Can the Inter-Jurisdictional Redistribution of Property Tax Increase Housing Supply?

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Abstract This paper looks at the effect of municipal tax-revenue redistribution on land allocation across space and attempts to answer the question: can local property tax reallocation can be used to stimulate housing supply? Using spatial cointegration tests, we highlight a long-term spatio-temporal co-movement of residential and non-residential building starts related to fundamental socio-economic variables. Fiscal deficit has a significant impact on commercial construction starts but shows almost no effect on residential construction. The paper also simulates the property tax revenue redistribution effect of transfers from fiscally independent cities to fiscally-weak and peripherally-located municipalities. Counterfactual exercises show that the redistribution effect promotes housing starts in peripheral localities and discourages non-residential building starts. The policy implications of these findings are discussed.

1. Introduction

Akin to many countries worldwide, property tax is one of the most important sources of revenue for municipalities in Israel. Municipal governments often perceive the conversion of open spaces and land development as a means to attract new businesses and residents, thereby generating additional tax revenue (Lewis 2016). Alternatively, studies find that property tax has a negative (although limited) effect on the supply of new housing (Lyytikäinen 2009; Bimonte & Stabile 2020). In a decentralized planning system as exists in Israel, where local governments control zoning and building permits, house prices grow rapidly relative to commercial building prices. This is because local authorities face a negative incentive to increase housing supply and residents in areas under their jurisdiction (Eckstein et al. 2014), especially in peripheral regions with limited agglomeration rent.

If a mobile factor such as employment is completely agglomerated in one region, it earns an agglomeration rent (Baldwin & Krugman 2004, Borck & Pfluger 2006). Therefore, the property tax effect of new construction can differ sharply across urban and rural municipalities and across cities with different population densities. This effect has been reported in a variety of national contexts for example Germany (Langer & Korzhenevych 2018) and Spain (Jofre-Monseny 2013). In order to increase the economic welfare of weak localities, the Israeli government operates a centralized public finance system (Ben-Bassat et al. 2016). A key feature of this system is the intergovernmental grant mechanism. This unconditional equalization model allocates funds to weaker localities. Since 2011 this instrument has been coupled with an additional government intervention that encourages large scale residential construction in peripheral areas (Dahan 2022, Shani et al. 2023). This policy shock makes the effect of property tax redistribution trackable through inferential statistical analysis.

Fusing property tax redistribution with increasing housing supply has been suggested as a panacea for the supply side constraints on residential construction that have led to rising house prices in many countries (Wetzstein 2017). In Israel, a slow and inefficient regulatory system has exacerbated this situation (Rubin and Felsenstein 2017). The ensuing affordability crisis has been fueled by rising incomes and population growth. This makes the supply of residential land critical. As noted by Glaeser and Gyourko (2005) due to the lack of synchronization between the expectations of planners and developers, residential land supply in both growing and declining cities tends to be far from the social optimum. Furthermore, residential land supply tends to suffer from a negative incentive syndrome whereby differences in price and tax incomes encourage cities to favor supplying commercial over residential land.

The relationship between housing supply and property tax public is especially pertinent in countries like Israel where land is publicly held. Local land planning directly determines the local authority's independent fiscal revenue through the property tax (known as Arnona[1]). Although the property tax system in Israel is not an ad valorem tax, it approximates the market value of houses. Instead of direct assessment, the tax rate is based on the physical size of a property, its location, and existing use rather than on any discrete estimate of open market value (Portnov et al. 2001).

Insufficient housing supply becomes especially severe in the case of an agglomeration economy when the location choices of firms have externality effects for new firm entries. While local public goods are sufficiently supplied through fiscal decentralization within cities populated by heterogeneous agents (Tiebout 1956, Mieszkowski & Zodrow 1989), this efficiency is weakened in the presence of agglomeration economies. This is because agglomeration can generate taxable rents for core cities, whereas peripheral cities generate less taxes (Baldwin & Krugman 2004, Borck & Pfluger 2006). When there are many municipalities, property tax rates are determined in a competitive equilibrium, such that each local public authority provides an optimal amount of public services to accommodate residents and workers. Agglomeration rent encourages local authorities to promote commercial development and make residents less sensitive to local taxation in the central area.

An important insight from spatial economics is that local and regional housing markets are a key factor in generating spatial general equilibrium and due to the existence of spatial spillovers, they do not operate as independent islands (Beenstock et al 2020). Construction is unlikely to be independent regionally either, especially when the property tax rate is raised in one region relative to others corresponding to a price increase. Building contractors may choose neighboring locations where prices are lower, or they may have local preferences so that construction in one location is not a perfect substitute for construction in another.

Given this spatial dependence across places, this paper attempts to answer the

[1] The term is apparently derived from ancient Aramaic where it means "agricultural tax". In 1968, this system replaced the 1934 British mandatory system of ad valorem taxation.

question: can the inter-jurisdictional redistribution of property tax affect housing supply? We start by testing the long-run cointegration relationship between property tax rates and housing starts for different land uses and the effect of a redistribution policy on housing starts. Using financial reports for 69 Israeli municipalities from 2003–2019 we find that area-based property tax rates adjust dynamically with the municipal grant mechanism. The econometric methodology used stems from the intrinsic features of our data. First, the municipal level data cover a long period making it difficult to distinguish individual specific policy instruments. Secondly, once a policy is implemented it applies ubiquitously. This causes difficulty in identifying a control group to investigate the treatment effect of policies. Third, under cointegration, parameter estimates are super-consistent and hence are robust to problems such as omitted variables, simultaneity, and endogeneity. Based on the estimated long-run cointegrated model, we are able to quantify the effects of municipal tax-revenue redistribution on land allocation across space, with a special focus on its effect on house prices.

We offer several contributions to the literature. First, our analysis tests the redistribution effect of a move from planning centralization to decentralization through a policy shock that started in 2011 and fused property tax redistribution with housing construction in peripheral locations. Second, in a decentralized system, poorer and peripherally-located local authorities have limited fiscal revenue and therefore have limited flexibility to permit new houses. In a centralized regime, rich and centrally located authorities can assist poor regions through property tax redistribution. We quantify these long-run dynamics between local authorities' property tax adjustment and central government subsidies. Third, we simulate the effect of property tax revenue redistribution from fiscally independent municipalities to other localities. Counterfactual exercises show that the redistribution effect promotes housing starts in peripheral places and discourages non-residential housing starts. Finally, we use spatial autoregressive modeling to estimate possible spillover effects of a policy shock between neighboring locations. This calculates how much neighboring construction would respond to a local property tax rate change.

2. Theoretical Framework

To frame the relationship between property tax redistribution and housing starts, assume each household i living in the city j has an identical utility function at each time period t, denoted by u, where w_{jt} is the real wage, g_{jt} is the amount of public goods provided by the local authority j, when its population is N_{jt} and A_j is the exogenous level of amenity.

$$U_{ijt} = u\big(g_{jt}(G_{jt}, N_{jt}), w_{jt}, A_j\big) \qquad (1)$$

The local authority's role is to provide local public good to its residents (both pure and impure). We assume the quality of public services g_{jt} is a function of population N_{jt} and total expenditure G_{jt} as follows. Consumption of public services is independent of location within the city. The simplest case is when the quality of public service is a linear function of total expenditure divided by the population.

Expenditure G_{jt} on public service in city j is generated by total property tax revenue A_{jt}^{k} of different land uses k and central government grants, $Grant_{jt}$:

$$G_{jt} \leq \sum_{k=1}^{2} Grant_{jt} + A_{jt}^{k}\, , k = commercial, residential \tag{2}$$

Thus, a typical formula for total property tax revenue of use k in municipality i at time t is the ad valorem tax on the taxable construction area, which is calculated as follows:

$$A_{jt}^{k} = AR_{jt}^{k} \cdot S_{jt}^{k} \tag{3}$$

where AR_{jt}^{k} and S_{jt}^{k} are the property tax rate and taxable floor area(m^2) for use k (i.e., $k = residential\ or\ commercial$) in municipality j (Portnov et al. 2001). Property tax rates are adjusted endogenously by local authorities and usually correlate with property prices. Total construction area S_{jt} is the aggregation of construction of previous years building starts, $Start_{jt}$.

$$S_{jt}^{k} = S_{jt-1}^{k} + Start_{jt}^{k} \tag{4}$$

In the competitive equilibrium, each resident will choose the municipality that maximizes its' benefit, when all the residents are allowed to move freely. In such case, all residents will obtain identical utility levels by choosing to live in any city.

$$U_{ijt} = U_{t}^{*} \tag{5}$$

If each municipality competes for residents by providing its own bundle of public services G_{jt}, competition among municipalities will lead to a sorting mechanism under which the provision of local public goods is efficient and depends on the real wage and the amenity level of the individual city. The demand of public expenditure G_{jt}^{D} can be written as follows

$$G_{jt}^{D} = G_{jt}^{D}\left(w_{jt}, A_{j}, N_{jt}\right) \tag{6}$$

The supply of public expenditure G_{jt}^{S} is derived from equation (2) -(4), with the initial construction stock S_{j0}^{k} set to a constant.

$$G_{jt}^{S} = G_{jt}^{S}\left(Start_{jt}^{k}, AR_{jt}^{k}, Grant_{jt}, S_{j0}^{k}\right) \tag{7}$$

Equating the supply and demand of public expenditures, forms a long run equilibrium, where construction $Start_{jt}^{k}$ is a function of local attribute variables such as N_{jt} w_{jt}, AR_{jt}^{k} and central government grant $Grant_{jt}$. When the latter is exogenous, and redistributed among local authorities, building starts respond accordingly to achieve fiscal balance.

From the above we can formulate two main hypotheses. The first is that the redistribution effect of central government grants promotes/suppresses housing starts in certain areas, if the total grant is fixed. The second is that since the agglomeration effect determines the property tax rate level AR_{jt}^{k}, residential and commercial building respond differentially to redistribution effect across the localities. These hypotheses are empirically tested below.

