baltic boom-bust cycle. Hilmarsson (2013, 2019) analyses the Baltic housing markets taking several aspects into account, highlighting the importance of the financial sector. In a more country-specific analysis, Tupeinate et al. (2017) analyse housing market fluctuations in Lithuania in the period 2005–2015, finding newly issued mortgage loans and interest rates to be central. The importance of interest rate and mortgage availability for the Lithuanian market is also argued by Gaspareniene et al. (2016), while Henilane (2015) argues the two factors' importance in the Latvian market. Cuestas & Kukk (2020) analyse the mutual dependence between house prices and housing credit in Estonia, finding asymmetric relations between house prices and credit supply.

[16] This graphic analysis abstracts away from potential overshooting and considers only long-run equilibrium, leaving the illustration of overshooting to the next subsections.

In terms of the DPW model the boom-bust cycle might be illustrated as in Borgersen & Emblem (2022). This section mirrors their approach. While tighter credit market conditions are associated with a higher mortgage market risk premium and an increase in the user cost, a credit market expansion with easing credit conditions may be viewed as the opposite. Figure 6 illustrates the latter situation where a mortgage market expansion and a lower mortgage rate reduce the user cost.

The effect of a boom period may be reasoned as follows: the initial housing market equilibrium is given by R_0, P_0, C_0, S_0. The user cost reduction lifts house prices, $P_0 \rightarrow P_1$, which again stimulates the number of housing starts, $C_0 \rightarrow C_1$, and the housing stock, $S_0 \rightarrow S_1$. The supply increase brings down the equilibrium rent level, $R_0 \rightarrow R_1$. Again, there is some overshooting in house prices, $P_0 \rightarrow P_1 \rightarrow P_2$, and construction, $C_0 \rightarrow C_1 \rightarrow C_2$. The new housing market equilibrium is given by R_1, P_1, C_1, S_1.

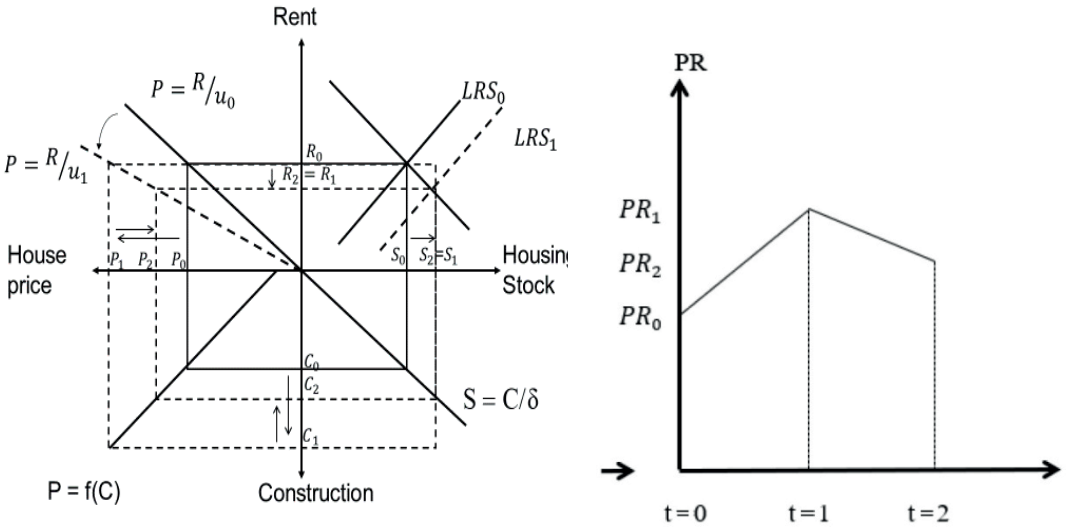

Fig. 6. Effects on the housing market system and the PR ratio of a lower mortgage rate and a reduction in the user cost.

While a lower mortgage rate increases house prices, renters also benefit as the housing industry expands and the housing stock increases. A combination of higher house prices and lower rental prices lifts the PR ratio, as seen in the period preceding the financial crisis. However, there is also some overshooting in the PR ratio, but the process to the new PR equilibrium is $PR_0 \rightarrow PR_1 \rightarrow PR_2$.

Figure 7 illustrates the effects of a bust where the initial housing market equilibrium is given by R_0, P_0, C_0, S_0. When the user cost increases due to a higher mortgage rate, house prices fall, $P_0 \rightarrow P_1$. Lower prices have a negative impact on activity in the housing industry, $C_0 \rightarrow C_1$, which reduces the housing stock, $S_0 \rightarrow S_1$. The reduced supply increases equilibrium rent, $R_0 \rightarrow R_1$. The overshooting processes are present in both house prices, $P_0 \rightarrow P_1 \rightarrow P_2$, and construction,

$C_0 \rightarrow C_1 \rightarrow C_2$. The new housing market equilibrium is given by R_1, P_1, C_1, S_1. Again, there is some overshooting/undershooting in the PR ratio.

