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REAL ESTATE ECONOMICS

The Economic Implications of House Price Capitalization: A Synthesis

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In this article, I synthesize an emerging literature that explores the conditions under which public and private investments and intergovernmental transfers are capitalized into local house prices and the broader economic implications of such capitalization. The main insights are: (1) house price capitalization is more pronounced in locations with strict regulatory and geographical supply constraints; (2) capitalization can induce the provision of durable local public goods and club goods; and (3) capitalization effects—which are habitually ignored by policy-makers—have important adverse consequences for a wide range of policies such as intergovernmental aid and the mortgage interest deduction.

Introduction

Municipalities and neighborhoods differ enormously in their levels of local public good provision, accumulation of social capital or private investments in the housing stock. Some localities—often suburbs that surround large and prosperous cities—have excellent public schools and other public services, as well as close ties among helpful neighbors. These places are typically also exceptionally well maintained. Other locations, however, are confronted with appalling public services, nonexisting or dysfunctional social networks and decay. Inner city neighborhoods in less prosperous cities or more rural locations are often hampered by some or all of these problems.

One potential explanation for these stark differences in local public and private investments is that they are fundamentally caused by local differences in natural amenities (*e.g.*, scenic views or access to nice public parks) and resulting sorting by income. If households appreciate natural amenities, they will bid up house prices (and rents) in locations with more desirable characteristics. And as the most affluent households can afford to live—and own—in the highest amenity locations, holding other things constant, the outcome of the

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sorting process will likely be that the wealthiest households own the houses in the highest amenity places. The presence of affluent homeowners, in turn, will likely generate positive externalities (including fiscal externalities and peer effects), ultimately resulting in better local public services (including schools with better outcomes), stronger social ties, and—as affluent residents are more likely to own their home—better maintained housing in places that are otherwise more desirable as well.

Yet, public good- and club good-provision are not always superior in locations with nice natural amenities or put differently: often places with excellent public good- or club good-provision are not very exceptional in terms of their natural amenities. Apart from natural amenities and income-sorting, various other factors (*e.g.*, heterogeneous preferences for local public services, relocation costs, social attributes, proximity to the work place or 'historical accidents' and chance) are important.

This article explores one particular mechanism that may cause local public and private investments to vary significantly across places, independent of the fundamental desirability of these places: locations may differ in the extent to which fiscal variables—local public services and taxes—are capitalized into house prices, for example because of spatial differences in local housing supply constraints that determine the local housing supply price elasticity. Differential capitalization effects in turn may provide varying incentives to local property owners (homeowners and landlords) to (1) vote in favor of or lobby for investments in their communities and neighborhoods and (2) carry out private investments that exert positive externalities (*e.g.*, private contributions to local social capital, creation of scenic gardens or maintenance of the housing stock).

Another characteristic of house price capitalization is that it can cause significant redistribution. For example, federal or central government grants or interjurisdictional transfers that aim to help disadvantaged households may have perverse effects in that they help well-off property owners (including absentee landlords) rather than deprived renters. These redistribution effects are 'hidden' and quite likely not intended by policy-makers.

Finally, house price capitalization may not only have adverse redistribution effects, but may also offset the intended incentive effects of certain policies. For example, the mortgage interest deduction (MID) aims to improve homeownership attainment. However, to the extent that the MID generates greater demand for owner-occupied housing it may also increase house prices, potentially offsetting the policy induced incentives to own homes. In fact, to the extent that future MID benefits are capitalized into higher house prices,

the MID may decrease the likelihood that down-payment constrained potential house-buyers may qualify for a mortgage. Similarly, MID-induced higher house prices may increase housing related transaction costs as these are typically proportional to house prices. This in turn reduces the incentives of mobile—often young—households to own. Hence, the net effect of the MID on homeownership may, for some groups, be negative in places with substantial capitalization.

The aim of this article is to review and synthesize the existing research that explores the incentive and redistribution effects and unintended consequences of house price capitalization. This research ties into two well-established strands of the literature: (1) on the role of capitalization for local public sector efficiency and (2) on the empirical evidence of the capitalization of local public goods and taxes into house prices. It also ties into a more recent strand of the literature on the "New Economics of Equilibrium Sorting" and resulting possibilities for policy analysis. I briefly review these three related strands of the literature in the next section. The subsequent section explores under what conditions fiscal variables and other local attributes—such as social capital—are capitalized into property prices. In particular, I discuss the role of the demand price elasticity and of local supply constraints, which can be of a regulatory or geographical (physical) nature. In the following section I examine the incentive effects of capitalization for the provision of local public goods and club goods. The aim of this section is to provide a first step towards a "taxonomy". In particular, I investigate the role of homeownership, transaction costs and the corresponding expected duration in the property. The next section then discusses the distributional consequences of house price capitalization—the "hidden" redistribution effects and other unintended consequences. The last section concludes and briefly discusses possible future directions in what I think is a fertile area of research.

Related Literature

The Roots of the Capitalization Literature: Capitalization and Efficiency

The point of departure for the theoretical considerations is the proposition most prominently expressed by Musgrave (1939) and Samuelson (1954) that there is no viable market mechanism that reveals individual preferences and ensures the optimal provision of public goods. Individuals may always have an incentive to free-ride on other individuals' contributions to public goods, necessitating a political solution to overcome market failure. Yet, as Tiebout (1956) pointed out, this pessimistic view may not apply in the case of *local* public goods. Tiebout proposed that consumer mobility and interjurisdictional

competition, at least under restrictive assumptions,[1] may generate an efficient provision of local public services. This proposition has subsequently become known as the "Tiebout-hypothesis."

Whereas Tiebout did not consider the role of the land market and capitalization effects in his theoretical analysis, in another seminal article, Oates (1969) suggested that if residents indeed "vote with their feet" for local public goods, as argued by Tiebout, then fiscal differentials among communities should be capitalized into house prices. This proposition has later been labeled the "capitalization-hypothesis." Using a sample of New Jersey municipalities, Oates did indeed find evidence suggesting that fiscal differentials are capitalized to a large extent into house prices. That is, all else equal, property taxes reduce house prices; expenditures on local public schools have the opposite effect. Oates originally interpreted this finding as evidence in favor of the "Tiebout-hypothesis."

Oates' (1969) study induced a voluminous theoretical literature that by and large rejected his proposition that capitalization provides a test of the Tiebout-hypothesis. Instead the literature reached consensus on three points: (1) fiscal differentials can be expected to be capitalized into house prices, (2) existence of capitalization is consistent with foot-voting and (3) this does not necessarily imply efficiency of local public good provision. Chaudry-Shah (1988) and Ross and Yinger (1999) provide comprehensive surveys summarizing the relevant theoretical and empirical literatures surrounding this debate.

A few studies that followed up on Oates (1969) are particularly noteworthy as they have important implications for empirical research. In a series of articles, Brueckner (1979, 1982, 1983) developed a bid-rent model framework of property value determination, which considers a world that is *not* in perfect Tiebout-equilibrium. In Brueckner's framework, a local government finances the provision of local public services from a local property tax, with the objective of maximizing the value of its housing stock. Households with homogeneous tastes, but heterogeneous incomes, are freely mobile between locations, so that they bid for units until the utility from dwelling is the same everywhere. As a consequence, both the households' marginal willingness to pay for local public services and the local property tax are fully capitalized

[1]The restrictive assumptions are: costless mobility, perfect knowledge of fiscal packages in all municipalities, a large number of competing local jurisdictions, endogenous community size, no external economies or diseconomies, no multidimensional preferences, no spillover losses of local public good provision to surrounding jurisdictions, no land or labor market and no commercial real estate. See Tiebout (1956) for details and the survey by Chaudry-Shah (1988) for an interpretation of the assumptions and their implications.

into house prices. The local government should set the level of public expenditures such that the capitalized tax needed to finance a further rise in services would just offset the capitalized willingness to pay for them. When this condition is met, the public expenditure level is *efficient* in that it satisfies the Samuelson condition: at the margin, the aggregate willingness to pay for additional services equals the cost of providing them.

Suppose now that for some reason spending on public services is below the level where it maximizes the value of the aggregate housing stock. This could be because of institutional constraints (*e.g.*, property tax limits) or simply because local public policy is the outcome of a political process in which many conflicting interests interact. By implication, the capitalized willingness to pay for an increase in expenditure would exceed the capitalized tax needed to pay for it, and hence, an increase in expenditure would capitalize "more than fully" into house prices. Conversely, overspending on local public services would lead to less than full capitalization. This reasoning can be illustrated graphically: aggregate property values of a local jurisdiction are an inverted U-shaped function of the level of public good provision.

