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Immigration and House Prices in Stockholm

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Abstract

In this paper we investigate the impact of changes in the share foreign born population on property values in Stockholm Municipality. We use 35,000 single-family home transactions between 2000 and 2017 to estimate the direct and indirect effect of changes in the share of foreign born population on house prices using demographic information from 130 neighbourhoods. We find significant evidence of decreasing house prices from the three-year lagged immigration with shift-share and geographic diffusion instrumental variables. No impact from immigration is found on the size of the native population or high income earners. When we estimate the indirect impact of different levels of immigration at the closest nearby rail transit station to homes within a neighbourhood, no significant effect is found but the ethnic composition along the entire subway line is close to significant. The results indicate a negative effect of immigration in line with recent research, but the number of observations and neighbourhood control variables should be extended to overcome significance and endogeneity concerns.

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1 Introduction

The effect of immigration on society at large is a recurring topic of debate in Sweden and other countries subject to substantial migration. The debate often focuses on the effects on native employment and government finances, but seldom on house prices. Since housing constitutes the largest investment for most people, any appreciation or depreciation is likely to have a large effect on the individual's net wealth. Immigration can be expected to cause house prices to appreciate in the short-run through increased demand due to a larger population facing a relatively unchanged supply of housing. However, immigration may also induce the process often referred to as "native flight" in sociological research, even where preferences along ethnic lines may be weak (Schelling, 1971). Since this would cause the demand from natives to decrease in the area, this may constitute at counteracting effect.

Mirroring the general debate, the impact of immigration was often studied within the field of labour economics to examine the effect on native wages. A seminal paper on the topic finds that a large number of Cuban refugees to Miami had little effect on wages in accordance with the scientific consensus (Card, 1990), but such conclusions have later been questioned (Borjas, 2017). However, the effect on house prices is usually estimated to be more pronounced, even though the magnitude varies from positive (Degen & Fischer, 2009; Saiz, 2007) to negative (Saiz & Wachter, 2011; Sá, 2015). This is a consequence of the widely different composition of migration across time and countries, and the different institutional settings of the receiving countries. Moreover, it depends on the level of analysis; the national effect or regional effect may well be different from the neighbourhood effect (Accetturo et al., 2014).

While the effect of immigration on house prices has been studied in both American and European contexts before, there is no Swedish study to our knowledge. Sweden shares some general features with other European countries, but there are several reasons why the effect of immigration may differ in Sweden. Since the 1990s, Sweden has had a relatively large immigration compared to other Western European countries. Recent years have witnessed the largest immigration yet and one of the highest recorded among developed countries, with 1.2 million residence permits having been granted 2005–2016. Swedish immigration has been extraordinarily dominated by people seeking refuge from war-torn countries, and tolerant attitudes toward migration are widespread.[1] Sweden is also a country with exceptionally generous welfare systems and similar to other European countries a rigid labour market; the unemployment among those born outside of Europe was 37 per cent in 2016. Simultaneously, the rental market is heavily regulated and house prices have doubled since 2005.

In this paper we investigate the impact of changes in foreign born population on

[1] According to the 2017 Gallup Migrant Acceptance Index, Sweden was the 7th most accepting country towards migrants in the world and 1st in the European Union among the countries included in the study.

property values in Stockholm municipality using micro data on all house transactions between 2000 and 2017. This enables repeated sales analysis connected to neighbourhood socioeconomic data including the share of foreign born from different foreign regions. We first create a yearly index of property values to estimate the effect from immigration on the *same* neighbourhood in which the immigrants settle in. Following the literature by using different versions of the shift-share instrument, which assumes that immigrants prefer to settle in communities with existing immigrant populations from the same region, we are able to estimate the causal impact of immigration on neighbourhoods with an average population of 7,000.

In order to estimate the indirect impact of immigration, we consider the framework of Accetturo et al. (2014) where immigration affects the quality of local amenities in the neighbourhood. Consequently, we also investigate the effect of immigration on house prices through channels unrelated to the housing demand of immigrants. The amenities may constitute limited access to scarce resources such as parks or local public services, or the preferences of the house occupants for a particular environment. To isolate this effect, we examine the relative price trend of houses within neighbourhoods depending on their closest rail transit station. Since the areas of the stations vary in the share of foreign born, we are able to treat otherwise similar houses with different levels of foreign born. This model akin to a difference-in-difference approach with important limitations allows us to estimate the indirect effect of immigration.