3. The Context

3.1 Local Property Tax and Public Finance in Israel

The Arnona (municipal property) tax in Israel is collected from two principal sources: property tax on areas zoned as residential and on areas zoned as nonresidential. There are 259 local authorities in Israel, 60 of them are fiscally independent cities including nearly all the large cities with the exception of Jerusalem[2]. They represent over 3 million population (40 % of the national total) and are responsible for 65-70% of GDP. The rest of the local authorities receive an equalization grant each year from the Ministry of Finance and the Interior Ministry to balance their budgets. This funding is worth about $1.2 billion annually[3]. The wealthy cities voluntarily cooperate under the umbrella of 'Forum 15'[4]. This non-statutory lobby was established in 2002 to represent their interests to central government. Foremost amongst these is the prevention of fiscal equalization based on the transfer of their property tax surpluses to poorer locations. Fiscal independence is generated from (nonresidential) property taxes. On average, the cities that are fiscally independent generate over $1.7 billion of fiscal surplus annually (one-third of this generated by Tel Aviv alone).

In Israel, agglomeration rent results in large disparities in tax income across local authorities. Israel's monocentric urban structure has Tel Aviv as the dominant metropolitan area (Ben-Shahar et al. 2020) where house prices, land prices and structural density of all localities are negatively correlated with their traveling time to Tel Aviv in all directions (Eckstein et al. 2014; Genesove et al. 2021). Agglomeration rent on tax competition can be tested by the correlation between tax rates and population or other variables indicating agglomeration and scale economies. Evidence shows that that more populous municipalities often set higher local business tax rates (Buettner 2001). Additionally a significant relationship between the tax rate and market access has been shown to exist in French municipalities (Charlot and Paty 2007) suggesting a taxable agglomeration rent. This positive relationship between locality economic scale and tax rates also exists in Israel (Eckstein et al. 2014). However, recent work claims that the link between the Arnona tax and the socio-economic status of local residents is weak Mintz and

[2] They include Tel Aviv, Ramat Gan, Givatayim, Holon. Herzliya, Ramat Hasharon, Ashdod, Beer Sheva, Ashkelon, Petach Tikva, Rishon LeZion, Raanana, Netanya Rehovot, Kfar Saba, Haifa and Hadera.

[3] [3] Until the mid 1990's, the size of this grant was fixed via negotiations between the Israeli Ministry of Interior and the local authorities. In 1993 criteria were set for the first time for allocating budget-balancing grants and these have subsequently been revised over time.

[4] The forum represents most of Israel's major cities, including the metropolitan centers of Haifa, Tel Aviv, and Beer Sheva. These cities are home to over 3 million people (representing approximately 40% of Israel's population).

Portnov (2023).

3.2 Provision of Housing in the Israeli Planning System

The planning system is hierarchal providing strong oversight over local planning decisions. In this three-tiered system (national, district and local), national government plays a key role in land-use planning providing most representatives for the planning institutions at the national and district (regional) levels. Therefore, it not only wields the authority to steer development through the formulation of binding national and district master plans, but it is also accountable for approving numerous plans at the local level.

Most of the land in Israel (93%) is nationally owned, administered buy a national agency- the Israel Land Authority (ILA) and released to developers through a competitive tendering system. In this, Israel is unique among Western countries. Consequently, Israeli public-national land use is diverse. It includes residential, commercial, and industrial land uses in addition to the traditional uses of public land, such as parks, natural resources, and infra-structure. Rubin and Felsenstein (2017) have shown that that ILA tenders exert a modest influence on new construction (with only about half of new construction occurring on public land). The land is offered in areas of low demand rather than high demand, resulting in the 'crowding-in' of private land.

National-scale planning in Israel is partly justified by the contention that, given its small size, the whole country should be regarded as a single metropolitan region. One of the motivations for governmental land control in Israel is to reduce inefficiencies generated by market failures and to ensure a more equitable distribution of the means of production. In practice however, land allocation via the ILA may cause other inefficiencies caused by ineffective governmental decision-making and bureaucratic restrictions (Werczberger & Borukhov 1999). These problems may lead to a slow and inefficient supply of land when there is persistent increasing demand over space and time (Eckstein & Perlman 1997).

The ILA provides the government with political control over land use in the long run. On the approval of planners in the Ministry of Interior, ILA auctions these land reserves to private building contractors (See Appendix, Table A1, stages 3 and 4) who then apply for building permits from the local authority (stage 5), which decides on building intensity (high versus low-rise). The terms of the auction usually involve an element of subsidy in favor of the contractors. For example, the government may cover all or part of the development costs, and it may provide financial guarantees. Finally, it takes time for contractors to organize and build (stages 6 and 7). The total process takes about 13 years. Beenstock et al. (2020) simulate the land planning process using Israeli regional data and insert it into a spatial general equilibrium framework. They find that increasing land availability for housing construction and reducing planning time increases the affordability of housing.

Housing supply is largely determined by the land planning system in Israel. Rubin and Felsenstein (2019) find a causal link between the inflexibility of land-use planning and the low elasticity of housing supply. Urban expansion and population growth present ongoing dilemmas for planners, who must determine how to allocate land efficiently across different land uses as a city grows. The first dilemma relates to mediating the conflict between centralized land ownership and decentralized planning which results in insufficient housing supply (Alfasi & Migdalovich 2020). Second, the inequality in fiscal revenue among rich and poor local authorities reduces the willingness for local authorities to promote new residential construction (Eckstein et al. 2014)..

4. Data and Descriptive Statistics

We employ two data sets in this analysis. For the short-run, static analysis we use a data set that comprises the 105 municipalities in Israel with a population greater than 50,000 (2017-2019) obtained from the Israel Central Bureau of Statistics (CBS). Small localities are excluded since they do not have enough people to form a separate land use equilibrium. Much of their available land for building is designated as residential only and they operate as bedroom communities with most of their population working in other cities. For the long-run (cointegration) analysis we use a spatial panel of 69 areas covering the whole country and comprised of the 30 largest cities and 39 sub-districts from 2003-2019 from the CBS.

House prices, residential and commercial starts, and land reserves are plotted in Figure 1. This shows that land reserves are relatively plentiful in the periphery rather than the central areas of the country such as metropolitan Tel Aviv. In addition, land reserves have steadily decreased over the last two decades. This is especially the case in central regions such as metropolitan Tel Aviv (plotted in green in Figure 1). The demand for housing is concentrated in the central regions of the country and ideally needs to be aligned with areas targeted for large-scale housing programs. While increasing the number of housing units reduces the housing shortage, the location of newly built housing needs to synchronize with the location choice of the population[5]. An examination of the price per square meter in commercial real estate transactions in the Israel tax authority database, 2000-2013 yields a surprising result (Eckstein et al. 2014). While the price per square meter of built area intended for residential use in cities rose by 40% over the period 2006-2013, the per sq m price of buildings for commercial use did not change significantly over the period.

[5] In Israel, large-scale housing programs usually focus on developing state-owned land, which constitutes about 93% of the national land area. However, policymakers must consider that the remaining 7% of land is not randomly distributed across the country.

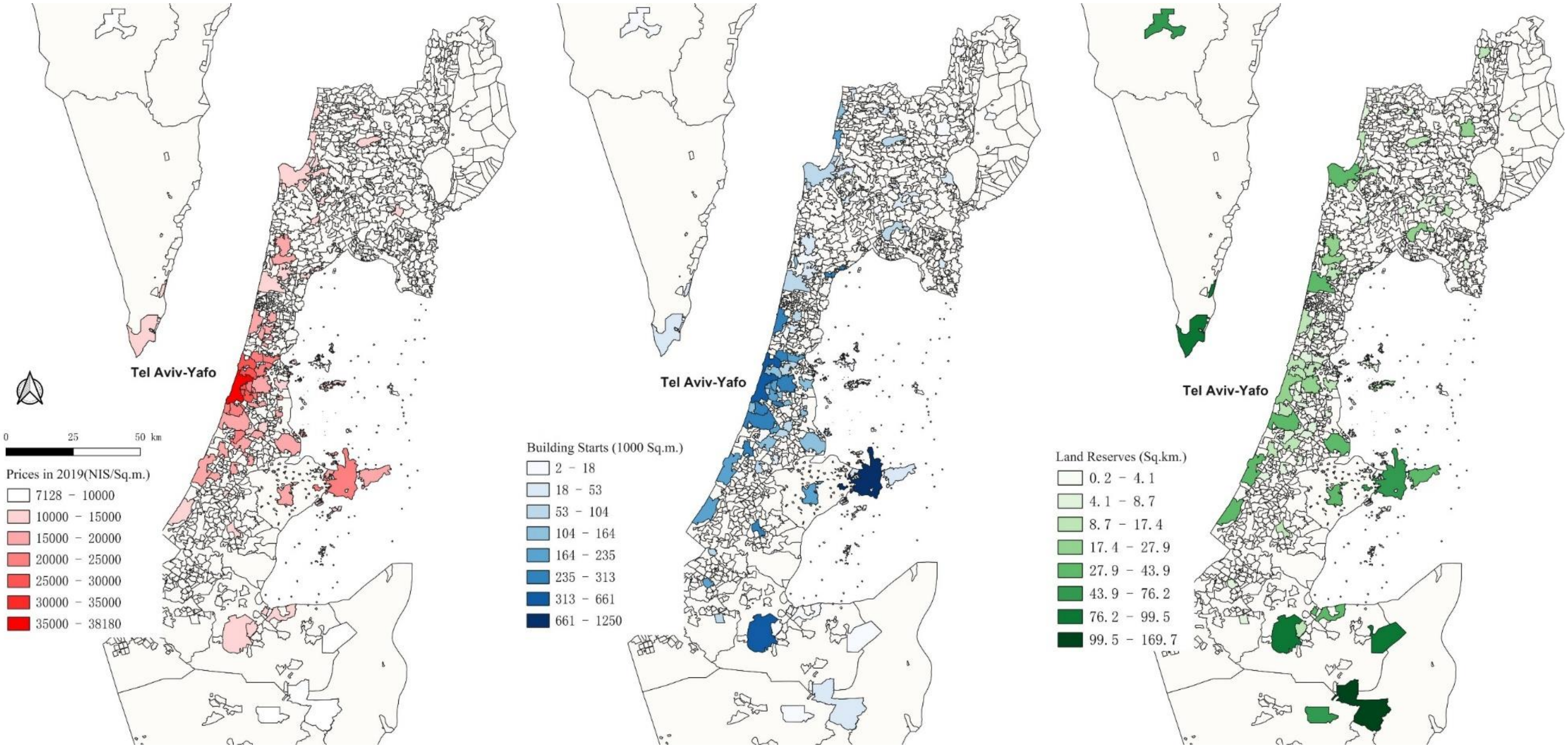


Figure.1. House Prices, Building Starts and Land Reserves (2019) in the sample municipalities

The first factor to be considered is local authority independent revenue starting with the local property tax (Arnona). Municipal rate payments in the city of Tel Aviv constituted 75% of its locally generated revenue in 2011. The almost perfect linear correlation between Arnona and house price per square meter (plotted in the right panel in Figure 2) shows that the Arnona tax can be treated as an ad valorem tax. This finding is in line with Horne and Felsenstein (2010), who provide statistical evidence suggesting that property value is the most significant predictive variable of the tax. As shown in Figure 2, property tax per square meter for residential building is remarkably lower than that of commercial buildings. Since property tax rates for both uses form almost linear relationships with property value, similar productivity spillover intensity is expected.