Taking this theoretical model to the data, in an empirical equation that omits local taxes, a positive coefficient on local public spending can be interpreted as under-provision of local public services, whereas a negative coefficient can be interpreted as over-provision. A coefficient that is not statistically different from zero implies optimal local public good provision. See Brueckner (1979, 1982) for early empirical applications and Bradbury, Mayer and Case (2001) and Hilber and Mayer (2009) for more refined empirical analyses in the same spirit.[2]

In a similar vein, within the Brueckner framework, full capitalization of any "windfall gain" at the local level—for example state educational aid in the United Staes or central government grants in the United Kingdom—implies

[2]Bradbury, Mayer and Case (2001) provide evidence for underspending on education in a sample of Massachusetts municipalities that were constrained by the property tax limit "Proposition 2½." The authors speculate that underspending on education was not only related to institutional constraints, but also to a conflict of interests between households with and without children. In this context, Hilber and Mayer (2009) document that whereas the median homebuyer outside of central cities in the United States has school-aged children, the median voter does not. Hence, house prices, which are determined by the marginal homebuyer, may reflect a strong preference for spending on education, from which the median voter derives few or no direct benefits. To the extent that the median voter puts more weight on the tax required for educational spending than on the capitalization of good schools into property values, the political process may yield underprovision of educational services from the perspective of the marginal homebuyer.

an *efficient* level of local public spending (see Barrow and Rouse 2004, Hilber, Lyytikäinen and Vermeulen 2011).

However, Brueckner's framework builds on a number of restrictive assumptions, perhaps most importantly; costless mobility, homogeneity of tastes and perfect substitutability of locations. If places are inherently different and households vary in their appreciation for these differences and/or in their relocation costs, the demand curve for living in a certain place becomes downward sloping (see Arnott and Stiglitz 1979 for an early discussion of this argument; the sub-section below entitled "Theoretical Considerations: Assumptions on the Demand Side" examines it in more detail). The proposition of a downward sloping local demand curve has important implications for the provision of local public services: for example, spending on services for the elderly can be expected to capitalize less strongly than spending on education. This is because in most places an elderly household is less likely than a household with young children to be a "marginal homebuyer." (The reverse argument of course applies to retirement communities in states such as Florida or Arizona.) Furthermore, downward sloping demand introduces a role for supply conditions: capitalization can be expected to be stronger in places where housing supply is less elastic, either because of limited availability of developable land (geographical supply constraints) or because of regulatory constraints on new residential development (I discuss this point in the sub-section below entitled "Theoretical Considerations: Assumptions on the Supply Side").

Another stringent assumption in the Brueckner framework is that additional spending is not "wasted." Yet, additional resources may not only be used to provide more and/or better public services but may be devoted to economic rents, *e.g.*, by increasing the salaries of existing public sector workers or by granting additional perks, leading not only to Pareto-inefficient but also X-inefficient provision of public services (see *e.g.* Wykoff 1990). To the extent that additional spending is wasted, all else equal, it does not increase the desirability of a location, will not increase housing demand and will therefore leave house prices unaffected. Of course, all else may not be equal: to the extent that local spending is funded by local taxes rather than federal or central government grants (which—from the perspective of local jurisdictions—can be interpreted as "windfall gains"), the fiscal differential can be expected to be negatively capitalized.

In conclusion, one ought to be very cautious in inferring normative claims (under- or over-provision of local public services) from an empirical analysis of capitalization. In an empirical specification that omits local taxes, a zero coefficient on local public services may not be interpreted as a

Pareto-efficient outcome. In a similar vein, full capitalization of federal, state or central government grants into local house prices, all else equal, may not necessarily imply allocative- and/or cost-efficiency. This is because full capitalization could be a combination of various opposing effects. For instance, heterogeneity in tastes for education could lead to underspending from the perspective of the marginal homebuyer (implying more than full capitalization) and at the same time, some of the aid or grants could be wasted on bureaucracy (implying less than full capitalization), so that on balance full capitalization could not be rejected empirically. Generally, in settings where (1) locations are not perfect substitutes, (2) relocation costs are quite high and vary between different types of households,[3] (3) households are heterogeneous in many respects other than their income and (4) housing supply price elasticities vary across locations, the extent of capitalization of fiscal variables into local house prices may contain little information content that would permit making an efficiency claim (see also Ross and Yinger 1999, Hilber, Lyytikäinen and Vermeulen 2011).

Another important theoretical question, which has implications for empirical work, is whether house price capitalization is a characteristic of long-run equilibrium. Building on Brueckner's framework and also integrating a voting process, Yinger (1982) suggests that capitalization can persist in long-run equilibrium and is not eliminated by supply responses. He concludes that efficient outcomes depend on local residents voting for the efficient level of services; foot-voting alone does not guarantee efficient levels of public goods.

In a similar vein, a number of theoretical articles explored whether capitalization can persist in Tiebout-equilibrium. Edel and Sclar (1974), Hamilton (1976a) and Epple, Zelenitz and Visscher (1978), among others, proposed that in a world with completely elastic supply of local communities, public sector variables should be uncorrelated with house prices in full Tiebout-equilibrium. Hence, capitalization should be interpreted as a disequilibrium phenomenon that will disappear in the long-run. However, Epple and Zelenitz (1981) demonstrated that capitalization can exist in equilibrium if community boundaries are fixed exogenously; a reasonable assumption, at least in the short and medium run.

As the theoretical literature on house price capitalization is ambiguous about whether (full) capitalization of fiscal variables into house prices should persist in long-run equilibrium, I turn next to the empirical work.

[3]Relocation costs are particularly high for homeowners but also for households in public rental housing. Public housing is not very relevant in the United States but in many countries a large share of the housing stock is public (*e.g.*, in Holland or Scotland).

Evidence on the Extent of Capitalization of Fiscal Variables and Amenities

On the empirical side, numerous studies followed up on Oates (1969) and suggested improvements.[4] The vast majority of the earlier studies explore the capitalization of fiscal variables—mainly local expenditures on public schools and property taxes—into house prices and find substantial if not full capitalization (*e.g.*, Oates 1969, 1973, King 1977, Stull and Stull 1991, Man and Bell 1996). Reinhard (1981) even finds evidence of overcapitalization.[5] Only a few studies, notably, Pollakowsky (1973), Wales and Wiens (1974), Follain and Malpezzi (1981) or McMillan and Carlson (1977), do not find any evidence of capitalization. The last study is particularly noteworthy because it estimates capitalization effects in small towns in rural Wisconsin. One proposition—further explored below in the sub-section entitled "Theoretical Considerations: Assumptions on the Supply Side" is that the no-capitalization finding may be due to fairly elastic long-run housing supply in rural places.

Over the last few decades various methodological advances have led to more reliable estimates of capitalization effects. One important innovation has been the introduction of the "boundary discontinuity" (BD) approach, first applied by Cushing (1984) to study the capitalization of interjurisdictional fiscal differentials into house price differentials between adjacent blocks at the border of two jurisdictions. Cushing finds roughly full capitalization of tax rates as well as significant capitalization of education and library services. Subsequent, more refined, BD studies focus on the capitalization of school quality (*e.g.*, Black 1999, Gibbons and Machin 2003, 2006, Davidoff and Leigh 2008, Fack and Grenet 2010, Gibbons, Machin and Silva 2013, Gibbons and Machin 2008 provide a comprehensive survey). Whereas all these studies find statistically significant effects, quantitative effects vary significantly: a one standard deviation increase in school quality raises house prices by between 2% and 10%.[6]

[4]Chaudry-Shah (1988), Dowding, John and Biggs (1994) or Ross and Yinger (1999) provide comprehensive reviews of the earlier literature.

[5]Under the assumption of a discount rate of 5% and a time horizon of 40 years the implied rates of capitalization of the local property tax are as follows: Oates (1969): 67%; Oates (1973): 93%; King (1977): 67%; Man and Bell (1996): 90%; Reinhard (1981): 145%. Stull and Stull (1991) assumed a discount rate of 10% and an infinite time horizon to compute a capitalization rate of the property tax of 75%. Numerous studies explored capitalization rates of other types of taxes. Man and Bell (1996) concluded that the extent of capitalization of the sales tax was relatively low with 18%. The findings of Stull and Stull (1991) imply a rate of capitalization of the US income tax, from the viewpoint of a median income household, of 75%. Basten, von Ehrlich and Lassmann (2014), focusing on income taxes in Switzerland, demonstrate that about a third of the capitalization effect of income taxes can be traced back to sorting of high-income households into low-tax municipalities.

[6]See Davidoff and Leigh (2008, Table 1) for a more extensive comparison and discussion of these studies.

