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Estimating spatial spillover in housing construction with nonstationary panel data

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ABSTRACT

A model is proposed in which building contractors have regional preferences so that housing construction in different regions are imperfect substitutes. The model hypothesizes spatial and national spillovers in construction. Although the government does not engage directly in housing construction, it influences regional housing markets by auctioning land to contractors. Contractors are hypothesized to use housing-under-construction as a buffer between starts and completions. Spatial panel data for Israel are used to test the model and investigate the determinants of regional housing construction. Because the spatial panel data are nonstationary, we use spatial panel cointegration methods to estimate the model. The estimated model is used to calculate impulse responses which propagate over time and across space.

> *"Virtually every paper written on housing supply begins with the same sentence: While there is an extensive literature on the demand for housing, far less has been written about supply."* DiPasquale (1999)

1. Introduction

As noted by DiPasquale and many others, the empirical determination of house prices has attracted much more attention than the determination of housing construction. This continues to be so even now. This asymmetry is puzzling because house prices vary inversely with the stock of housing (Smith, 1969; DiPasquale and Wheaton, 1994, Bar Nathan et al., 1998). Therefore a complete account of house price behavior requires analysis of both sides of the housing market, the demand for housing and its supply.

The extant research on housing construction has been largely concerned with national housing construction (Ball et al., 2010). In this paper, we focus on the determinants of regional housing construction. Our motivation stems from a variety of reasons. First, regional house prices and construction vary considerably and systematically. Therefore, national housing parameters might not be relevant to specific regions. Second, national aggregation of regional housing markets might be inappropriate. Indeed, it is possible to reject a hypothesis nationally due to aggregation bias, when the hypothesis is valid regionally. Third, since regional panel data are inevitably more informative than their national counterparts, it is easier to test hypotheses using regional panel data than national data. Fourth, national models of housing supply do a poor job in capturing the unique local and regional factors that bear upon supply. Finally, to our best knowledge there is no published research on regional housing construction.

Attention has recently been drawn to local phenomena such as topography, zoning and building regulations in the

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determination of housing construction (Meen and Nygaard, 2011; Saiz, 2010; Paciorek, 2011). The price elasticity of supply of new housing is expected to vary inversely with the degree of inflexibility in zoning and land use policy as well as with topographical difficulties that raise the cost of construction. Since these parameters are quintessentially local, it makes more sense to estimate local or regional models rather than national models, which ignore local heterogeneity. In our empirical application for Israel the key local phenomenon of interest is the supply of land rather than topography and building regulation since the latter is set nationally, while the former is captured by regional specific effects.

Regional models are not simply national models applied regionally. This is because regional housing markets are not independent islands. Construction is unlikely to be independent, especially if building contractors operate across locations. Building contractors may choose to operate in locations where profits are higher, or they may have local preferences so that construction in one location is not a perfect substitute for construction in another. We therefore distinguish between absolute and relative profitability in housing construction. An absolute increase in profitability in a location is hypothesized to increase construction locally. However, an increase in profitability in another location will reduce relative profitability. If construction in different locations are gross substitutes, this will reduce construction locally. On the other hand, if they are gross complements the opposite will apply. Gross complementarity may be induced, for example, by scale economies in which local building costs are affected by construction in other locations, and by advances in building technology, which encourage multi-location operations. In addition, if construction is credit constrained, this constraint may be eased when construction increases in other locations.

We distinguish between neighboring locations and other locations since for logistical reasons construction in the former might be related differently to construction between more remote locations. In practice we use spatial econometric methods to estimate spillover effects between neighboring locations, while the latter are specified at the national level. Therefore, our main contribution is to test hypotheses about housing construction using dependent regional panel data.

A second contribution is methodological. Since the data are nonstationary we use the methodology of panel cointegration to test hypotheses regarding the determination of housing construction. Standard panel cointegration tests (Pedroni, 2004) assume that the panel units are independent, which in the present context means that unobserved heterogeneity is regionally independent. There have been a number of attempts to introduce strong cross-section dependence into panel cointegration tests e.g. Banerjee and Carrion-i-Silvestre (2011). We extend Pedroni's panel cointegration test statistics to the case in which the units in the panel are spatially dependent and the cross-section dependence is therefore weak.[1] This is the first study of housing supply which takes account of both nonstationarity and spatial dependence in the panel data.

We show that when the number of panel units is fixed, as it is in spatial data, demand and supply schedules are identified without recourse to instrumental variables. Potential simultaneous equations bias that would arise in stationary data tends to vanish asymptotically when the data are nonstationary and when the model is panel-cointegrated. This convenient feature results from the super-consistent property of OLS estimates of cointegrating vectors. We are thus able to obtain consistent estimates of the supply schedule for housing without taking into consideration how the demand for housing is determined. The same principles enable the consistent estimation of spatial spillovers without recourse to ML or IV as would be required had the data been stationary.

We use regional panel data for Israel to test the model and to estimate spatial and national spillovers in housing construction. In previous work (Beenstock and Felsenstein, 2010) on regional house prices we found that standard panel cointegration methods led to the rejection of the null hypothesis. However, spatial panel cointegration methods overturned this result. In the present paper we start by estimating a standard, non-spatial housing starts regression. Using spatial panel data we then test whether housing construction models are miss-specified if they omit spatial spillovers in housing construction. We also highlight the effect of spatial factors in the estimates of elasticity of supply for housing.

2. Theory and methodology

2.1. The price elasticity of supply of housing construction

The price elasticity of supply of new housing is made up of two key components. First, if house prices increase (relative to building costs) contractors have a greater incentive to build on land that is already available for housing. Marginal plots that were previously empty will be built upon and the housing stock will increase. Also, contractors will build more intensively (high rise) if building costs vary directly with the number of floors. Furthermore, marginal housing intended for re-designation (for offices, shops etc) will be retained as housing since it is more profitable, and offices and shops will be re-designated as housing. The latter does not directly affect construction but it affects the supply of housing.

Whereas the first component takes the designation of land use to be fixed, the second component assumes that land use is endogenous. If the price of housing increases, land use will be re-designated in favor of housing, which will increase new housing construction. This applies to privately owned land and publicly owned land. However, the price elasticity might be greater when land is owned privately. If land use is entirely regulated the second component will be zero because privately owned land cannot be re-designated. Also, planning permission required to build high-rise housing will adversely affect the elasticity of supply of new housing construction. However, planning permission and zoning are unlikely to be completely

[1] Studies in housing supply (Saiz, 2010; Paciorek, 2011) typically ignore nonstationarity. For an exception see Mayer and Somerville (2000a). Also, most studies including those mentioned, assume that the panel units are spatially independent.