As hypothesized by Eckstein et al. (2014) increasing commercial construction can be a channel for local authorities to raise municipal revenue. Moreover, the slopes of Arnona for both commercial and residential use are negative with respect to the distance to Tel Aviv (Figure 2 left hand panel) and the slope of commercial property tax is notably steeper than that of residential property tax. Figure 2 also depicts the municipal rates on different land use by regions in the year 2015. The municipal rate per square meter for businesses is four times that of the municipal rates for residences in municipalities in the Tel Aviv region, while it is three times more in the Jerusalem and central regions. Local authorities prefer not to absorb populations that need expensive services and whose contribution to revenue is low (Ben-Bassat & Dahan 2009). According to Razin (2003) this situation is expressed in local authority's manipulation of housing and construction plans.

The second possible determinant of construction starts is local authority fiscal status. A direct measure of this is local authority fiscal balance and another indicator is accumulated deficit (surplus). Israeli local authorities show relative fiscal weakness as their finance is characterized by large central government grants and high dependence on property-based local taxes (Razin 2003). Small cities are less productive since they are less agglomerated, therefore they benefit less from productivity spillovers. Compared with large cities, small cities have less income from property tax, and therefore are less fiscally independent.

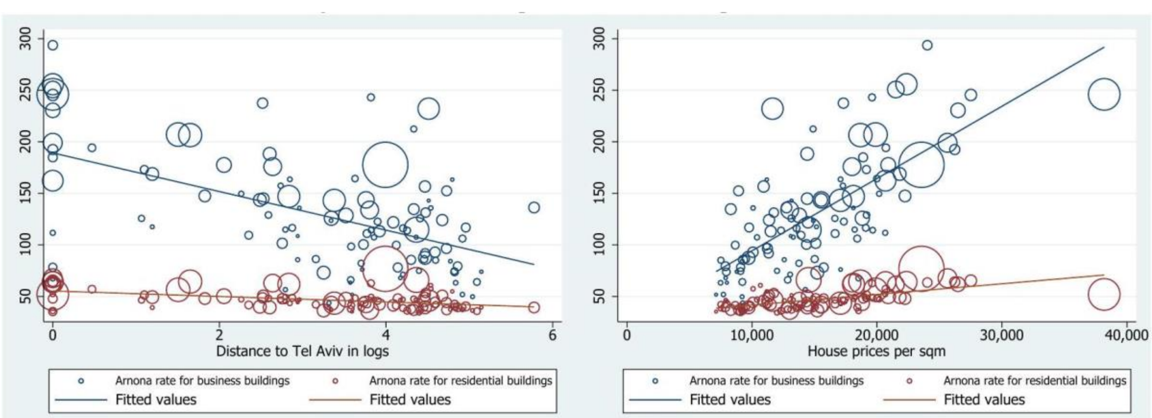


Figure.2. Arnona per Square Meter in Municipalities (2015)

Notes: Marker sizes are proportional to city population. For each panel in this figure (each corresponding to a pair of variables), there are 105 data points, each representing a municipality. We estimate OLS regressions of the variable on the vertical axis on the variable on the horizontal axis. Significance levels are all below 5%, and the OLS fit line is included. Data points are weighted by municipal population.

Since land tendering income does not enter municipality accounts, inefficiency may arise when there are conflicts of interest between local and central authorities. Moreover, the interests of central government may not only be driven by market forces. Conflicts of interest arise when the central government land plans deviate from the development target of the municipalities. Central government tends to bail out localities in financial distress. Localities that repeatedly deviate from a balanced budget are able to extract transfers from other more financially responsible localities. Hence, a common pool practice behind the financing of local expenditures creates strong incentives for local officials to overspend. One of the most exceptional central government land policies is the 'House-Buyers Price' [6] program aiming to provide residential construction on publicly owned land, below market price. These policies can distort land prices, making local authorities less effective in zoning policies (Werczberger and Borukhov 1999).

The third main factor in determining land use is land reserves. Available land has a highly unbalanced distribution across space. Most available land is distant from the center in less populated and inhabitable areas such as the Negev Desert. The left panel in Figure 3 plots the distribution of land reserves by the distance to Tel Aviv. Beenstock et al. (2020) document the effects on housing affordability of planning delays in tendering land for housing construction and issuing building permits. In their model, scarcity of available land lowers planning speed, and eventually compresses the land supply. The right panel in figure 3 plots a remarkably positive correlation between total building starts and land reserves.

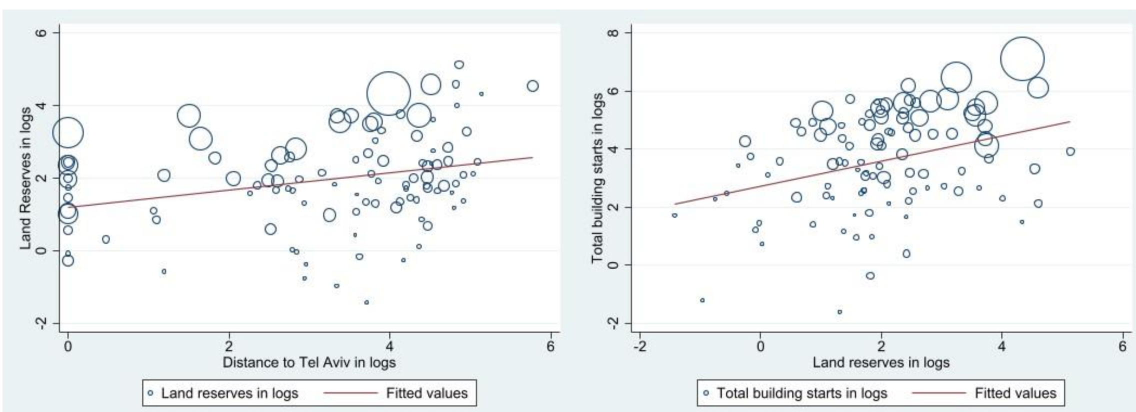


Figure.3. Land Reserves and Prices (2019)

Notes: Marker sizes are proportional to city population level. For each panel in this figure (each corresponding to a pair of variables), there are 105 data points, each representing a municipality. We estimate

[6] The House-Buyers Price program consists of land auctions in which developers compete in the per-meter price offered to consumers. The winning bidder is required to pay the stipulated assessed land value less a subsidy of $35,000 per unit (in high-value areas) or twenty percent of assessed value (low-value areas), plus, as usual, infrastructure costs. The assessment is based on past standard land auction results. Relative to new construction, this program is large scale and has replaced traditional ILA land sales.

OLS regressions of the variable on the vertical axis on the variable on the horizontal axis. Significance levels are all below 5% and the OLS fit line is included. Data points are weighted by municipal population.

5. Empirical Analysis

This section extends the description of the last section by formulating the short-run static estimation and long-run cointegration analysis. We present a building starts model for both commercial and residential use in municipalities. The determinants of municipal building starts in which we are interested include house prices, municipal tax (Arnona) rate, fiscal status, land reserves, etc. The motivation for this model stems from a variety of reasons. First, we distinguish between different land uses. As a result of a municipal competitive equilibrium, land planning for different uses varies considerably and systematically. Therefore, residential building supply parameters might not be relevant to commercial buildings. Second, we use locality-level data, since the aggregation of city housing markets into regions ignores the internal structure of urban land use, and therefore, might be inappropriate. Third, we use municipal panel data instead of cross-section data since panel data are inevitably more informative than their static counterparts. Furthermore, parameter identification is easier using panel data than cross-section data. Fourth, we use spatial lags for explanatory variables to capture the spatial spillover effect. Ignoring spatial dependence causes bias in estimation and misidentification.

We use spatial panel data to estimate the following basic model for residential housing starts and commercial housing starts in logs $\ln S_{it}^{(k)}$, where the superscript k denotes land use, such that $k =$ Residential, Commercial. The empirical model can be written as:

$$\begin{gathered} \ln S_{it}^{(k)} = \alpha_i^{(k)} + \boldsymbol{X}_{it}\boldsymbol{\beta}^{(k)'} + \epsilon_{it} (i) \\ \ln S_{it}^{(k)} = \alpha_i^{(k)} + \boldsymbol{X}_{it}\boldsymbol{\beta}^{(k)'} + \gamma^{(k)}\widetilde{\ln AR_{it}^{(k)}} + \rho\widetilde{\ln Start_{it}^{(k)}} + e_{it} (ii) \\ k = \text{ Residential, Commercial} \end{gathered} \tag{8}$$

The explanatory variables $\boldsymbol{X}_{it} = (LR_{it}, \ln P_{it}, \ln Dist_i, \ln F_{it})$ in the first specification include land reserves LR_{it}, house prices P_{it}, road distance to Tel Aviv $Dist_i$, fiscal status F_{it} in logarithms. The second specification replaces P_{it} by arnona rates per square meter $AR_{it}^{(k)}$ in the building start equations for different land uses and extends this model to include spatial regression. Specifically, $\widetilde{\ln S_{it}^{(k)}}$ is the spatial autoregressive term, which is constructed as the weighted sum of the dependent variable in the neighboring municipalities. $\widetilde{\ln AR_{it}^{(k)}}$ is the spatial Durbin term, which is constructed as the weighted sum of the independent variable (Arnona rates $\ln AR_{it}^{(k)}$).