A few studies use variation induced by "natural experiments." For example, Bogart and Cromwell (2000) exploit school-redistricting, using a difference-in-difference estimator. Reback (2005) examines the adoption of an interdistrict school choice program to identify the capitalization effects associated with the diminished relevance of school district boundaries. Kane, Staiger and Riegg (2006), finally, exploit variation in school boundaries caused by a court-imposed desegregation order. The estimates of the latter two studies suggest comparable quantitative magnitudes to the BD studies: a one standard deviation increase in school quality raises house prices by 3.8–7.7% and by 10%, respectively.

Various other studies use alternative methodological approaches to examine whether local taxes or public services are capitalized into house prices. They too, by and large, reach the conclusion that fiscal variables impact house prices. For example, Brasington and Haurin (2006) use spatial statistical tools to identify the effect of school quality on house prices. Their findings suggest that a one standard deviation increase in school quality raises house prices by 7.6%. Clapp, Nanda and Ross (2008) use panel data and control for neighborhood unobservables to explore the effect of long-run changes in school quality and property taxes on house prices. Interestingly, their estimates of property tax capitalization increase significantly when they consider long-run changes. Palmon and Smith (1998a) focus on the spurious correlation problem between public services and taxes. Using unique data that varies in taxes but not in public services and thereby avoids the spurious correlation problem, they find full capitalization. Palmon and Smith (1998b), finally, address the under-identification problem by using estimates of rental values instead of net user cost. Their findings also imply capitalization rates indistinguishable from full capitalization.

While identifying causal effects of fiscal variables on house prices has been the focus of earlier studies that used a two-stage-least-squares (TSLS) technique, there have been advances in finding more plausibly exogenous instruments that arguably do not directly impact house prices (*i.e.*, valid "excluded instruments" from a theoretical point of view) and are not weakly correlated with the endogenous fiscal variables. For example, Rosenthal (2003) uses the random assignment of school inspections in England as an exogenous source of variation. He finds a price elasticity of school exam performance of 5%.

A number of studies focus on the question whether it is school inputs (expenditures) or school outputs (typically proxied by test scores) that are capitalized into house prices. For example, Downes and Zabel (2002) combine panel data techniques with the instrumental variable (IV) approach to identify the causal effect of reading test scores on house prices. Their estimates suggest that

school outputs rather than inputs are capitalized. In contrast, Bradbury Mayer and Case (2001) and Hilber and Mayer (2009) use a property tax limit as an exogenous source of variation to identify changes in school spending. Controlling for school test scores, they find that communities that were constrained by the property tax limit realized gains in property values to the degree that they were able to increase school spending despite the limitation, suggesting that at least in these constrained locations the marginal homebuyer valued additional spending on schools beyond the test scores alone.

A related question is whether the effect of school quality on house prices is linear, as is assumed in most capitalization studies. Cheshire and Sheppard (2004), using data for the United Kingdom, document that better school quality only commands a substantial price premium in the top third of the quality distribution. Chiodo, Hernández-Murillo and Owyang (2010) explicitly test the nonlinearity between school quality and house prices in a U.S. context and confirm its importance, concluding that the relationship between school quality and house prices in the BD framework would be better characterized as a nonlinear relationship.

A few studies focus on fiscal transfers across jurisdictions (both, of a horizontal and vertical nature). Barrow and Rouse (2004) estimate the effect of state education aid in the United States on residential property prices within the Brueckner (1979, 1982, 1983) framework outlined in the previous sub-section. In such a restrictive setting, a full capitalization finding (*i.e.*, a $1 increase in state education aid generates a properly discounted $1 increase in property values) may be interpreted as evidence that school districts spend their money efficiently. Their results provide no evidence of massive overspending by school districts, that is, potential residents appear to value education expenditure. In a similar vein, Hilber, Lyytikäinen and Vermeulen (2011) explore the impact of central government grants on local house prices in England. Using panel data and an exogenous source of variation in grants to identify the causal effect on house prices, their results indicate substantial to full capitalization. Interestingly, they find that house prices respond more strongly in locations in which new construction is constrained by physical barriers. The latter result suggests that long-run supply constraints may affect the extent of capitalization; a proposition that is explored in more depth below in the sub-section "Theoretical Considerations: Assumptions on the Supply Side".

Finally, a few recent empirical studies advanced knowledge by focusing on the determinants of the extent of house price capitalization. For example, Figlio and Lucas (2004) demonstrate that the likely capitalization effect is greater the more information on school quality is available, suggesting that the degree of information availability may affect the extent of capitalization.

Hilber and Mayer (2009) establish, using a first-difference IV specification, that municipalities with less available land for new construction have a lower supply–price elasticity and a greater extent of capitalization of various demand factors, including instrumented school spending. Cheshire and Sheppard (2004) estimate a lower hedonic price of school quality in areas with more construction. They conclude that their finding is due to rational discounting of current school quality in areas with plenty of new housing supply as a result of greater risk that the quality may not persist in the longer run.

The "New Economics of Equilibrium Sorting"

Although the "traditional" capitalization literature, discussed above, has been focusing on local public sector efficiency and empirical evidence of capitalization effects, more recently, advances in economic models of the household sorting process have led to a new framework—the "New Economics of Equilibrium Sorting" (Kuminoff, Smith and Timmins 2013)—that has close links to the literature discussed above but has a rather different focus and intellectual foundation. Although sorting models are largely based on the idea of Tiebout sorting, the theoretical framework crucially builds on the intellectual foundations of the literature on hedonic and discrete-choice models of differentiated product markets. The foundations can be traced back to the seminal contributions by Rosen (1974) on hedonic prices and implicit markets and by McFadden (1974) on discrete choice modeling.

In a nutshell; equilibrium sorting models (ESMs) combine the information provided by an equilibrium hedonic price function (Rosen 1974) with a formal description of the choice process that underlies market sorting of heterogeneous agents (McFadden 1974). Two types of sorting models can be distinguished. Vertical sorting models (*e.g.*, Epple and Sieg 1999) summarize differences in choices by a single index (*e.g.*, neighborhood quality) that everyone agrees on. In these models, agents may have heterogeneous preferences for neighborhood quality versus other types of consumption. In contrast, horizontal models (*e.g.*, Bayer, Ferreira and McMillan 2007) allow for heterogeneity across individuals in preferences for specific neighborhood attributes.[7] The basic idea of all these models is to use information on sorting decisions of heterogeneous agents to infer behavioral parameters. These parameters are then typically used to (1) infer welfare effects of a (large) policy change and (2) predict behavior in response to a (large) policy change. The framework

[7]For example, consider one household that values good schools and another one values clean air. Both households may end up in the same neighborhood. Although horizontal models are arguably more realistic, one caveat is that they frequently rely on an "idiosyncratic taste" shock to facilitate estimation (Timmins 2014).

can be used to evaluate past policies, but it is particularly useful to evaluate prospective policies. The ESM framework has been applied to various types of public goods and services, amenities, externalities or housing policy reforms. Examples include the quality of public education (*e.g.*, Bayer, Ferreira and McMillan 2007, Kuminoff and Pope 2014), air quality (*e.g.*, Banzhaf and Walsh 2008, Tra 2010), congestion (*e.g.*, Murdock and Timmins 2007) or mortgage interest deduction reforms (Binner and Day 2015). Kuminoff, Smith and Timmins (2013) provide an excellent and comprehensive review of the state of knowledge in this literature, the possibilities for policy analysis and the conceptual challenges that define the frontiers of this literature.

Particularly relevant for this synthesis article, Kuminoff and Pope (2014) discuss factors other than the supply price elasticity—highlighted in this synthesis article—that can drive a wedge between capitalization effects (*i.e.*, changes in house prices as a response to exogenous shocks to, *e.g.*, local public goods, amenities or externalities) and the public's willingness-to-pay. Kuminoff and Pope demonstrate that in a setting with trading between heterogeneous buyers and sellers in a market, capitalization effects can in some cases have a welfare interpretation comparable to that of Rosen's (1974) hedonic model (which assumes perfectly elastic local housing demand and thus implies "full capitalization"). In other cases, however, it is unclear how to interpret capitalization effects, even if one is willing to accept the assumption that local housing demand is perfectly elastic and the supply price elasticity thus does not affect the extent of capitalization. This is due to the economic implications of some of the assumptions maintained in the hedonic model. One crucial assumption is that the gradient of the hedonic price function is constant over time. This assumption is questionable since even small changes in one amenity can trigger tipping effects via Tiebout sorting that can produce large changes in other features of equilibria (*e.g.*, Sethi and Somanathan 2004). As Kuminoff and Pope (2014) demonstrate, using BD designs and focusing on school quality, capitalization effects may understate parents' willingness to pay for public school improvements by as much as 75%. It is worth emphasizing however that regardless of the welfare interpretation of capitalization effects, accurate measurement of these effects has inherent value as these effects matter to homeowners, renters and beneficiaries of programs funded by property tax revenue (Kuminoff, Smith and Timmins 2013).