We find no significant impact of the first-difference change in foreign-born on house prices using instrumental variables, but a highly significant decrease of 3.4 per cent with a one percentage point increase in foreign born using a three-period lag to accommodate for slower effects. This effect is in accordance with previous literature finding 1–3 per cent lower prices on a neighbourhood level. Our larger magnitude may be explained by using smaller neighbourhoods where moving patterns create a larger effect, or the large and refugee-dominated migration from Sweden creating different outcomes than the composition of migration to other Western countries. When considering amenities, we find no significant effect on the changing amount of foreign born in adjacent neighbourhoods, but a small negative effect from an increasing share along the entire subway line.

In Section 2, we consider the literature on the empirical evidence on immigration and house prices, housing segregation and native flight and other social factors affecting house prices. We also consider how to value housing. In Section 3 we develop a theoretical framework leading to a set of hypotheses and their empirical implementation. In Section 4, we detail the process of mapping property transactions to socioeconomic data and develop price indices. In Section 5, we present our results. In Section 6, we discuss how the findings relate to previous literature and our hypotheses. Finally, we conclude our paper in Section 7.

2 Literature Review

2.1 Empirical Evidence on Immigration and House Prices

There is a large amount of studies testing the direct effect on property prices of immigration, a field related to those studying immigration's effect on wage levels. The key concern is that immigrants settle endogenously in relation to an area's attractiveness and future price trends. Consequently, the literature often employs a shift-share instrument to estimate the effect using an exogenous source of variation, which can be examine immigration's impact on a range of factors. A shift-share instrument uses the initial dispersion of immigrants to predict settlement patterns of future migration. The identifying assumption of the instrument is that the settlement decisions of immigrants is largely determined by the location of the existing population of countrymen. An example is a US study indicated a positive effect on house prices and rents of about 1 per cent from immigration for every immigration inflow equal to 1 per cent of a city's population (Saiz, 2007). This instrument was also used in a UK study which indicated a negative effect of 1.7 per cent on house prices for every percentage point increase in foreign born due to natives with high incomes leaving areas with higher immigration (Sá, 2015). Another UK study found a negligible effect on price, but a substantial shift from owned to rental properties and a propensity among immigrants to live in more crowded housing (Braakmann, 2016). A similar Swiss study indicated a 2.7 per cent increase on single-family homes for every 1 per cent increase of foreign born inhabitants in a district (Degen & Fischer, 2017).

Noticeably, the previously mentioned papers all dealt with nationwide data using large and independent areas as the level of analysis, such entire cities, metropolitan areas or even larger regions. Since labour markets seldom span across several of such large areas and moving is associated with large costs in terms of social networks and the need for new employment, the impact on different neighbourhoods within a city and a unified labour market may be very different. Even if the aggregate impact of immigration on house prices is positive, the variation within cities might be different since there is a low cost associated with moving to a different neighbourhood (Accetturo et al., 2014). An analysis performed across neighbourhoods in US metropolitan areas indicate a negative effect of immigration (Saiz & Wachter, 2011). The paper employed an instrument using a geographic diffusion model, assuming that immigrants have a preference to reside in areas near other areas with a high proportion of immigrants. The resulting estimates were around an 0.3 per cent decrease in house prices for every percentage point increase in foreign born. In a traditional hedonic regression using a rich data set from the Netherlands, a method which will be discussed in detail below, the author found that the social status of a neighbourhood and share of non-western immigrants has a negative effect on house prices and removed the significance of tenure mix and housing types in vicinity (Visser et al., 2008).

When discussing any aggregate impact of immigration, it is important to remember that immigrants themself are a heterogeneous group. Saiz & Wachter (2011) finds that the effect on house prices differed across different ethnicities of the immigrants. Similarly, a paper from 2004 by Cortes analysed the human capital and wage difference between refugees and economic migrants. By using data from 1980 and 1990 of immigrants in U.S who arrived in 1975 to 1980, the author found that initially the economic migrants had superior labour market outcomes. However, this was subsequently reversed in 1990 and the refugees that came in the period between 1975 to 1980 surpassed the economic migrants on the labour market, even though both groups possessed similar English skills. This could partly be explained by higher human capital accumulation among the refugees (Cortes, 2004). In contrast, Bevelander & Pendakur (2014) found that the refugees in Canada did not surpass the economic migrants with regard to labour market outcomes. The groups converged over time but the refugees never reached the same level as the economic migrants. In Norway, Bratsberg et al. (2017) showed that refugees from low income countries improve their outcomes on the labour market the first five to ten years relative to natives, after which the outcomes of refugees starts to diverge to a lower level. Furthermore, a new study examined the labour market outcomes of immigrants in Europe (Fasani et al., 2018). Controlling for numerous variables they still found that the outcomes for refugees was well below those of other comparable immigrants. Refugees had about a 12 per cent lower chance of having a job and 22 per cent higher risk of being unemployed compared to other immigrants with similar characteristics. This difference was gradually reduced and the gap closed after about 10 years after immigration. The same study also showed that refugees left dependence on the welfare systems faster than non-refugee immigrants (Fasani et al., 2018).