5.1. Stylized Facts

Based on our model and given the existence of agglomerations, we expect larger cities with business centers to be more fiscally independent. This is because non-residential (commercial) buildings generate more property tax as their land price is higher. In the classic land use model (Duranton & Puga 2015), urban land price is represented by accumulated transportation costs if urban residents need to work in the city center via daily commuting. To illustrate this relationship, we define fiscal independence (S_{IND}) as the share of self-generated revenue out of total final revenue in the ordinary budget and S_{RES} as the share of residential tax revenue in total property tax.

$$S_{IND} = \frac{\text{local (self generated) municipal revenue}}{\text{total municipal revenue}}$$
$$S_{RES} = \frac{\text{residential tax revenue}}{\text{total tax revenue}} \tag{9}$$

The left panel in Figure 4 plots S_{RES} on the vertical axis and fiscal independence S_{IND} on the horizontal axis. There appears to be a strong negative correlation between share of residential tax revenue and fiscal independence. In other words, municipalities with more revenue from commercial property tax are less dependent on central government support. The marker sizes represent city population. The fitted negative correlation reports better prediction for larger cities. Moreover, most large cities are located above the fitted line. The negative correlation indicates that local authority revenue may largely depend on revenue through property tax from commercial buildings, especially for large cities. The graph on the right in Figure 4 plots construction starts for commercial purposes on the vertical axis and fiscal independence on the horizontal axis. The positive slope of the fitted line shows there are more commercial buildings built in municipalities where local tax revenues are higher. Similarly, most large cities are located above the fitted line. This is no surprise given that large cities have more commercial buildings than small cities.

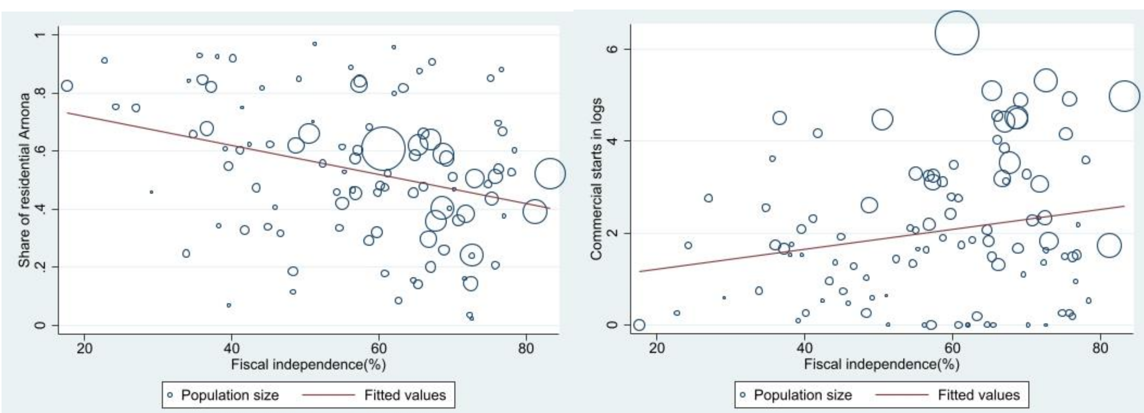


Figure.4. Fiscal Independence, Shares of Residential Arnona and Housing Starts, 2019

Notes: For each panel in this figure (each corresponding to a pair of variables), there are 105 data points, each representing a municipality in Israel. We estimate OLS regressions of the variable on the vertical axis on the variable on the horizontal axis. Significance levels are all below 5%, and the OLS fit line is included. Data points are weighted by municipality population.

5.2. Static Model Estimation

Table 1 presents the estimation results of construction start models according to the specifications in Equation (1). In these specifications, the dependent variable is the log of construction starts for commercial and residential use in municipality i at year t. The estimates of independent variables for different uses are compared. For both residential and commercial starts, Specification 1 is the estimate specification (i) in Equation (1) and Specifications 2-4 are estimates of formula (ii) in Equation (1).

Table 1: Estimates of Building Starts

Dependent Variables	lnS Residential				lnS Commercial			
Specification	1	2	3	4	1	2	3	4
$lnDist$	-0.262***	-0.321***	-0.307 ***	-0.291***	-0.247***	-0.204***	-0.235***	-0.235***
	(0.076)	(0.067)	(-5.110)	(-4.778)	(0.081)	(0.072)	(-4.155)	(-4.159)
$lnLR$	0.529***	0.505***	0.571***	0.607 ***	0.600***	0.557***	0.612***	0.643***
	(0.082)	(0.082)	(7.007)	(7.173)	(0.083)	(0.082)	(7.572)	(7.767)
$lnAr$		1.962***	0.594***	0.463***		0.801***	0.280***	0.210***
		(0.611)	(6.156)	(3.704)		(0.260)	(5.294)	(3.126)
$\widetilde{lnAr}$				0.129*				0.088*
				(1.672)				(1.691)
$lnFis$	0.008	0.010	0.010	0.007	0.019*	0.020*	0.023**	0.019*
	(0.010)	(0.010)	(1.017)	(0.656)	(0.011)	(0.011)	(2.057)	(1.623)
lnP	1.113***				0.552*		0.077	0.045
	(0.340)				(0.363)		(0.819)	(0.458)
$\widetilde{lnS}$			0.243***	0.234**				
			(2.691)	(2.557)				
Constant	-7.557**	-4.245*			-3.706***	-2.308*		
	(3.390)	(2.425)			(3.622)	(1.346)		
R^2	0.3709	0.3840			0.3196	0.3502		
Likelihood			-809.378	-630.264			-568.724	-570.068
Spatial Effect	No	No	Yes	Yes	No	No	Yes	Yes

Notes: The sample in this estimation includes all the municipalities with a population above 50,000 in Israel from 2017-2019. The estimations for residential building start appear in the first 4 columns, and commercial building starts appear in the last 4 columns. SEs in parentheses for model 1 and 2, Z-statistics in parenthesis for Specification 3 and 4. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

The estimates in table 1 show that both residential and commercial construction models predict new construction as a decreasing function of the distance to Tel Aviv. This indicates that new construction meets the needs of population growth in general. As the central area is heavily populated more building is needed in this area. A second finding is that the elasticity of land reserves is significantly different across different uses. In each specification, residential starts are less elastic to decreasing land resources. For example, in Specification 1, a 1% decrease in land reserves reduces new construction by 0.55% for residential building and by 0.6% for non-residential. This implies that residential land consumption is less elastic than commercial land when total land supply drops. A third interesting finding is that for each specification, the marginal effect of the Arnona property tax on residential buildings is almost twice as much as that of commercial buildings. For example, in Specification 1, a 1% increase in the Arnona rate in residential buildings encourages 1.962% growth in new residential construction but only an 0.8% growth for commercial construction. Finally, fiscal balance has a significant impact on commercial starts but shows almost no effect on residential construction. This finding is line with Rubin and Felsenstein (2019), who find that municipalities with larger deficits tend to delay planning approval. Fiscally dependent municipalities are more inclined to approve commercial construction because governmental support per new resident is insufficient (Ben-Bassat & Dahan 2009).

Specifications 3 and 4 in Table 1 estimate the spatial autoregressive Specification of the specifications and Specification 4 includes the spatial Durbin term for Arnona rates. An interesting finding is commercial starts show almost no spatial spillover effect with the SAR coefficient very low (0.077 and 0.045) compared to that of residential starts (0.243 and 0.234). This suggests residential construction is more spatially correlated, possibly because residential areas are more connected and continuous between cities. They are also much more ubiquitous. In contrast, commercial, industrial and business areas are much less pervasive. Lastly, in Specification 4, the spatial Durbin term for Arnona rates is positive for both uses, which means that new construction is not only affected by local Arnona rates but also by Arnona rates in nearby cities. The main reason is that Arnona rates are highly correlated with house prices and the spillover effect of property value on housing starts is revealed though the property tax. Another reason is that the spillover effect of Arnona rates is an indication of public service spillover. Consequently, a city with higher Arnona rates sustains more public expenditure and attracts more residents to live in nearby cities, thereby inducing more construction.

5.3. Structural Break Test

In panel data, structural breaks (or change points) between key variables can occur and might influence interpretations and policy recommendations. Breaks can be unknown or known and single and multiple breaks can occur. Estimations and forecasts depend on knowledge about structural breaks. Hence, structural break tests are necessary for our data even if prior information is known.

Fiscal status (surplus if positive, deficit if negative) and independence are our two main policy variables. The hypothesis of no structural change in period 9 (2011) was rejected with high significance in the Wald test statistics (17.00 and 19.98) introduced by Bai and Perron (1998); Karavias et al. (2023). Figure 6 plots these variables for the 69 municipalities in our analysis, 2003-2019. As the Israeli government centralized its public finance system in 2004, less regions are trapped in deficit from 2004. In the right panel of Fig.5, average fiscal independence rates (S_{IND}) decline significantly after the policy shock, since more local authorities are subject to redistribution. Figure 6 (left hand panel) also shows that fiscal independence rates converge after the policy shock in 2011, when comparing the cross-sectional variance before and after the policy shock. This fact indicates that the local authorities adjusted their independent revenue dynamically after the redistribution policy shock such that the difference across municipalities on self-reliance via the property tax became smaller.

5.4. Cointegration Analysis

The long-term effect of fiscal redistribution on housing starts can be tested by the stationarity of cointegration residuals. We employ the spatial panel dataset described above in Section 4. Using spatial panel cointegration tests, we are able to discover the long-term interactions between these variables[7]. The main hypothesis is that local fiscal status has an impact on commercial building starts over the long term.

The panel spatial cointegration model of residential and commercial housing starts can be written in the following spatial VAR (Vector Autoregressive) form:

$$\begin{pmatrix} lnS_{it}^{Residential} \\ lnS_{it}^{Commercial} \end{pmatrix} = \begin{pmatrix} \boldsymbol{X}_{it}\boldsymbol{\beta_1} \\ \boldsymbol{X}_{it}\boldsymbol{\beta_2} \end{pmatrix} + \begin{pmatrix} \gamma_1 lnS_{it}^{Commercial} \\ \gamma_2 lnS_{it}^{Residential} \end{pmatrix} + \begin{pmatrix} \rho_1 lnS_{it}^{\widetilde{Residential}} \\ \rho_2 lnS_{it}^{\widetilde{Commercial}} \end{pmatrix} + \begin{pmatrix} \epsilon_{it} \\ e_{it} \end{pmatrix} \quad (9)$$

Where γ_1 and γ_2 measure the substitution/integration effects of commercial and residential construction when the local authorities face zoning decisions. ρ_1 and ρ_2 are the spatial autoregressive coefficients which characterize the regional construction spillovers.