Housing Demand Price Elasticity, Local Supply Constraints and the Extent of House Price Capitalization

Why Does It Matter Whether Fiscal Variables Are Capitalized?

In the early capitalization literature that followed Oates (1969), house price capitalization was thought to be a means of testing for efficiency in the local

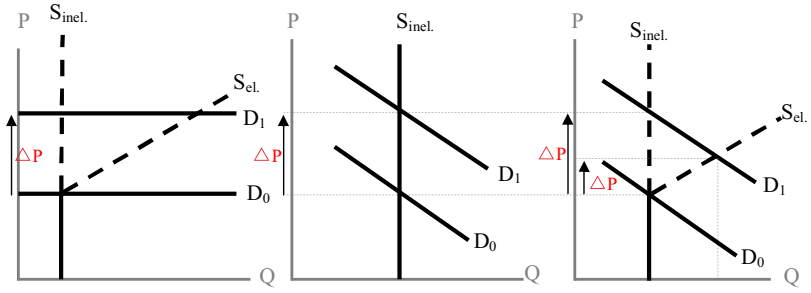
public sector: either in a more narrow sense—testing the Tiebout hypothesis—or in a broader sense—testing whether municipalities provide an optimal level of local public goods. The central point made in this article instead is that *the extent of house price capitalization itself* may have important economic implications. Specifically, house price capitalization *may provide incentives to invest* in the provision of local public goods, club goods or even private goods with positive externalities. Capitalization, or the lack thereof, may also have *important unintended redistributive consequences* and *other unintended effects*: they may offset the positive incentive effects of certain policy measures.

Furthermore, the possibility that the extent of capitalization systematically varies across locations has important implications for various strands of the economic literature. Research in many areas makes the implicit assumption of uniform capitalization (*i.e.,* local property values fully reflect the present discounted value of future benefits and costs). Such research includes urban quality-of-life comparisons (*e.g.*, Blomquist, Berger and Hoehn 1988, Gyourko and Tracy 1991, Gyourko, Kahn and Tracy 1999), capitalization studies of environmental amenities (*e.g.*, Smith and Huang 1995, Bui and Mayer 2003), capitalization studies of school quality and spending (see the above sub-section "Evidence on the Extent of Capitalization of Fiscal Variables and Amenities"),[8] capitalization studies of taxes (see also the sub-section "Evidence on the Extent of Capitalization of Fiscal Variables and Amenities") and capitalization studies of government subsidies or state aid (*e.g.*, Barrow and Rouse 2004).

The approach taken in these studies depends on demand factors alone and assumes either that demand for housing is perfectly elastic everywhere, so that the elasticity of the long-run housing supply curve is irrelevant and shifts in demand are thus fully capitalized everywhere (the situation depictured in Figure 1, Panel A) *or* that local demand curves are downward sloping but that the supply of undeveloped land is inelastic and similar across locations, so that shifts in demand are also fully capitalized everywhere (Figure 1, Panel B). If however local demand curves are downward sloping (somewhat inelastic) and the supply elasticity varies across locations, then the extent of capitalization will also vary across locations. This situation is illustrated in Figure 1, Panel C. To the extent that we are in a setting as depictured in Panel

[8]Studies that use a BD approach, such as Black (1999), only look at houses very close to attendance district boundaries where land supply might indeed be equally and completely inelastic. Cross sectional studies, however, normally present estimates based on much less disaggregated data and do not take into account differences in the land supply elasticity. The estimated coefficients in these studies may be biased.

Figure 1 ■ The Role of Demand and Supply Price Elasticities



C, the conclusions of all the studies listed in the previous paragraph may be inaccurate. This is because house price capitalization estimates cannot be easily interpreted as a household's willingness to pay for local amenities or local fiscal variables. This is often true in the United States outside of coastal areas as well as in parts of Continental Europe and in the less urbanized areas of many developing countries.[9]

The next two sub-sections discuss the factors that determine the elasticities of the local demand and supply curves respectively. They thus help determine the extent to which house prices respond to changes in local demand.

Theoretical Considerations: Assumptions on the Demand Side

In a world where households are homogenous and can relocate without any moving costs and locations are perfectly substitutable, the local demand for housing will be perfectly elastic. In such a setting a given exogenous demand shock should always be fully capitalized into house prices independent of the long-run supply price elasticity (at least as long as the supply curve is not perfectly elastic). Two important spatial equilibrium models—the Rosen-Roback model (Rosen 1974, Roback 1982) and the open monocentric city model (see, *e.g.*, Brueckner 1987) —implicitly assume such perfectly elastic local housing demand. The crucial assumptions are that households all have the same preferences and can relocate without costs. If these two assumptions hold, even if places differ in their local attributes, local supply constraints on

[9]The long-run supply may be particularly elastic in Africa and parts of Asia where few cities have effective controls on land availability. The important exceptions are India (see Bertaud and Brueckner 2005) and China (see Cheshire 2007), where supply of land is quite strongly regulated and constrained.

housing in a particular location that offers a particular amenity (*e.g.*, access to a lake) do not only raise prices locally but in all locations that offer the scarce amenity (*i.e.*, all locations that offer access to lakes). Local supply constraints should not matter at the local level; they should only matter in aggregate as they restrict the supply of a scarce amenity so raise the price of that amenity everywhere. This is because demand for housing in all locations that offer the scarce amenity is perfectly elastic and therefore the price of the amenity must be the same everywhere.

In reality places differ in their provision of local public services, in their local taxes and their amenities. Some of these local attributes are rather unique (*e.g.*, a view on the Golden Gate Bridge) or are at least in short supply (*e.g.*, top quality local public schools). Moreover, households have heterogeneous tastes, that is, they vary in their appreciation for differences in local attributes.[10] Households with a strong preference for a certain local attribute (subject to income) are willing to pay more for that attribute than other households. This induces sorting of households with different preferences into different places so the preferences of the marginal homebuyer and the corresponding willingness-to-pay for certain amenities may differ across space. In such a world with heterogeneous tastes, the local housing demand curve becomes downward sloping. With each additional household entering a community, all else equal, the marginal homebuyer has an ever lower willingness to pay for living in the place. By implication, house prices cease to reflect the willingness to pay for local public services and amenities of inframarginal households.[11]

Households—especially homeowners but also renters in public housing—also face very substantial relocation costs. This is another mechanism that can induce the local demand curve to become downward sloping (at least in the short- and medium-run). It is quite intuitive that with heterogeneity in relocation costs, the housing demand curve becomes downward sloping—even if all households have the same tastes. Krupka and Donaldson (2013) provide

[10]See Bayer, Ferreira and McMillan (2007) who demonstrate that there is considerable heterogeneity in preferences for schools and neighbors, with households preferring to self-segregate on the basis of race and education.

[11]See for example Arnott and Stiglitz (1979) for an early discussion of this argument. For a more recent discussion and formal treatment of taste heterogeneity (and imperfect mobility) see Albouy (2011, section 5). Theoretical models with imperfect substitutability between locations generally assume heterogeneity in tastes for locations. See e.g. Gyourko, Mayer and Sinai (2013), Aura and Davidoff (2008) or Hilber and Robert-Nicoud (2013). In such models, supply constraints may raise prices because they constrain the number of households, so that the marginal household has a higher willingness to pay for residing in the place.

a formal treatment of this argument by altering the Rosen-Roback framework to allow for moving costs which vary among a city's residents and businesses. In such a setting regional differences in rents and wages can no longer be interpreted as compensating. Although in a world with heterogeneous housing costs amenities are still important for housing rents, the local housing supply becomes the main other factor determining regional rents.

A special form of relocation costs or taste heterogeneity is "attachment to one's home": households may differ in their willingness-to-pay for access to certain locations because of an attachment to their place of birth (see, *e.g.*, Mansoorian and Myers 1993, Krupka 2009). That is, households may have similar preferences for certain locations once they leave their home town (they have the same utility in the rest of the economy); however, their willingness-to-pay for living in their own home town will always be greater (households derive idiosyncratic benefits from this particular location). Gibbons, Overman and Resende (2011) note in this context "... when people have different preferences over locations, even when they offer the same amenities, ... [s]upply constraints in one location can make an amenity there look more expensive, because those with the strongest preferences for that location want to live in that location, and are prepared to pay more for any amenity in that location than other people. ..." and "... the implication is that the price differentials between areas measure the value of these areas to the marginal household, which is not necessarily the average household in terms of preferences."