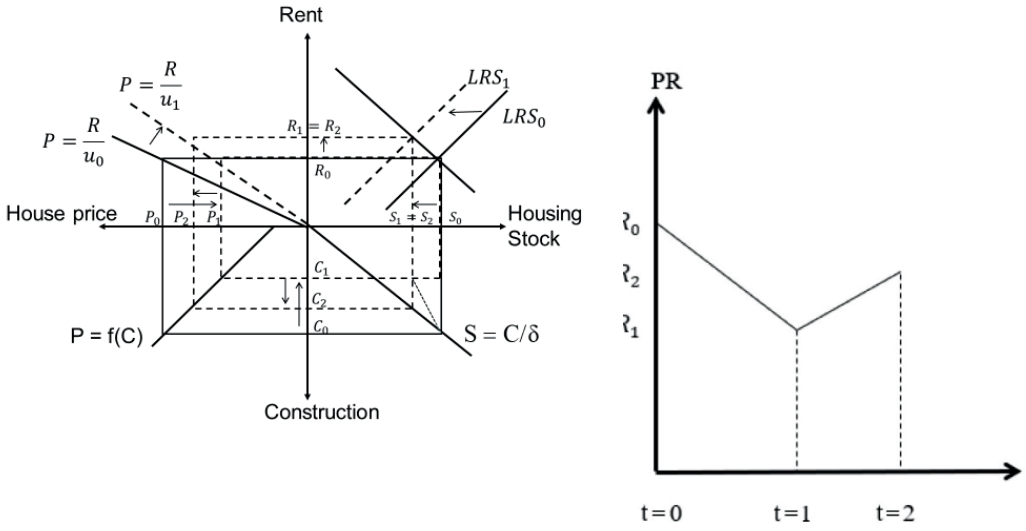

Fig. 7. Effects on the housing market system and the PR ratio of a higher mortgage rate and an increase in user cost.

The Baltic economic bust that followed the US subprime crisis produced tighter lending conditions, which lifted the mortgage rate and increased the user cost. The higher user cost reduces house prices, which, over time, lifts the price of rentals as housing construction contracts in response to reduced profitability in housing construction. Both a higher price of rentals and a reduction in house prices impact the PR ratio negatively.

3.3. The "Tiger Economies" and Shocks from the Real Side of the Economy

Knowing the "tiger history" of the Baltics, where economic growth reached record highs, we consider how economic growth impacts the housing market. Figure 8 illustrates the volume effect of a business cycle expansion on housing markets, as given by Borgersen & Emblem (2023, Section 4), but extended to allow for overshooting.

The initial (Period 0) housing market equilibrium is given by R_0, P_0, C_0, S_0. A higher rate of economic growth, which stimulates household income, is represented by a positive shock to the demand for rental housing. The rent increase, $R_0 \rightarrow R_1$, lifts house prices, $P_0 \rightarrow P_1$, and stimulates activity in the construction industry, $C_0 \rightarrow C_1$. A higher number of housing starts increases the housing stock, $S_0 \rightarrow S_1$. As the housing stock adjusts in Period 1, there is a correction in the next period in rental prices, $R_1 \rightarrow R_2$, a correction which again is fed through the system, reducing both house prices, $P_1 \rightarrow P_2$, and construction, $C_1 \rightarrow C_2$. There is some overshooting in the system as the short-run effect on house prices, $P_0 \rightarrow P_1$, exceeds the long-run

effect, $P_0 \rightarrow P_2$. There is also overshooting in construction, $C_0 \rightarrow C_1 \rightarrow C_2$. The new equilibrium is R_2, P_2, C_2, S_2. Compared to the initial equilibrium there is an increase in house prices, rent, housing construction and in the housing stock while the effect on the PR ratio is ambiguous.