The first step of cointegration analysis is testing for non-stationarity in the variables used in our model. The IPS statistic (Im et al. 2003) and Hadri statistic (Hadri 2000) are used to test for non-stationarity in the panel data variables. The IPS statistic allows for heterogeneity in the roots of each panel unit. In Table 2 below, we report the z-IPS statistics (Im et al. 2003) and z-LMH (Hadri 2000) for the logarithms of the variables in the model. Based on the z-IPS statistic, we can reject the null hypothesis that the log level of residential, commercial starts, yearly balance and fiscal independence have unit roots when the number of lags is 0 and 1. This result is less obvious as Fig.5 shows that the mean level of fiscal status has been growing over time and fiscal dependence is declining overtime. In contrast, Hadri's LM test clearly rejects the null hypothesis that these data are stationary. The inconsistent result of two-unit root tests does not mean they are contradictory as the null hypotheses of these two tests differ (see Beenstock and Felsenstein (2019). Other variables such as number of employees, residential and commercial Arnona rates and accumulated deficit show consistency between these two tests. In terms of 1st differences, all the variables are shown to be difference stationary by both z-IPS and z-LMH statistics and no such conflict arises between the tests. Thus, we conclude that all the variables used in our regressions are difference stationary.

Since the data are nonstationary, the parameter estimates have non-standard distributions, in which case standard t, Chi square and F statistics do not indicate statistical significance unless the covariates happen to be strictly exogenous and cannot be used for hypothesis testing. Instead, we use cointegration tests and estimate the model twice, once with the variable of interest and once with this variable omitted. If the model is cointegrated with the variable but not in its absence, the restriction may be rejected. Another issue is the consistency of the parameter estimates. We use the nonstationary test of estimated residuals as an indicator of cointegration. Estimates of cointegrating vectors are consistent even in the case that the variables in the model happen to be jointly determined (Beenstock et al. 2012). We therefore test for statistical significance by dropping variables from the model. If this induces cointegration failure, we conclude that the variable or variables concerned are statistically significant. We use group cointegration test statistics (Pedroni 1999) designed for panel data, which allow for heterogeneity in the autoregressive behavior of

[7] See Appendix 2 for plots of the main variables in the cointegration analysis.

the residuals. Since we are only interested in panel cointegration, time-invariant variables such as distance to Tel Aviv are omitted. This fixed effect is indeed correlated with distance.

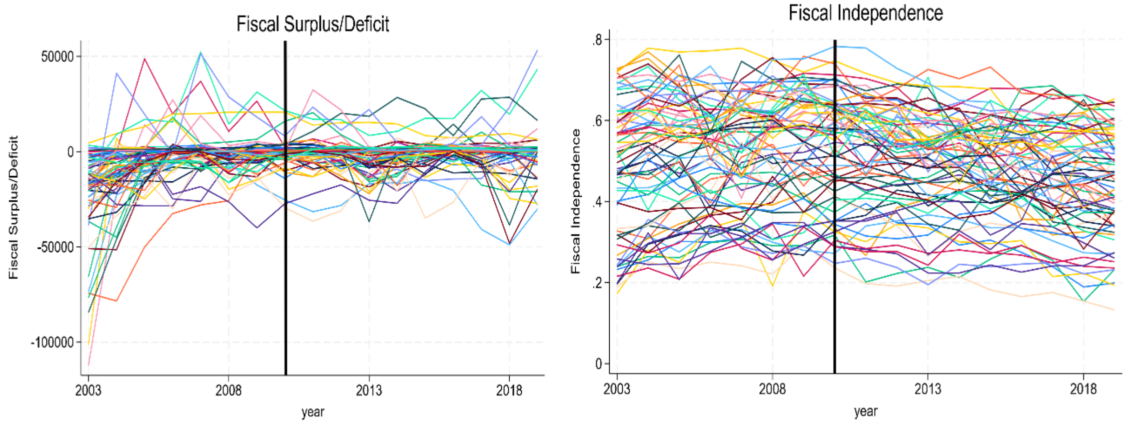


Figure 5. Fiscal status and independence 2003-2019

Table 2: Panel Unit Root Tests

	IPS						Hadri	
		Level			1st Difference		Level	1st Difference
Variable	lag=0	lag=1	lag=2	lag=0	lag=1	lag=2	lag=0	Lag=0
Number of Employees	14.444	15.359	12.369	-41.571***	-27.590***	-5.688***	76.381***	-4.004
Residential Building Starts	-7.515***	-2.662***	-0.072	-32.273***	-17.203***	-9.6550***	31.015***	-5.434
Commercial Building Starts	-15.859***	-8.233***	-3.960***	-38.075***	-23.421***	-11.315***	11.773***	-6.575
Arnona for Residential Buildings	8.086	7.051	0.693	-31.112***	-18.070***	-8.120***	59.865***	1.035
Arnona for Commercial Buildings	2.536	0.9960	0.248	-26.055***	-14.389***	-9.178***	74.721***	-0.180
Yearly Balance	-17.780***	-11.305***	-8.323***	-32.451***	-19.825***	-13.026***	12.178***	-5.350
Accumulated Balance	-5.879***	-13.830***	-2.787***	-28.176***	-17.889***	-5.110***	30.134***	-1.620
Fiscal Independence	-7.082***	-1.156	0.7881	-35.088***	-16.045***	-8.948***	28.897***	-4.512

Notes: z-IPS is the z statistic based on Im et al. (2003) by testing the null hypothesis of Ho: "All panels contain unit roots", and z-LMH is based on Hadri (2000), by testing null hypothesis of Ho: "All panels are stationary". Augmentations and number of lags are specified. Data in logarithms (except Fiscal Independence). *** $p < 0.01$,** $p < 0.05$, * $p < 0.1$.

The estimation results and cointegration tests are shown in Table 3. All the specifications are cointegrated significantly according to the panel cointegration statistics.

GADF and GPP are standard normal variable z-statistics which are transformed from the 1st order ADF and PP statistics of estimated residuals (Pedroni 1999)[8]. Their one-sided critical value is -1.65 at $p = 0.05$. Unlike the static estimation in the last section, the most interesting finding in this cointegration analysis is that construction starts for residential building and commercial building are cointegrated with totally different variables. As predicted by Specification 2 and Specification 6 in Table 3 (baseline), residential starts show a cointegration relationship with Arnona rates in logs (lnAr), resident's income in logs ($lnInc$) and population inflows in logs ($lnIm$). Commercial starts are cointegrated with a local authority's fiscal status (yearly surplus or deficit) in logs ($lnFis$), fiscal independence (S_{IND}) and number of employees in log ($lnEmp$). Both residential and commercial starts are cointegrated with land reserves in logs ($lnLR$). Since the magnitude of land reserves is comparatively stable over time, it can be treated as a regional fixed effect.

Similar to the static estimation in the last section, residential starts are positively cointegrated with Arnona rates with high elasticity. The estimates of elasticity on residential Arnona rates are 1.109 in non-spatial specifications and 0.706-0.731 in the spatial specifications. The main reason for residential starts comes from residents' housing demand. Specifications 1-4 show that the elasticity of residential starts on local population inflow ($lnIm$) is 0.621-0.662. Specification 3 and 4 include spatial lags of residential starts. There is a slight improvement in the GADF and GPP statistic indicating the spatial spillover of residential construction. The local effect of income decreases in the spatial specifications due to the spatial spillover effect. The spatial autoregressive coefficient ranges from 0.368-0.392. This indicates that a 1% increase in residential starts can be explained by 0.36% increase in residential starts in neighboring municipalities over the long term. This spatial elasticity implies that residential construction in neighboring regions and local construction are close but imperfect substitutes.

[8] The Pedroni test statistics have been transformed into standard normal variable z: $z_p = \frac{\sqrt{N}[(S_i)-E(S_i)]}{s.d.(S_i)} \rightarrow N(0,1)$, where S_i is region i 's particular statistic (such as PP and ADF) and $E(S_i)$ and $s.d.(S_i)$ are the expected value and standard deviation of S_i obtained by Monte Carlo simulation under the assumption that the panel units are independent.

Table 3: Cointegration Analysis of Building Starts

Dependent Variables	lnS Residential				lnS Commercial			
Specification	1	2	3	4	5	6	7	8
$lnAr$	1.109	1.109	0.731	0.706	0.466	0.307	0.335	0.204
$lnInc$	1.170	1.046	0.628	0.474				
$lnFis$					-0.238	-0.235	-0.225	-0.221
S_{IND}					-1.616	- 1.284	-1.385	-1.177
$lnIm$	0.621	0.615	0.662	0.658				
$lnEm$	-0.372	-0.397	-0.358	-0.381				
$lnEmp$					0.499	0.350	0.172	0.122
$lnArea$						55.859	46.431	48.273
$lnLR$	0.399	0.387	0.411	0.400	0.164			
lnS Commercial		0.094		0.090				
lnS Residential						0.122		0.116
$\widetilde{lnS}$			0.368	0.392			0.299	0.285
R^2	0.697	0.701	0.704	0.708	0.611	0.617	0.617	0.621
GADF	-2.020**	-2.013**	-2.076**	-2.069**	-2.604***	-2.619***	-2.609***	-2.618***
GPP	-2.653***	-2.473***	-2.710***	-2.740***	-3.491***	-3.541***	-3.495***	-3.537***
Likelihood			-1266.31	-1259.14			-1455.74	-1449.68
Regional FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Spatial effect	No	No	SAR	SAR	No	No	SAR	SAR

Notes: The sample in this estimation includes 69 municipalities in Israel from 2003-2019. The estimations for residential building starts are columns 1-4, and commercial building starts are columns 5-8. Non-spatial specifications are estimated by the least squares method with regional random effects; spatial specifications are estimated by the maximum likelihood method with regional random effects. GADF: group (1st order) ADF panel cointegration z-statistic, in which Pedroni test statistics (Pedroni 1999) have been transformed into the standard normal z-statistic. Their one-sided critical value is 1.65 at $p = 0.05$,2.32 at $p = 0.01$. *** $p < 0.01$,** $p < 0.05$,* $p < 0.1$.