To what extent (differences in) *local* supply constraints matter is—in the end—an empirical question. It will depend on (1) the degree of substitutability of locations (how heterogeneous locations and preferences are), (2) relocation costs (the share of the population that moves between labor markets in each period) and, as a special case; (3) idiosyncratic benefits that some households derive from certain locations (*e.g.*, their place of birth).

Glaeser and Ward (2009) argued that housing demand may be pretty elastic across municipalities within a metro area and hence local supply constraints may not matter much for the extent of house price capitalization at the very local level. They state that "[t]he same abundance of similar, small jurisdictions that makes Greater Boston a natural place to examine the impact of land use controls on new construction makes the area a much less natural place to examine the impact of land use controls on price. There are so many close substitutes for most towns that we would not expect restricting of housing supply in one town to raise prices in that town relative to another town with similar demographics and density levels. Restrictions on building in one suburban community should not raise prices in that community relative

to another town with equivalent amenities, any more than restrictions on the production of Saudi Arabian crude will raise the price of Saudi Arabian crude relative to Venezuelan crude. Of course, Saudi Arabia's quantity restrictions will still raise the global price of oil, but this cannot be seen by comparisons of prices across oil producers."

The analogy of oil and land is not unproblematic, however. Whereas Saudi Arabian and Venezuelan crude may indeed be perfect substitutes, the same is typically not the case for two parcels of land; even if these are located in neighboring municipalities. To begin with, not all metro areas are as homogeneous as the Greater Boston area. Moreover, even in the Greater Boston area, say downtown Boston or Cambridge are poor substitutes for the less urbanized towns surrounding Boston. Hence, while land parcels in two neighboring towns in the outer ring of Greater Boston may indeed be close substitutes, this is not true for all places in Greater Boston. In fact Hilber and Mayer (2009) provide evidence that comparably less physically developed locations in Massachusetts have more elastic supply of housing and a smaller extent of house price capitalization, compared with the more developed locations. Their results hold even if they confine their sample to the Greater Boston area only (although the effects are slightly less pronounced). In a similar vein, Lutz (2015) examines the effect of a large exogenous shift in property tax burdens induced by a 1999 school finance reform in the state of New Hampshire. His estimates suggest that, in most of the state, municipalities with a reduced tax burden experienced a large increase in residential construction. In the area of the state near Boston, the region's primary urban center, however, the shock cleared through price adjustment. Lutz attributes these differing responses to differing housing supply elasticities. Both, the findings of Hilber and Mayer (2009) and of Lutz (2015), are suggestive that local demand in the Greater Boston area is not perfectly elastic.

Theoretical Considerations: Assumptions on the Supply Side

In a world with downward sloping local demand curves, assumptions on the slope or elasticity of the local supply curve are crucial for the response of house prices to given demand shocks. Local long-run supply constraints are bound to affect the local supply price elasticity and, consequently, the "extent" of capitalization of fiscal variables. In this sub-section I explore the degree to which the extent of house price capitalization can be expected to vary across locations due to differences in *geographical (or physical) supply constraints* and/or due to differences in *regulatory supply constraints*.

A number of empirical studies suggest that *geographical supply constraints* may affect the supply price elasticity and that therefore demand shocks should

have a stronger impact on house prices in such constrained places. To begin with, McDonald and McMillen (2000) show for Suburban Chicago that residential development is greater in areas with a large share of agricultural land. Brasington (2002) documents, by splitting a sample into houses on the interior and the edge of the urban area, that capitalization is weaker towards the edge where housing supply–price elasticities and developer activity are greater. Hilber and Mayer (2009) use aerial survey and satellite land cover data to compute for each municipality in Massachusetts and for each school district in the contiguous United States the *share of already developed residential land to total developable land*.[12] Their findings strongly support the proposition that more physically constrained places have less elastic housing supply and a greater extent of house price capitalization of demand factors. Saiz (2010) provides further evidence for the United States that geographical constraints affect the price elasticity of housing supply. His focus is on topography and the presence of water bodies (including Pacific and Atlantic oceans). Saiz measures the amount of developable land based on the presence of water bodies and high elevation, demonstrating that most metropolitan areas that are widely regarded as supply-inelastic are severely land-constrained by topography and water.

A number of theoretical explanations exist that can rationalize the finding of a link between geographical or physical constraints on the one hand and the inelasticity of supply of housing on the other. To begin with, at the extreme, when a highly desirable place is *fully built-up*, it is quite intuitive why the supply of developable land is almost perfectly inelastic: existing physical structures, which are typically well-maintained in desirable places, can only be demolished and reconstructed at higher density at an extremely high cost.

Most places have at least some developable land however. So the perhaps more relevant question is: Why should *more developed* locations have more inelastic supply and a greater extent of capitalization? The first argument is a purely mechanical one; mathematically, as long as the supply curve has a positive price intercept, even a linear curve generates a positive relationship between scarcity of developable land and the price *in*elasticity of supply.[13]

[12]Hilber and Mayer (2009) consider land to be non-developable if it is classified as open water, perennial ice, barren, or wetland. Their main definition of 'non-developable' land also includes industrial land but their results are essentially unchanged if they drop industrial land from the list of non-developable uses.

[13]The assumption of a positive price intercept is not restrictive. It merely implies that the present value of future land rents from farming is greater than zero. In locations where land is 'developable' (i.e., the land is not wetland or desert land) this is almost certainly the case.

A second argument is founded in the "endogenous zoning" literature. Saiz (2010) argues that high house prices, induced by geographical constraints, spur homeowners to vote for tighter regulation (*homevoter hypothesis*). He documents that, all else equal, more geographically constrained places have higher house prices and that these geographical constraints correlate positively and strongly with regulatory barriers to development and that both types of constraints negatively affect the elasticity of housing supply.

Hilber and Robert-Nicoud (2013) consider land use restrictions as political outcomes determined not only by voting but also by lobbying and considering also the role of landlords and owners of undeveloped land. They argue that owners of developed land—homeowners and landlords—have an incentive to limit new housing supply to protect the value of their assets, whereas owners of undeveloped land have an interest in flexible zoning (to keep development costs low). Both groups can potentially influence the political process through voting and lobbying. Hence, to the extent that the tightness of land use regulation is indeed the outcome of a political process, new housing supply ought to be more price-inelastic in more developed locations where owners of developed land are more numerous and, hence, arguably politically more influential (*influential landowner hypothesis*[14]). This reasoning also provides an explanation for why highly desirable areas (such as San Francisco or New York City) tend to be more tightly regulated: Desirable locations are more developed and, consequently, more regulated. This explanation reinforces the argument made for *fully built-up* places: to the extent that these places are also the most regulatory constrained, regulatory costs add to the already excessive

[14]The *influential landowner hypothesis* not only encompasses the voting mechanism (*i.e.*, the *homevoter hypothesis*), but also emphasizes the possibility that political outcomes are determined by lobbying. That is, owners of undeveloped land and absentee landlords may be able to influence the political process and the decision of planning boards even though they may not be able to directly elect the members of the (local) planning boards. The fact that the most regulatory constrained metro areas (New York City, San Francisco, Los Angeles) have (among the) lowest homeownership rates in the country is at least indicative that "homevoting" alone may not explain across metro area differences in regulatory restrictiveness. Numerous studies provide empirical support for this theoretical argument. Hilber and Robert-Nicoud (2013) provide extensive evidence at U.S. metro area level that suggests that the degree of physical development (local land scarcity) in a metro area may have a causal positive effect on the overall regulatory restrictiveness of that metro area. Various other studies provide additional support. For example, Rudel (1989) demonstrates that municipalities in Connecticut adopted land use laws later if they were at a greater distance to New York City and had a greater share of farmland. Increases in restrictiveness occurred in those places that experienced the largest declines in farming during the 1960s. Fischel (2004) documents that land use regulations typically originated in the centers of large cities and then spread to the surrounding suburbs and towns. Lastly, Glaeser, Gyourko and Saks (2005a) find a very high "regulatory tax" for Manhattan condominiums and much lower values for the entire metro area.

demolition and reconstruction costs when redeveloping existing sites in those places.[15]

A final argument can be derived from the real options literature, which assumes that land redevelopment is costly and developable open land therefore has an option value (see, *e.g.*, Titman 1985, Capozza and Helsley 1990, Capozza and Li 1994, Novy-Marx 2007). In such a setting, when a place becomes increasingly built-up, the incremental opportunity cost of adding an extra housing unit—the real option—increases, at some point, likely exponentially, implying inelastic supply of new housing.