2.2 Segregation and Native Flight

Since immigration does not only represent an inflow of people but also may differ in their ethnic and cultural characteristics form the native population, the effect may be hard to distinguish from that of different ethnicities moving within countries. In this regard, the effect from immigration on house prices builds on a rich tradition of research on the effects of racial segregation in the United States.Harris (n.d.) finds evidence for the racial proxy hypothesis, which suggests that the reason for lower property prices in predominantly black areas was not racial preferences. Instead, it was because areas with a lower share African Americans in the population were more affluent and had more well educated inhabitants. Another study made by Myers (2004) with comprehensive neighbourhood controls showed that house values decrease with 0.5 to 0.7 per cent, where the larger effect is in white neighbourhoods, as the black population increases by one percentage point indicating that racial preferences indeed effect housing prices.

In order to understand the local effect of immigration on house prices, it is important to understand the dynamics of segregation. If there is a negative price effect of immigration, outmigration of natives from the areas where immigrants choose to locate is often suggested as a mechanism. There are several factors that might explain native flight. It has famously been shown that even in situations where most people prefer living in a mixed neighbourhood the result can be near-complete segregation (Schelling, 1971). The motives for caring about the composition of the neighbourhood at all may range from outright racism to concern for crime or social cohesion. The idea that particular share of a minority among residents in a neighbourhood triggers the majority to leave is often described as a tipping point. Most often, this is discussed in the context of white Americans leaving neighbourhoods in response to a growing black population, eventually leading to African Americans completely dominating a neighbourhood. A study by Card et al. (2008) found that the level of the tipping point in the United States ranges from 5–20 per cent and appears to have increased over time. It also appears to be higher in cities with more tolerant attitudes. However, the same study found no evidence of an effect on house prices around the tipping point. Another study showed that immigration has a significant effect on out-migration of natives on a neighbourhood level (Crowder et al., 2011). The effect is attenuated when the neighbouring areas also contained a high degree of immigrants, presumably because this implies a lack of other destinations to move to.

Since our topic of study is the effect of immigration in Stockholm, we also consider segregation and native flight in a Swedish context. A Swedish study indicated that there is a tipping point of 3 to 4 per cent immigrants with non-European ancestry where native residents start to leave a neighbourhood (Aldén et al., 2015). Since immigrant groups, and non-European in particular, have lower employment rates and wages than native Swedes, it is reasonable to expect immigrants moving to an area constitute a weaker demand increase than a similar native population increase. A study in 2006 by Bråmå (2006) studied whether there was "white flight" due ethnic preferences present in Sweden during the 1990s. Compared to a US context there are few, if any, homogeneous ethnic enclaves in Sweden. Instead, most segregated areas tend to be multi-ethnic. In the 1990s Sweden had a influx of immigrants and housing segregation across the ethnic dimension increased. The same study argued that the increase in neighbourhoods mainly populated by immigrants was a result of low in-migration to these areas from native Swedes, commonly referred to as native avoidance. However, evidence was found for a persistent but small outmigration of natives from such areas.