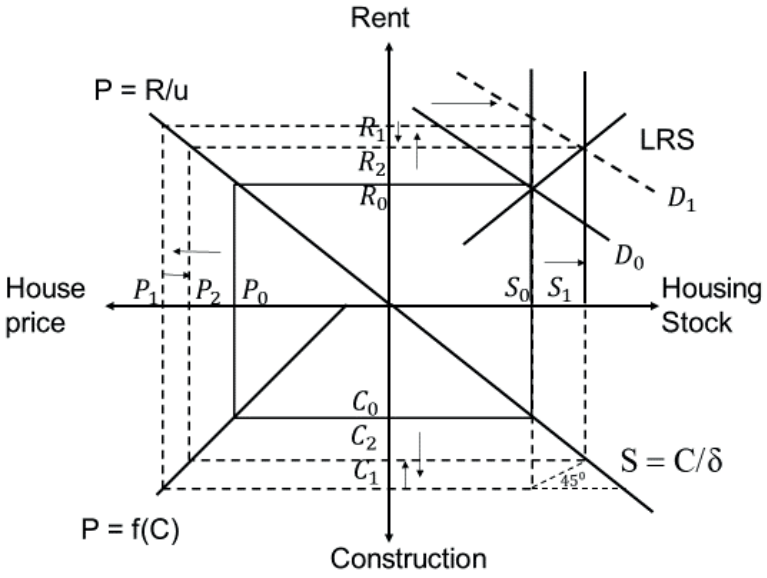

Fig. 8. Real side shocks and increased demand for rental housing.

4. CONCLUSIONS AND DISCUSSION

The macroeconomic development of the Baltics, exposed to the effects of both transition and integration, provides an interesting framework for analyzing housing markets. Experiencing a credit-driven boom, followed by a severe financial crisis in 2007/2008 and a credit-less recovery in the years after the crisis, the Baltics is a case with multiple contexts.

This paper reflects on the Baltic housing markets using a modified DPW model as a frame of reference. The DPW model provides a theoretical benchmark for the relationship between the market for owner-occupied housing and the rental market, as well as for the housing construction industry. A theoretical model always comes with a cost as it abstracts away from real housing markets. First of all, the indirect effect of the model depends upon the two links between rental and owner-occupied housing and the link between construction and house prices. In real housing markets, context matters, and both long-run outcomes and short-run market dynamics may deviate from the theoretical benchmark. Hence, the model's volume effects may be supplemented by factors originating in the transition process adding more complexity than the DPW model as such. A DPW framework assumes, for instance, perfect substitutability between rental and owner-occupied housing, a questionable assumption across the Baltics. For instance, the lack of mortgage

availability that some households experience might constrain the indirect effect of mortgage sentiment, with implications for the use of the PR ratio as an equilibrium indicator. Even so, the supply-side effects of transition, where older types of apartments are replaced by a more modern housing stock, bring a supply-side effect into the PR ratio and provide a more nuanced relationship between markets for owner-occupied and rental housing relative to mature economies, complicating PR ratio assessments. Naturally, a heterogenous housing stock assumption would bring our modelling closer to real housing markets than our homogenous housing stock assumption.

Still, the DPW model provides some interesting illustrations of Baltic housing markets in a period where both transition and integration effects impact housing markets. The boom-bust cycle and how it fed through the housing market system is one example. Euro-denominated mortgages with low mortgage rates created incentives for increased borrowing in the boom years before the crisis. After the crisis, the recovery was initially credit-less. Tighter lending standards brought house prices back in line with fundamentals as described by the PR ratio. These two periods fit nicely with the DPW reasoning, as higher prices stimulated construction across the Baltics in the years before the crisis, which took off steam from rental markets as the housing supply increased. As lending standards tightened, the user cost of housing increased. This higher user cost had a negative impact on house prices, construction and the availability of rental housing, pushing up rent and bringing PR ratios back down. Naturally, housing markets in the Baltics were also affected by other shocks from the financial side of the economy. There was also significant speculation. Speculative buying of real estate during the pre-crisis boom period is reported to be the biggest in Latvia. Market analysis of the Global Property Guide (GPG) 2016 suggests that around 15–30 percent of all properties in Latvia in the pre-crisis boom period were purchased by real estate speculators. Speculation may increase market responses to underlying price drivers and increase volatility across the housing market system.

Likewise, to only consider the effect of increased demand for rental housing is too partial when analysing how Baltic housing markets are affected by an expanding real side of the economy. For instance, taxation – both policy and implementation – e.g., social security, unemployment compensation, and pension legislation all have a bearing on household budgets and are relevant for housing market developments. An improved tax base may, e.g., increase social security payments and stimulate lower-income households' ability to acquire mortgage-funded housing, lifting house prices and/or rent more than the volume effect inherent in economic growth. Likewise, an improved tax base may allow taxes on housing wealth, which impacts the user cost of owner-occupied housing. The real side of a transitioning economy that experiences economic growth and the increased modernisation of its economic structures that goes alongside transition may thus entail a wider set of housing market effects than indicated in Fig. 6.

However, internal housing market features may be best at showing how and why transition economies are different from mature market economies. The higher rate of depreciation that comes about as old-Soviet-type apartments are replaced by modern housing characterizes transition economies, and new standards affect house

prices, rent and construction. As the higher rate of depreciation reduces the housing stock, both rental prices and house prices increase. This offers a supply-side effect on the PR ratio, counteracting the demand-side effect, producing a potentially more volatile PR ratio in economies exposed to both transition and economic integration.

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