A number of recent studies, conducted in the United States, document that *tight land use regulation* reduces the housing supply price elasticity (*e.g.*, Mayer and Somerville 2000, Harter-Dreiman 2004, Green, Malpezzi and Mayo 2005, Quigley and Raphael 2005, Saiz 2010) while raising price levels (*e.g.*, Malpezzi 1996, Glaeser and Gyourko 2003, Glaeser, Gyourko and Saks 2005a, b, Hwang and Quigley 2006, Quigley and Raphael 2005, Saks 2008). Mayer and Somerville (2000) find that metropolitan areas with more extensive regulation can have up to 45% fewer starts and price elasticities that are more than 20% lower than those in less regulated markets. Glaeser, Gyourko and Saks (2005a, b) conjecture that tight land use controls may be largely to blame for the exorbitant rise in housing prices in the United States during the late 1990s and early 2000s.

Whereas the studies discussed above focus on house prices, a small recent literature in the United States has explored the impact of supply price elasiticies—as measured by Saiz (2010) using variation in both regulatory and geographical constraints—on land values. Consistent with the literature discussed above, Davis and Palumbo (2008) find that land values are more volatile in metro areas with inelastic supply. Interestingly, Kuminoff and Pope (2012), who study land price volatility during the great boom and bust between 1998 and 2009, document the opposite pattern *within* metro areas: neighborhoods at the urban fringe experienced the most volatility in land values. Kuminoff and Pope speculate that this may be because the relaxation of credit constraints was particularly important for lower income households, allowing them to purchase houses at the fringe of the suburbs. In a setting with myopic agents or unrealistic expectations (irrational exuberance) and short-term construction lags, this might explain the higher land price volatility at the fringe.

[15]In the United States, typically, subdivision of existing developed parcels requires a zoning ordinance waiver.

Two recent studies, discussed above, suggest that the two types of supply constraints—regulatory and geographical—can be expected to be interlinked. Saiz (2010) suggests that the undevelopable area in an MSA is strongly positively associated with regulatory constraints. In a similar vein, Hilber and Robert-Nicoud (2013) provide evidence indicative of a causal effect running from share developed developable land to regulatory restrictiveness.

Hilber and Vermeulen (forthcoming) exploit a unique panel dataset of English local authorities[16] and use an IV-approach to jointly identify the independent causal effects of three different types of local supply constraints (all measured at the local authority-level): (1) regulatory constraints (proxied by residential refusal rates), (2) scarcity of developable land (proxied by the share of already developed land relative to all developable land, based on geo-coded satellite land cover data) and (3) topography-induced constraints (proxied by elevation ranges and measures of ruggedness). Hilber and Vermeulen (forthcoming) find that house prices react more strongly to labor demand shocks in more regulatory and in more physically constrained local authorities. The effect of regulatory constraints is strong across most of England (in line with the stylized fact that the British planning system is very restrictive by world standards), whereas the effect of constraints due to scarcity of developable land is confined to highly urbanized areas—mainly the Greater London Area.[17] Uneven topography has a quantitatively less meaningful impact. Finally, they find that the effects of supply constraints are greater during boom than during bust periods. Overall, Hilber and Vermeulen's (forthcoming) findings for England are consistent with the proposition that both types of constraints—regulatory and geographical constraints—reduce the long-term responsiveness of new construction to prices. Put differently, the extent of house price capitalization is greater in places that are constrained by regulatory restrictions *and* by physical barriers to residential development. Both types of constraints may thus serve as proxy measures that allow researchers to identify the effects of house price capitalization on the provision of public goods, club goods and private goods.

[16] Although the typical English local authority—with an average of around 144,000 residents—is significantly larger than an average sized American municipality, it is significantly smaller than the larger U.S. metro areas.

[17] Interestingly, this finding is consistent with the combined results in Hilber and Mayer (2009) and Lutz (2015). Although land availability does not have a significant impact on the housing supply elasticity in New Hampshire where land for development is abundantly available in most parts of the state. In much denser neighboring Massachusetts—the Commonwealth is the third densest U.S. state—land availability does influence the housing supply elasticity.

Capitalization and Incentives to Invest: A First Step Towards a "Taxonomy"

In this section I explore how house price capitalization induced incentives in supply constrained locations may provide a mechanism—besides other factors such as altruism or reciprocal behavior—to induce homeowners and, in particular, mobile homeowners to invest in local public goods, club goods, or even private goods with positive externalities (such as exterior home improvements). The broader aim is to develop a "taxonomy" of how house price capitalization and homeownership may affect the provision of these different types of goods. As I will outline below, the underlying mechanisms differ for different types of goods and institutional settings. I also review the scant empirical evidence that tests the theoretical predictions.

Local Public Goods: the Case of Collective Investments in Public Schools

A few theoretical studies have pointed out that the presence of house value capitalization may induce homeowners to take into account preferences of eventual buyers of their house when voting on durable local public goods (*e.g.*, Wildasin 1979, Sonstelie and Portney 1980, Brueckner and Joo 1991). The theoretical models of Wildasin (1979) and Sonstelie and Portney (1980) both illustrate that, all else equal, (mobile) voters prefer public good levels that maximize their house values. If the public good level is suboptimal from the viewpoint of local residents they have the option to sell their house and move to another local jurisdiction, in which the fiscal package better matches their preferences. Brueckner and Joo (1991) consider the decision of imperfectly mobile voters in the presence of house price capitalization. Their model demonstrates that a voter's ideal public spending level reflects a blend of his or her own preferences for local public goods and those of the eventual homebuyer. In a world with imperfect mobility, the voter no longer solely seeks to maximize the house value, although house value maximization considerations become more important, the shorter the expected duration in the local jurisdiction. Their model also suggests that liquidity constrained households are more likely to behave like property value maximizers than unconstrained households. Fischel (2001a, b) described homeowners as "homevoters" whose voting and local political activities are guided by their concerns about home values.

A few empirical papers provide support for this view. To begin with, Brunner, Sonstelie and Thayer (2001) examine voter behavior in a California school voucher initiative. Their finding of a negative correlation between the premium paid for housing and support for the school choice initiative suggests that homevoters who feared that their property values may be adversely affected,

voted against the proposal. In a follow-up study, Brunner and Sonstelie (2003), using a survey of potential voters on California's school voucher initiative, provide evidence consistent with the view that homeowners vote to protect their property values: homeowners without school children were significantly more likely to vote for the voucher if they lived in neighborhoods with inferior schools (where vouchers are expected to increase property values) than if they lived in neighborhoods with superior schools (where vouchers likely decrease property values). Dehring, Depken and Ward (2008) propose that homeowners vote in favor of public projects they perceive increase house values and against those that do not. Using information from pre-referendum events and the referendum itself on a proposed publicly subsidized NFL stadium in Arlington, TX, they provide support for the homevoter hypothesis in the sense that local residents voted in favor of the stadium if the project was likely to increase their house values. In a similar vein, Ahlfeldt (2011) examines support for a major urban development project in Berlin, albeit, in an environment of *very low owner-occupancy*, that is, in an area where the median voter is a renter. Consistent with the findings of the previous studies, Ahlfeldt's findings suggest that (renter-)residents oppose public projects they associate to increases in the local cost of living.

Hilber and Mayer (2009) developed a simple formal framework to examine the impact of house price capitalization on the decision of local voters whether to support a durable increase in local public school spending. The investment entails a commitment to increase school spending, financed via local taxes, over a number of periods. Hence, the benefit in form of better school quality and the tax cost accrue in the future, as well as in the present period. In this setting, whether the investment occurs depends on the payoff of the median voter.

Consider the (plausible) case where (1) the investment generates a positive net benefit for households with children in each period, (2) the marginal homebuyer has children and (3) some portion of the net benefit is capitalized into house prices (positive extent of capitalization). In this setting, all else equal, homeowners will always be more likely than renters to vote in favor of the investment. Moreover, existing homeowners without children (including the elderly) support the investment, as long as their expected duration in the property is short enough. The model further predicts that these households should be sensitive to the extent of capitalization. The simple framework—which is outlined in more detail in Hilber and Mayer (2009)—makes four empirically testable predictions for the provision of local public goods in a system where local residents vote on local public good provision (either directly or indirectly). In general terms, the predictions can be summarized as follows:

Prediction 1: An investment in a durable local public good (that has a positive net benefit from the perspective of the marginal homebuyer) will be greater/more likely in more supply constrained locations, where the expected "extent of capitalization" of given demand shifts is greater.[18]

Prediction 2: The positive link between the "rigidity of supply constraints" and investments in durable local public goods should only exist in locations where the median resident is a homeowner.

Prediction 3: The interaction between measures of the "rigidity of supply constraints" and a "high share of households with a relatively short expected duration in their property" should be positive. (Applied to the case of local public schools in the US institutional setting; the elderly, who have a comparably shorter expected time horizon in their property, can be expected to be more willing to support school spending in districts where the extent of capitalization is high.)

Prediction 4: The positive relationship between "share of households with a short expected duration" and "rigidity of supply constraints" should be strongest for the group of residents with the shortest expected duration.