Cointegration test statistics (GADF and GPP) for commercial starts in Specification 5-8 greatly exceed their critical values. Compared with Specification 1-4, the estimates of marginal effects in commercial Arnona rates lnAr (0.204-0.466) are much lower than that in residential starts (0.706-1.109). This result strengthens the findings in the static estimation that commercial starts are less sensitive with respect to property tax rates. Over the long term, the construction of commercial building is less sensitive to commercial building prices as property tax rate is a proxy of price. Over the long term, commercial starts are driven by the number of employees and the elasticity is 0.350-0.499 in non-spatial specifications and 0.122-0.172 in the spatial autoregressive specifications. Specification 7 and 8 again suggest a spatial substitution effect in that an increase 1% in local commercial starts with neighboring municipalities correlates with roughly 0.3% increase in commercial starts in neighboring municipalities. In Israel, the property tax on commercial buildings is much higher than for housing.

Local authority fiscal status has a significant impact on commercial starts with a negative marginal effect of fiscal status of -0.221 to -0.238. Local fiscal balance shows pro-cyclical movements with commercial construction starts, since property tax constitutes a high proportion of locally generated revenue as shown in Figure 5. Since property tax on commercial building is higher and more inelastic to construction supply than for residential buildings, this creates an incentive for the municipalities to allocate more land for commercial development and less for housing. More land for commerce attracts more jobs, and therefore generates higher income. This result is in line with Eckstein et al. (2014) who show that increasing commercial construction can be a channel for local authorities to raise municipal revenue. The negative cointegration relation between commercial starts and fiscal independence strengthens this result (-1.177 to -1.616). A lower percentage of independent income encourages municipalities to issue more construction permits.

The negative correlation between fiscal independence and commercial starts is contra to the result from the static analysis. In the latter, both fiscal independence and commercial starts positively correlate with the size of the local authority. Since cointegration analysis characterizes a long-term systematic relationship between a few non-stationary variables, this size effect is canceled out in the fixed effect.

Finally, the estimates of γ_1 and γ_2 are around 0.09 and 0.12 in residential and commercial starts respectively, which suggest a complementary effect of 9% additional commercial starts if residential starts increase by 100%. The spatial spillover effect is weaker in commercial starts. Including spatial lags does not improve the GADF and GPP statistics very much in Specifications 7 and 8 compared to Specifications 5 and 6. This result suggests that the spatial substitution effect in commercial starts is much lower and less significant than in residential starts.

6. Simulation Results

Previous empirical research on local public finance in Israel has shown that an increase in equalization grants constitutes a significant amount of total expenditures in disadvantaged municipalities (Dahan 2022; Shani et al. 2023) But these grants result in asymmetric outcomes for advantaged and disadvantaged municipalities. A grant reduction in rich municipalities causes a tax rise in those jurisdictions which is nearly double the size of the tax reduction following a grant increase. In terms of elasticities, a 1% reduction in equalization grants in wealthy municipalities results in a 6.5% increase in local taxes. For disadvantaged municipalities, a 1% increase in equalization grants results in a 4% decrease in local tax rates (Shani et al 2023).

In this section, we further test the policy effect of asymmetric government grants on housing starts. We use a spatial econometric model for Israel to simulate the implications of various redistribution policy shocks as well as exogenous shocks on housing starts. This general equilibrium model has been described fully elsewhere (Beenstock et al. 2017).

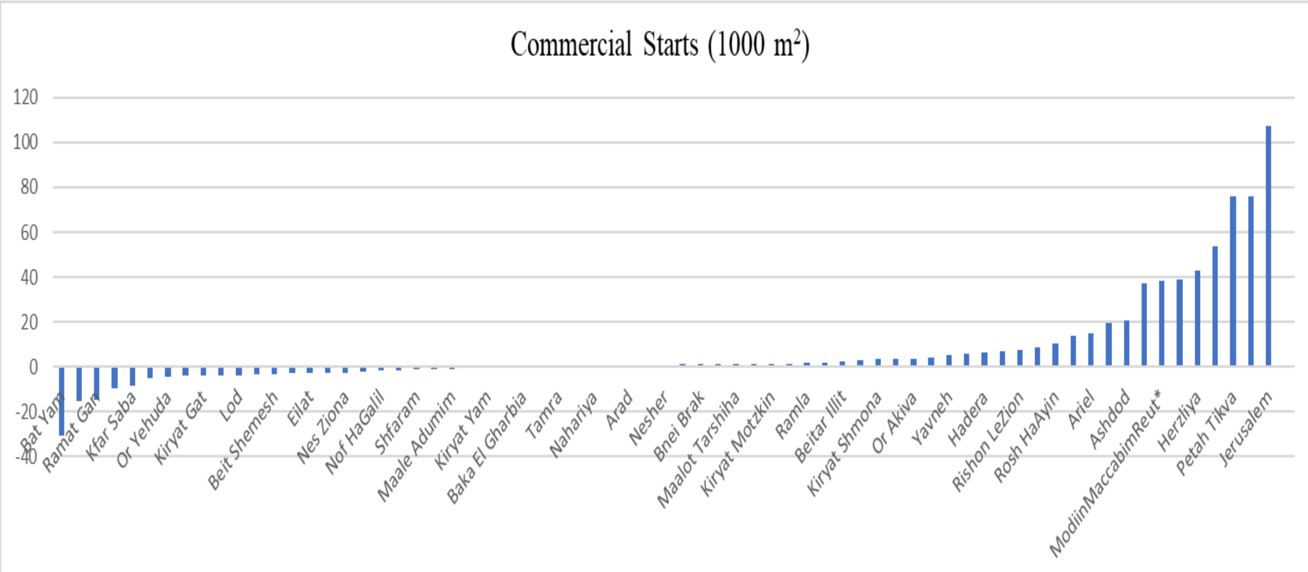
We adopt Specifications 4 and 8 in Table 3 for the construction starts models and combine a labor market equilibrium equation, fiscal budget and other linkages. The complete equation listing for the model is provided in Appendix 3. The model solves for various state variables such as population, employment, wages, house prices, capital, housing construction and housing stocks in terms of exogenous variables such as government-initiated housing construction, fiscal independences, immigration and public grants. Since these panel data are nonstationary and spatially dependent, we use panel cointegration to specify and test the model.

We increase government grants by 20% for localities with fiscal independence lower than 50% and reduce government grants by 20% for localities with fiscal independence above 50% from 2011. Since government grants encourage expenditure on public services in disadvantaged municipalities, more immigrants are attracted given the real wage. Residential starts increase as the population in these areas grows. Business building starts decline as government grants decrease for those advantaged municipalities with enough autonomy to adjust their Arnona rate without additional business construction.

The overall effect of tax redistribution is an additional 188,530 and 271,570 sqm for residential and business construction respectively, compared to the baseline. A clear center versus periphery divide emerges. Table 4 lists the top 5 localities with relative positive (negative) changes in percentages in total residential and business construction from 2011-2019. The localities with the strongest redistribution (mainly non-central cities) increase residential starts ranging from 2%-3%. In contrast, those experiencing a reduction in residential starts of -0.3% to - 4% over 2011-2019, are all centrally located cities. The effect on business construction is much stronger and more diversified with growth of more than 31 % in total in the city of Ariel (a non-central location) and a drop of 42% annually in the centrally located city of Giv'atayim.

Table 5 lists the top five localities with positive (negative) changes in total residential and business construction area (sq.m.). Figure 6 depicts the distribution of total building starts (1000 sqm in logs) of residential and business construction in 69 Israeli cities from 2011-2019 based on the simulated results[9]. Counterfactual exercises show that the redistribution effect promotes residential starts in most peripheral regions significantly while its effect on central regions is limited besides Tel Aviv-Yafo. Business construction is suppressed in most peripheral regions as more grants are redistributed from the central advantaged localities. However, in central cities such as Tel Aviv-Yafo and Rishon Lezion, growing business construction is permitted to attract employment. The total Arnona area for business activity is enlarged to raise local fiscal revenue as government grants are redistributed to disadvantaged places.

[9] Graphs of simulated results by city are presented in Appendices 4 (a) and 4(b)



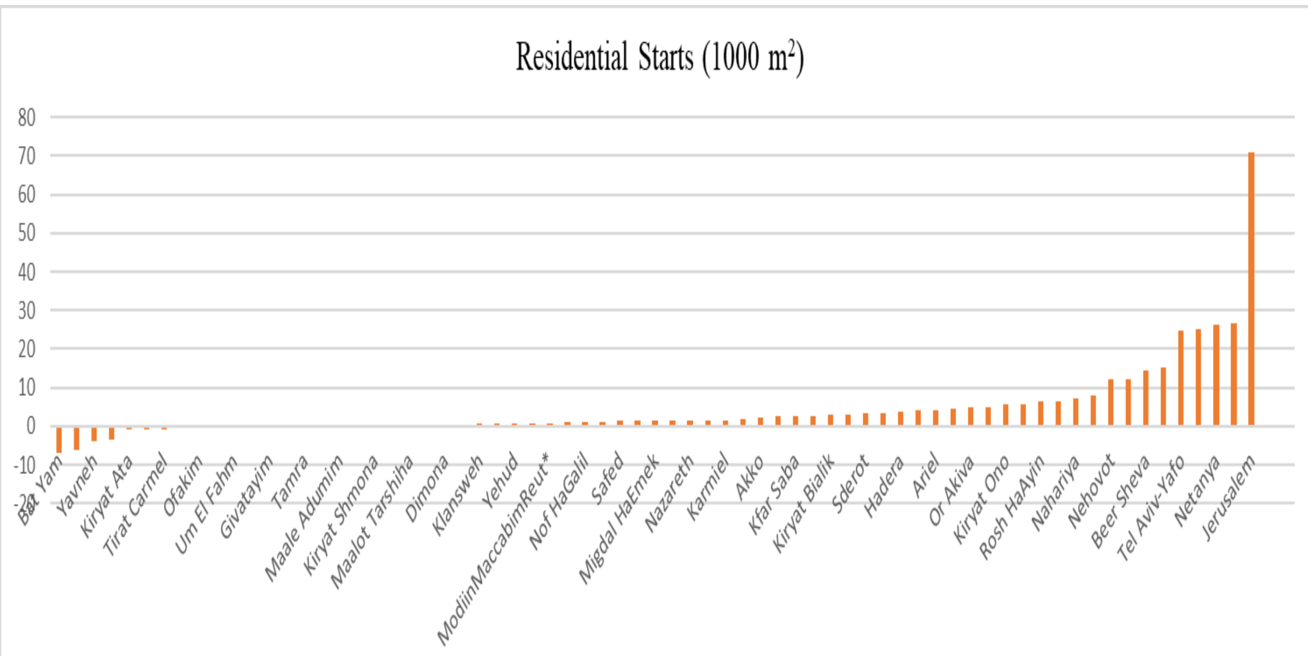


Figure 6. Simulation of Residential/Business Construction 2011-201**9**

Table 4: List of Cities with largest changes (%) 2011-2019 based on the simulation*