In their empirical work Hilber and Mayer (2009) identify a proxy for the extent of house price capitalization—the supply of land available for new development—and show that towns in Massachusetts with little undeveloped land have larger changes in house prices in response to a plausibly exogenous spending shock. Towns with little available land also spend more on schools. They then extend these results using data from school districts in 46 U.S. states, showing that per pupil spending is positively related to the percentage of developed land (Prediction 1). This positive correlation persists only in districts where the median resident is a homeowner (Prediction 2) and is stronger in districts with more elderly residents who do not use school

[18]Hilber and Mayer's (2009) interpretation of this prediction is that local supply constraints determine the extent of capitalization of demand factors: If the local demand curve is downward sloping—as discussed above in the sub-section "Theoretical Considerations: Assumptions on the Demand Side"—the rigidity of local supply constraints should determine the extent of capitalization. It is worth noting, however, that another mechanism may bring about the same empirical finding: In school districts with elastic supply, investment in a local public school may attract many new families with school-aged children. These additional children use up resources. The newcomer's children may also be difficult and costly to integrate. This in turn may 'dilute' the investment-induced school quality and, consequently, house prices may increase less than in the absence of the newcomers. Hence, even if the observed (diminished) school quality were fully capitalized, local supply constraints would still matter for 'incentives to invest'. The idea of a 'dilution effect' is discussed in the next sub-section in the context of individual social capital investment.

services and have a shorter expected duration in their home (Prediction 3). Finally, they find that these positive interaction effects are strongest for the group of older elderly with the shortest expected duration in their property (Prediction 4). Hence, their findings support theoretical models in which capitalization encourages the provision of durable local public goods (and provide an explanation for why some elderly support local school spending).

Club Goods: the Case of Individual Investments in Local Social Capital[19]

A number of empirical studies document a positive link between homeownership and individual investment in social capital and civic efforts (*e.g.*, Rossi and Weber 1996, DiPasquale and Glaeser 1999, Hoff and Sen 2005).[20] DiPasquale and Glaeser (1999) provide evidence that is suggestive of a causal effect from the former onto the latter. Capitalization of community quality into house prices may be a plausible mechanism explaining the link. In fact, Glaeser and DiPasquale (1999) argue that homeowners are "better citizens" because homeownership creates barriers to mobility and gives individuals an incentive to invest in local amenities and social capital *since community quality is capitalized into property values*. Coulson, Hwang and Imai (2003a, b) and Coulson and Li (2013) provide direct evidence that external benefits associated with higher neighborhood homeownership rates are capitalized into higher housing prices.[21] However, alternative mechanisms such as reciprocal behavior[22] could potentially also explain a positive link between homeownership and social capital (see Hilber 2010 for a discussion of alternative explanations).

It is tempting to conclude that the predictions outlined above for the case of public investment in local public schools (or other durable local public goods) should equally apply to the case of private investment in social capital/social capital induced neighborhood clubs (such as neighborhood watch groups). Yet, the two types of investment differ crucially from each other. In the former setting the *public* vote is binding for all residents and direct benefits accrue only to a minority of residents (households with children). Yet, all residents bear the direct tax costs. In the latter setting each resident makes

[19]This Section draws heavily on Hilber (2010).

[20]See Dietz and Haurin (2003) for a review of the wider literature on the microlevel economic and social consequences of homeownership.

[21]In contrast to the former studies, the latter exploits the panel nature of the American Housing Survey data to account for unobservable neighborhood and housing heterogeneity.

[22]For an exposition of the mechanism of reciprocal behaviour, see, for example, Helsley and Strange (2004).

an *individual* investment decision that only has private cost implications. As long as investors can largely exclude those who do not invest from access to social capital induced benefits, there will be a link between investment and direct benefits. Nevertheless, homeowners can in principle free ride on other neighbors' investments by not investing and selling their property. (In the case of local public schools, either nobody or all residents invest.) This implies that in the case of neighborhood specific social capital, nobody may initially have an incentive to invest, unless some "mechanism" prevents free riding. This mechanism may be the existence of *housing transaction costs*: selling a property *only* to free ride on other neighbors' investments is not an attractive option if the transaction costs exceed the benefits derived from social capital. Transaction costs of selling a house—even when excluding any other relocation costs—are typically quite high. For example, Haurin and Gill (2002) estimate these transaction costs in the United States as the sum of 3% of the house value and 4% of total household earning.

In a world with high transaction costs the question then becomes whether the homeowner's long-term benefits derived from social capital exceed the costs. The answer to this question crucially depends on the elasticity of new local housing supply. Consider a neighborhood where renters can relocate freely but transaction costs make existing homeowners immobile. In such a setting homeowners have greater incentives to invest in social capital compared to renters as long as the long-term net benefits exceed the initial investment costs *and* investors can, for the most part, exclude noninvestors from access to social capital induced club goods. This is because homeowners can internalize the long-term net benefits from their investments, whereas renters are at least partially deprived of those net benefits (landlords can pocket proceeds by increasing rents).

In this setting, the elasticity of new housing supply is critical for social capital investment because, all else equal, it affects the inflow of newcomers and thereby determines the homeowners' long-term net benefits from social capital. In a *built-up neighborhood* with inelastic supply of developable land, initial investors in social capital are largely protected from inflows of newcomers that could dilute the long-run net benefit from that social capital. Dilution may occur either as a consequence of an increase in social capital maintenance costs or due to congestion effects on the consumption side.

In contrast, in a *little developed neighborhood* with elastic supply, newly accumulated social capital will steer landowners to develop new housing units as long as the price exceeds the marginal (opportunity) cost of conversion. In the long-run, the net benefit from social capital is diluted to an extent that the marginal newcomer's net benefit and the corresponding house price premium

become very small. It is quite intuitive that in such a setting nobody has an incentive to make an investment in neighborhood specific social capital in the first place. The above theoretical considerations imply two general, empirically testable, predictions:

Prediction 5: The positive link between individual homeownership and individual investment in local club goods (*e.g.*, neighborhood specific social capital investment) should be stronger, all else equal, in more supply constrained locations.

Prediction 6: Newcomers should socially interact with other neighbors after a brief period (to get access to the club goods) and there should not be much increase in the intensity as the duration in the neighborhood increases.

The *expected* duration in the property should have a positive effect on individual investment in neighborhood specific social capital, unlike in the case of a durable increase in local public school spending. This is because the accumulated benefits derived from social capital increase with the expected length of stay, whereas the large initial burden (in the form of efforts needed to generate trust and friendship among involved club members) accrues even if the residents only have a short duration. Moreover, the benefits associated with the sale of a property at the time of exit accrue independent of whether or not a homeowner bears the investment costs. Hence, a longer expected duration should increase the likelihood that the investment has a positive payoff. The following should hold:

Prediction 7: Individual investment in local club goods (such as neighborhood-specific social capital) should be positively related to the expected time until the next move.

Moreover, unlike in the case of local public schools, homeowners with a short expected duration in the property should not react sensitively to the extent of capitalization. They will always be better off not investing, independent of the extent of capitalization.

Hilber (2010) uses an IV-approach and data from the Social Capital Community Benchmark Survey to document that the positive link between homeownership and individual social capital investment is indeed largely confined to more built-up neighborhoods with more inelastic supply of new housing (Prediction 5). The empirical findings provide support for the proposition that in these localities supply constraints, which ensure that initial social capital investments increase house values, provide additional incentives for

homeowners to invest in social capital. Hilber (2010) also provides evidence supporting Predictions 6 and 7.

Unintended Redistribution and Other Unintended Effects of Capitalization

Redistributive Effects: Theoretical Considerations and Empirical Evidence

The proposition that government policies are capitalized into land values and thereby can have unintended redistributive consequences goes back all the way to David Ricardo (1817) who studied the Corn Laws passed in England during the first decade of the 19th century. Ricardo argued that a tax on imported corn to raise its price, and thereby protect British farmers, would have the effect of raising the rent of wheat land (and hence its value) until the benefits to the farmer renting the land are effectively wiped out. The true beneficiaries of the policy would be the landlords who own the land.

In a residential (and more modern) context, several authors have argued theoretically that location-based aid (as opposed to grants to poor individuals) can have adverse consequences, as poor residents are typically renters who will be forced to pay higher rents if the transfers are capitalized into higher house prices (*e.g.*, Hamilton 1976b, Wyckoff 1995). Wyckoff (1995) developed a simple model with two communities and three income groups to demonstrate that in the case of an urban area in which the central city is small relative to the entire metro area, the welfare effect of intergovernmental aid (such as education aid) on poor voters should be expected to be completely offset by higher housing costs. In fact, the capitalization of any place based government policy potentially has important—often unintended—distributional consequences. A finding of substantial or full capitalization may jeopardize any distributional objectives that governed the design of policies and government programs aimed to help disadvantaged groups.

On the empirical side, a few studies investigated econometrically whether farm subsidies are capitalized into land values. For example, Goodwin and Ortalo-Magné (1992) find a strong relationship between producer subsidy equivalents and land values in six regions in the United States, Canada and France. Clark, Klein and Thompson (1993), however, using data for the region of Saskatchewan in Canada, find only weak evidence in support of the hypothesis that short-term subsidies are capitalized into land values, possibly because farmland in Saskatchewan is supplied quite elastically.

More recently, a few studies have investigated the distributional consequences of geographically targeted policies. Hanson (2009) explored the impact of the

federal Empowerment Zone (EZ) program, a set of tax incentives targeted to areas of select cities. Hanson's most rigorous (IV) estimates suggest that the EZ program had a large effect on property values implying that geographically targeted tax incentives may mainly benefit landowners. Hilber, Lyytikäinen and Vermeulen (2011) explore the impact of central government grants on local house prices in England. Their findings indicate substantial to full capitalization. Furthermore they find that house prices respond somewhat more strongly in locations in which new construction is constrained by geographical barriers (*i.e.*, in rugged terrain). This suggests that increases in grants to a local authority may mainly benefit the typically better off property owners (homeowners and absentee landlords) in that local authority. Or put differently: any adjustments in the distribution of grants over local authorities would boil down to redistribution of resources between property owners in gaining and losing local authorities without making private renters any better off.[23]

Other Unintended Effects: Offsetting of Policy–Induced Incentives

House price capitalization of government programs and policies does not only have unintended distributional consequences but may also offset intended policy induced incentives. A prime example to illustrate these perverse effects is the home mortgage interest deduction (MID). The aim of the MID is to create incentives to become a homeowner. Various researchers have pointed out that the MID is a poor instrument for encouraging homeownership as it benefits mainly higher income households, who are almost always homeowners anyway (see, *e.g.*, Glaeser and Shapiro 2003).

The capitalization of the MID into house prices casts an even more damning light on the MID. Hilber and Turner (2014) examine the impact of the combined U.S. state and federal MID on homeownership attainment. They find that capitalization of the MID into house prices offsets the positive effect on homeownership: The MID only boosts homeownership attainment of higher income households in less tightly regulated housing markets. In more restrictive places—typically larger coastal cities—an adverse effect exists. Arguably this is because in supply constrained metro areas the MID increases housing demand and, consequently, the price of owner-occupied housing relative to the price of rental housing (the reservation price). Would-be homeowners of course also benefit from the subsidy, so, all else equal to the extent that the subsidy is fully capitalized they should be neither better nor worse off. However, the MID—via increasing the price of owner-occupied housing—also

[23]Grant increases may benefit renters in the social sector to the extent that their rents are detached from market rents.

increases the costs associated with the transaction of owner-occupied housing, as the latter is roughly proportional to house values (see Haurin and Gill 2002). This matters a lot to mobile (typically younger and better educated) residents, including to first time buyers. Some of these mobile households—"the marginal owner-occupiers"—who preferred to own prior to an increase in the MID, may prefer to rent after an increase. In fact, this theoretical explanation may explain the finding by Bourassa and Yin (2008) that the MID has a negative impact on homeownership attainment of the young. In a similar vein, the capitalization of the MID into higher house prices reduces the likelihood of credit constrained households to be able to qualify for a mortgage. That is, an MID induced increase in house prices will cause down-payment constraints to become binding for certain "marginal households" with respect to the housing tenure decision, forcing previously "marginal owner-occupiers" to rent instead.

Conclusions and Scope for Future Research

This paper has two main objectives: (1) outline the relevant strands of the literature on house price capitalization and its economic impacts and (2) indicate possible directions for fertile future research. To advance the first objective, I have synthesized an emerging literature that explores the conditions under which public and private investments at the local and neighborhood level and intergovernmental transfers to local jurisdictions are capitalized into house prices and the broader implications of such capitalization. Theoretical considerations and recent empirical evidence suggest that house price capitalization is much more pronounced in locations with strict regulatory and geographical supply constraints. The effect of local scarcity of developable land on the extent of capitalization appears to be very nonlinear, being largely confined to the most built-up areas. Ruggedness or steep slopes matter too but, again, the effects on capitalization appear to be confined only to quite steep slopes. The impact of regulatory constraints depends on the country specific institutional settings. For example, in the United States the impact of regulatory constraints on the extent of capitalization varies enormously across metro areas, with capitalization effects being mainly confined to the more desirable coastal areas. The British planning system, in contrast, imposes constraints on the supply of space across the country, implying significant capitalization even in more remote places.

Only a few empirical studies have so far tested whether varying degrees of house price capitalization generate different incentive effects. The scant empirical evidence for the United States suggests that (1) such incentive effects do exist and (2) are mainly confined to more supply constrained locations. This has important implications for the provision of local public

goods and club goods as it suggests that the "capitalization induced" provision of such goods may be greater in more supply constrained places.

The theoretical and empirical research discussed in this paper also has important consequences for redistribution and the assessment of place based policies at various levels of government (federal/central, state/regional and local). The empirical findings discussed in this article are strongly suggestive that capitalization effects—which are habitually ignored by policy-makers—have important adverse consequences for a wide range of policies such as intergovernmental aid or the mortgage interest deduction. Although the *direct* effect of intergovernmental aid to disadvantaged places is positive (*i.e.*, considered in isolation making local residents better off), there is also typically an ignored *hidden* effect, namely, that better local public services or lower taxes are capitalized into property prices, so, effectively, the aid may mainly benefit typically better off homeowners and (often absentee) landlords who rent out their properties to typically lower income renters. These renters benefit from better local public services. However, they often do not benefit much from lower taxes, and, most importantly, they have to pay higher rents, reflecting the increased desirability of the receiving jurisdiction, so on balance they may be no better off or even worse off than without intergovernmental aid. Of course, in locations where such aid is not capitalized, the redistribution effects are more progressive. Overall, the empirical findings imply that policies with a redistributive aim might be much more effective if they "helped people rather than places." House price capitalization of government programs and policies have a particularly damaging effect in places with inelastic supply of housing, that is, in geographically constrained places (such as San Francisco or Los Angeles) as well as in locations that are confronted with tight land use planning (*e.g.*, New York City, San Francisco or Los Angeles; large parts of the United Kingdom and in particular the South East of England). Intergovernmental aid to poor inner city places may be a particularly poor tool to help disadvantaged people as the aid—due to capitalization effects—may make the disadvantaged quite possibly worse off.

Similarly, house price capitalization effects may offset the intended incentive effects of certain policies. For example, the explicit aim of the MID in most countries is to increase homeownership attainment. However, empirical findings for the United States at least suggest that the MID has an overall negligible effect on homeownership attainment and has a negative effect in more supply constrained locations, where capitalization effects are greater.

The research summarized in this article is by no means conclusive. I have emphasized the importance of regulatory and geographical supply constraints in determining the "extent of capitalization" and summarized the tentative

empirical evidence. However, other factors besides supply constraints may be important too. In particular the role of household mobility, and lack thereof, could be further explored in future empirical work. Empirical evidence on the incentive effects of capitalization is still quite limited. On the theoretical side, this article only provides a very tentative first step towards a "taxonomy" of the incentive effects of house price capitalization. The "taxonomy" sketched in this paper is very incomplete. For example, little is known whether capitalization effects can be expected to encourage the provision of largely private goods with positive externalities (*e.g.*, beautiful private gardens). Empirical evidence is also limited.[24]

Although some researchers have argued that house price capitalization may provide a mechanism so that present residents (or present generations) internalize the well-being of future residents (future generations) (*e.g.*, Glaeser 1996, Oates and Schwab 1988, 1996, Conley and Rangel 2001, Rangel 2005); there is little direct empirical evidence to date that capitalization provides intertemporal and/or intergenerational incentive effects. Such effects may be largely confined to the local level, so may not be very helpful to tackle important environmental problems at regional, country-wide, or global scale. More research, both on the theoretical and empirical side, may help to develop a better understanding on whether (and under what conditions) capitalization may provide an incentive mechanism in an intergenerational sense. Finally, this article summarizes recent evidence on the redistributive and policy implications of capitalization of central government grants in England and the MID in the United States. Capitalization effects are of course not confined to these two policies but are potentially present in all policies that target places. Future research could focus on these other policies. The "house price capitalization research" certainly provides highly fertile ground for future research.

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[24]One of the very few studies looking at private investments is the work by Galster (1983) who suggested that due to moral hazard problems tenants treat their units less carefully than homeowners.

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