City Name	Residential Starts	City Name	Business Starts
Positive Changes			
Ariel	3%	Ariel	31%
Or Akiva	3%	Herzliya	13%
Herzliya	2%	Rosh Haayin	13%
Sderot	2%	Holon	12%
Migdal HaEmek	2%	Sderot	10%
Negative Changes			
Or Yehuda	-4%	Giv'atayim	-42%
Bat Yam	-2%	Bat Yam	-41%
Yavne	-1%	Yehud-Monosson	-17%
Tirat Carmel	-0.3%	Tirat Carmel	-12%
Haifa	-0.3%	Or Yehuda	-8%

*Simulation: increased government grants by 20% for weak localities and reduced government grants by 20% for strong localities

Table 5: List of Cities with largest changes (1000 square meters) 2011-2019 based on the simulation*

City Name	Residential Starts	City Name	Business Starts
Positive Changes			
Jerusalem	70.75	Jerusalem	107.24
Petah Tikva	26.47	Tel Aviv-Yafo	75.92
Netanya	26.18	Petah Tikva	75.86
Herzliya	25.12	Holon	53.52
Tel Aviv-Yafo	24.89	Herzliya	42.63
Negative Changes			
Bat Yam	-6.87	Bat Yam	-30.56
Or Yehuda	-6.09	Haifa	-15.29
Yavneh	-3.72	Ramat Gan	-14.74
Haifa	-3.58	Givatayim	-9.42
Kiryat Ata	-0.79	Kfar Saba	-8.30

*Simulation: increased government grants by 20% for weak localities and reduced government grants by 20% for strong localities

7. Conclusions

We use municipal building starts data for residential and commercial uses to test the long-run spatial equilibrium in Israel. In this dynamic application of spatial equilibrium, new buildings are initiated to meet the demand of population growth and employment growth. The results from the static model of building starts suggest that the type of new construction in a city (residential versus commercial) will dictate a slew of differential responses to prices, fiscal status, and land supply. Residential buildings are less elastic to land reserves but more elastic to changes in prices. Fiscal status has a significant effect on new commercial building but has no impact on new residential building.

Over the long term, the cointegration analysis shows that construction starts for residential buildings and commercial buildings are cointegrated with totally different variables. Residential starts are cointegrated with property tax rates, resident income, and population in logs. In contrast, commercial starts are cointegrated with a local authority's fiscal status (yearly surplus or deficit), fiscal independence, and the log number of employees. Moreover, commercial construction supply is shown to be less elastic to change in price and less spatially substitutable than residential construction.

In practice however, the benefits from most local public goods do vary over space. This is because local public goods are supplied from public facilities with fixed locations and finite spatial boundaries. Moreover, 'undesirable' populations and free riders are excluded through regulatory (planning) constraints. In the case of neighborhood goods, benefits are assumed to be uniform within a city (neighborhood), and no spillover effect is assumed to exist among cities (neighborhoods). In fact, residents of a neighborhood can free-ride public services in an adjacent neighborhood. These extensions and relaxations may not lead to a competitive equilibrium. As such, the decentralization mechanism whereby fiscal equalization is coupled with residential construction in non-central cities, may not lead to an efficient outcome.

Turning to the policy implications, we note three universal findings relating to the role of land in mediating inter-jurisdictional fiscal equalization in fast growth countries. First, while rapid population growth enables local authorities to have abundant revenue from land leasing in the short run, this source is unsustainable as land resources are limited. As the Henry George theorem implies, optimal public expenditure through land capitalization should take into account aggregate land rent within the current city boundary. This implication is of generic application in both small countries as Israel and large countries such as China where local authorities rely heavily on land capitalization to generate large (but unsustainable?) economic rents.

Second, natural land rent generated by agglomeration effects in fast-growth places indicates that, in competitive equilibrium, land supply for commercial and residential buildings is subject to very different forces. Residential construction supply is sensitive to population and prices. In contrast, commercial construction supply is greatly affected by a municipality's agglomeration level and public expenditure level.

Third, cities are different in their ability to generate independent revenues and provide public services. Large, centrally located local authorities are able to generate more land rent from agglomeration effects making them more fiscally self-sufficient. Ideally, the redistribution of land-leasing revenue should balance regional disparities generated by agglomeration effects. Place-based policies such as fiscal equalization would seem to be in place to restore the spatial equilibrium at least on second-best grounds (Partridge et al 2017).

However, in small countries such as Israel, this place-based versus people-based policy dichotomy is not that clear-cut. As our results show, the existence of spatial spillovers ensures the persistence of fiscal disparities across cities on the basis of a core-periphery pattern. Given the dominance of land reserves in generating fiscal disparities and given the fact that 93% of land and half of land reserves are administered by a central government agency, we suggest that the 'place-based' versus 'people-based' dichotomy may be over-stated. This dominance implies that in small, centralized countries 'place-based' policy may also inherently be 'people-based'.

Finally, our findings bring empirical support to the linkage between property tax redistribution and housing supply. These two matters have traditionally been treated as separate and essentially macro topics each serving as a policy instrument for reducing inter-jurisdictional inequalities (Hsieh and Moretti 2019, Henkel et al 2021). Our results however show them as linked. Over the long-run, non-residential construction is cointegrated with fiscal independence while residential construction is cointegrated with property tax rates. A recent Israeli government policy initiative (the so-called 'Arnona Law' proposed as part of the national budget in 2023) recommends institutionalizing this linkage by making housing supply rather than local authority fiscal deficit, the key for property tax redistribution. Our results provide initial empirical support for this contention lending practical policy significance to our findings.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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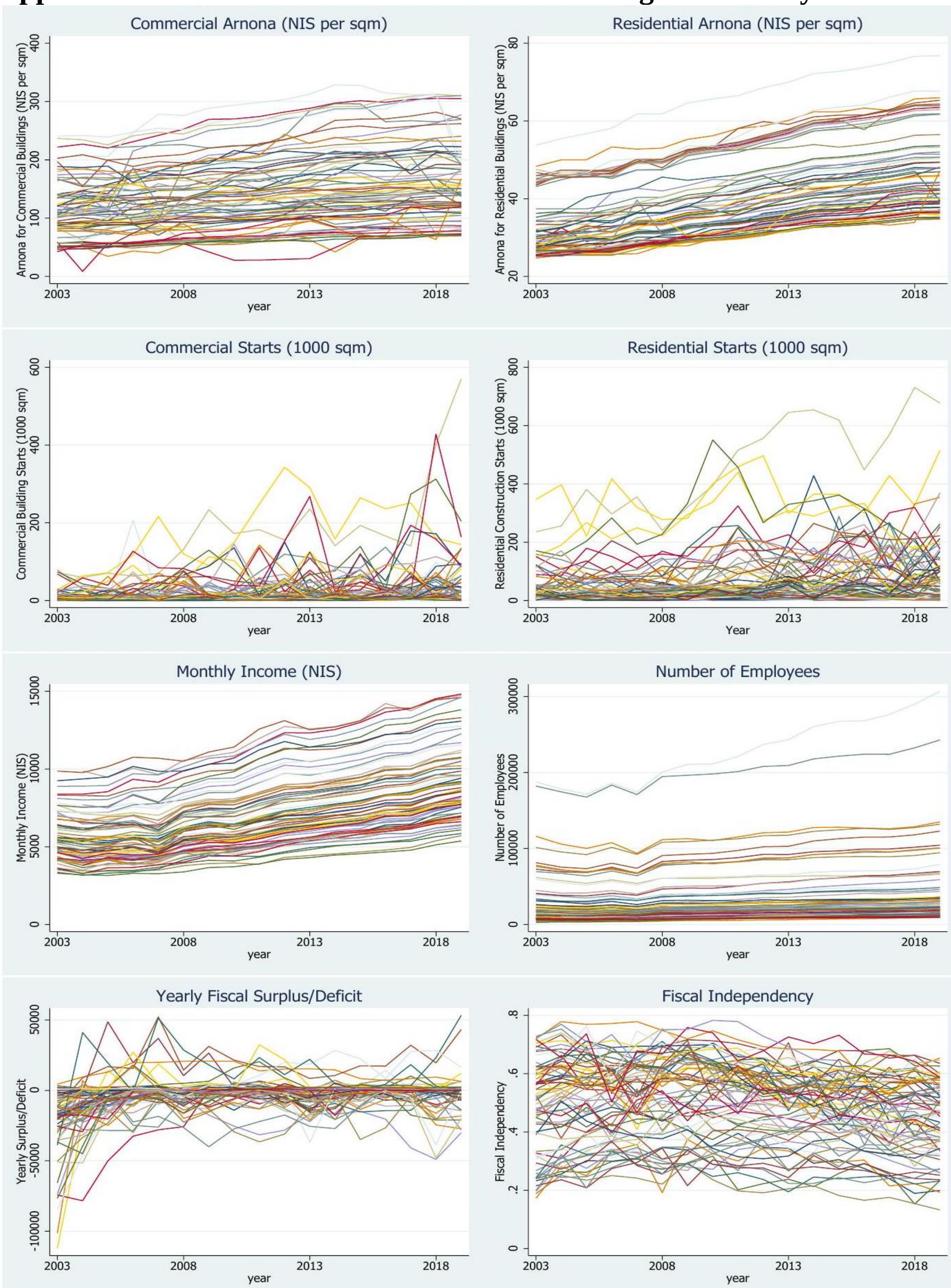
Appendix 1: Planning Stages in the Israeli Planning System and the Average Years Required

Stage	Responsible Entities	Average Years Required
1. Preparation by ILA	ILA	1
2. Discussion at Ministry of Interior	Ministry of Interior, Planning Administration	5
3. Preparation for tender	ILA	1.5
4. Auction	ILA	0.5
5. Building permit issued by local authority	Local Committees	3
6. Start construction	Contractors	0-0.5
7. Complete construction	Contractors	2
8. Total		13-13.5

Source: Annual Report 2014, Bank of Israel, Table 7A3.

Appendix 2: Plots of the Main Variables in Cointegration Analysis



Appendix 3. Equation Listing for Simulation

1. $revenue_{it} - expenditure_{it} = balance_{it}$
2. $revenue_{it} = individual\ revenue_{it} + grant_{it}$
3. $LOG(S^{Res}) = -7.588 + 0.658 * LOG(IMMI) - 0.381 * LOG(EMMI) + 0.706 * LOG_{ARNONA_{RATE_{RES}}} + 0.400 * LOG_{LAND_{RESER}} + 0.474 * LOG_{WAGE} + 0.090 * LOG(S^{Com}) + 0.392 * \widetilde{LOG(S^{Com}})$
4. $LOG(S^{Com}) = -0.627 - 1.177 * INDEPENDENCE + 0.122 * LOG(EMPLOY) + 0.137 * LOG(S^{Res}) - 0.221 * BALANCE + 48.273 * LOG(Area) + 0.285 * \widetilde{LOG(S^{Res}})$
5. $TOTALEXP = 215385.04 + 1.476 * GRANT$
6. $immi = abs(totalpopulation * 1000 * im\_rate + emmi)$
7. $IM\_RATE = -0.016 + 0.005 * LOG(EXP\_PER\_CAP) + 0.0119 * LOG\_REALWAGE - 0.0129 * LOG(POPULATIONDENSITY)$
8. $exp\_per\_cap = totalexp\ / total\ population$
9. $independence = independent\ income\ / (independent\ income + grant)$
10. $residentialstarts = exp(log\_start\_res)$
11. $businessstarts = exp(log\_start\_bus)$
12. $balance = independentincome + grant - totalexp$

Simulating construction starts i done by inverting the following linear system. We replicate Eq (9) from the main text. The panel spatial cointegration model of residential and commercial housing starts can be written as following spatial VAR (Vector Autoregressive) form:

$$\begin{pmatrix} lnS_{it}^{Residential} \\ lnS_{it}^{Commercial} \end{pmatrix} = \begin{pmatrix} \boldsymbol{X}_{it}\boldsymbol{\beta_1} \\ \boldsymbol{X}_{it}\boldsymbol{\beta_2} \end{pmatrix} + \begin{pmatrix} \gamma_1 lnS_{it}^{Commercial} \\ \gamma_2 lnS_{it}^{Residential} \end{pmatrix} + \begin{pmatrix} \rho_1 ln\widetilde{S_{it}^{Residential}} \\ \rho_2 ln\widetilde{S_{it}^{Commercial}} \end{pmatrix} + \begin{pmatrix} \epsilon_{it} \\ e_{it} \end{pmatrix} \quad (9)$$

Let $\boldsymbol{y}_t^{Res}$, and $\boldsymbol{y}_t^{Com}$ denote the vector form of panel data $lnS_{it}^{Residential}$ and $lnS_{it}^{Commercial}$ respectively, then equation (9) is written as

$$\begin{pmatrix} \boldsymbol{y}_t^{Res} \\ \boldsymbol{y}_t^{Com} \end{pmatrix} = \begin{pmatrix} \boldsymbol{X}_t\boldsymbol{\beta_1} \\ \boldsymbol{X}_t\boldsymbol{\beta_2} \end{pmatrix} + \begin{pmatrix} \gamma_1 \boldsymbol{y}_t^{Com} \\ \gamma_2 \boldsymbol{y}_t^{Res} \end{pmatrix} + \begin{pmatrix} \rho_1 \boldsymbol{W}\boldsymbol{y}_t^{Res} \\ \rho_2 \boldsymbol{W}\boldsymbol{y}_t^{Com} \end{pmatrix} + \begin{pmatrix} \boldsymbol{\epsilon}_t \\ \boldsymbol{e}_t \end{pmatrix}$$

By rearranging the equation

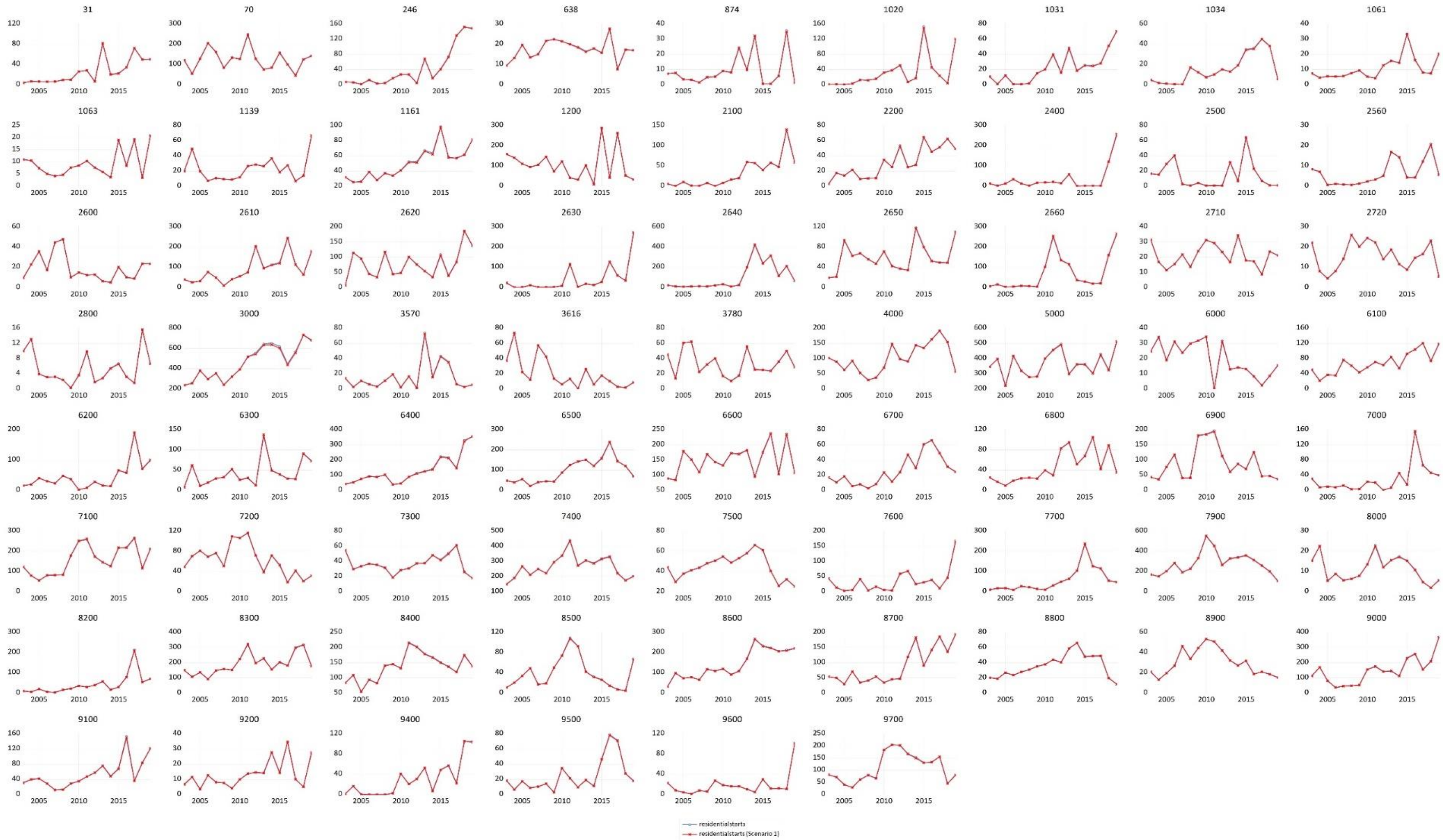
$$\begin{pmatrix} \boldsymbol{I} - \rho_1\boldsymbol{W} & -\gamma_2\boldsymbol{I} \\ -\gamma_1\boldsymbol{I} & \boldsymbol{I} - \rho_2\boldsymbol{W} \end{pmatrix} \begin{pmatrix} \boldsymbol{y}_t^{Res} \\ \boldsymbol{y}_t^{Com} \end{pmatrix} = \begin{pmatrix} \boldsymbol{X}_t\boldsymbol{\beta_1} \\ \boldsymbol{X}_t\boldsymbol{\beta_2} \end{pmatrix} + \begin{pmatrix} \boldsymbol{\epsilon}_t \\ \boldsymbol{e}_t \end{pmatrix}$$

Given the estimates of parameter $\rho_1, \rho_2, \gamma_1, \gamma_2$ are within 0 and 1, the matrix $\boldsymbol{I} - \rho_1 \boldsymbol{W}$ and $\boldsymbol{I} - \rho_2 \boldsymbol{W}$ are invertible.

Simulated construction starts can them be calculated as:

$$\begin{pmatrix} \boldsymbol{y}_t^{Res} \\ \boldsymbol{y}_t^{Com} \end{pmatrix} = \begin{pmatrix} \boldsymbol{I} - \rho_1 \boldsymbol{W} & -\gamma_2 \boldsymbol{I} \\ -\gamma_1 \boldsymbol{I} & \boldsymbol{I} - \rho_2 \boldsymbol{W} \end{pmatrix}^{-1} \begin{pmatrix} \boldsymbol{X}_t \boldsymbol{\beta}_1 \\ \boldsymbol{X}_t \boldsymbol{\beta}_2 \end{pmatrix} + \begin{pmatrix} \boldsymbol{I} - \rho_1 \boldsymbol{W} & -\gamma_2 \boldsymbol{I} \\ -\gamma_1 \boldsymbol{I} & \boldsymbol{I} - \rho_2 \boldsymbol{W} \end{pmatrix}^{-1} \begin{pmatrix} \boldsymbol{\epsilon}_t \\ \boldsymbol{e}_t \end{pmatrix}$$

Appendix 4(a): Simulated Residential Building Starts in 69 cities 2003–2019, 1000 sqm



Appendix 4(b): Simulated Non-Residential Building Starts in 69 cities 2003–2019, 1000 sqm