2.3 Other Social Factors Affecting House prices

Social factors are not limited to immigration or ethnicity. There may be other relevant characteristics which act on their own or are causally associated with immigration which affect house prices. Herath & Maier (2010) suggest that the effect of social factors on house prices, rather than physical attributes, is underresearched in general. Possibly, there may be an interaction between immigrants belonging to a different religion than the majority and xenophobia. However, the introduction of islamic public calls to prayer in Fittja, an immigrant-dense neighbourhood, had no effect on the outmigration of natives and a small positive effect on property prices (Blind & Dahlberg, 2015). Naturally, this may be an artefact of ingroup members appreciating the display of religion in the public sphere, and the result may well be very different in a neighbourhood with a large native population belonging to a different or no religion. Using a hedonic regression on Stockholm apartment prices, crime in neighbouring areas is found to have a strong negative effect ("The impact of crime on apartment prices: Evidence from Stockholm, Sweden", n.d.). A study on the London property market finds that a one-tenth standard deviation decrease in criminal damage increases property prices by 1 per cent(Gibbons, 2004). Burglaries, however, had no impact on price, which might be a product of endogeneity since more expensive houses usually contain more valuables. A US study in Florida finds that the *fear* of crime when a sex offender moves into a neighbourhood is associated with a 2.3 per cent decrease in house prices (Pope, 2008). In Sweden, there is solid evidence that foreign-born residents are suspects in criminal investigations disproportionately often, particularly those born in the Middle East and Africa (Martens & Holmberg, 2005). The same study found that the correlation is diminished, but not removed, after using rudimentary controls for socioeconomic factors.

2.4 The Hedonic Price Method

Having considered previous research on immigration and segregation, we still face the same challenges of any study trying to estimate an effect from a particular variable on house prices. In order to estimate the effect of immigration on housing prices, it is important to use a specification that accounts for the range of other factors affecting house prices in a plausible way. The Hedonic Price Method, has long been the primary method used to study property values in research. The Hedonic Price Method relies upon the assumption that a commodity, such as housing, has a value determined by some constituent properties, meaning that it can be estimated summing the values of its separate properties. Herath & Maier (2010).

Earlier works has shown that both inherent physical properties such as type, year of construction, number of bedrooms, and amenities and disamenities that can be attributed to the neighbourhood are valid determinants for housing prices (Grether &

Mieszkowski, 1974) (Lang & Jones, 1979). For example open spaces effects housing prices positively as well as proximity to water and green space (Lutzenhiser & Netusil, 2001; Anderson & West, 2006; Visser et al., 2008; Luttik, 2000; Cho et al., 2006) and less distance to schools increased the housing prices Owusu-Edusei et al. (2007) (Nguyen-Hoang & Yinger, 2011). Similarly, disamenities in the milieu such as noise and proximity to industrial facilities decrease the housing values (Wilhelmsson, 2000; Iman et al., 2009; Visser et al., 2008).

Since housing tends to be heterogeneous in its different properties, and even two identical houses must be placed on two different locations, it is inadvisable to estimate prices and demands for properties in a generic way. The hedonic approach offers a solution by decomposing the value of housing into separate properties that is easier to estimate individually.

Let α be a vector of all properties that a representative consumer value in housing (neighbourhood amenities and disamenities, contract conditions, the characteristics of the housing it self (number of room, living standard etc) and λ_p the value that the the representative consumer places on all these properties. Then the value of a particular housing $P(H)$ is equal to the sum of all the characteristics times its values.

$$P(H_n) = \sum_{n=1}^{N} \boldsymbol{\lambda_p \alpha}_n \tag{1}$$

In empirical applications the properties used to estimate the housing value tends to be governed by the availability of data, but variables used are often: number and types of rooms (bedrooms, bathrooms, etc.): year of construction; other features such as fireplaces, access to garage, material and structure, and exterior of the house. When the hedonic approach is used to estimate housing values there are two main approaches used; the statistical and the heuristic.

The statistical approach employs a multivariate regression with a large number of geographically dispersed housing transactions to estimate the value of the different inherent properties and their impact on the total housing value. The heuristic approach uses grids of recently sold properties to value the different properties and adjusting those estimates with a trend analysis, match-pairs or a market surveys.

Later hedonic models have been enhanced by using spatial information such as the distance to the central business district to account for spatial dependence and autocorrelation. There is a set of different models that are used in the literature: from the spatial lag model and spatial error model to the more sophisticated lattice model, geostatistical model and the semiparametrics model.

The Hedonic Price Method suffers from some central deficiencies: First, it places strong emphasis on the specification of variables and functional forms of the regression. This is Scholars differ in their use and interpretation of such models (O'Sullivan,

2003)(Sirmans et al., 2005). Second, the Hedonic Price Method faces substantial risk of multicollinearity between the separate properties and therefore risk yielding results difficult to interpret and incomparable estimates (So et al., 1997). These concerns are less important in our context, since we do need to find the value of individual attributes, but only aim to create a model which predicts prices well enough to avoid omitted variable bias. Third, the regression models also suffer from several left-hand problems. To estimate the value of the different properties a total housing value is needed, which tends to be in the form of a rent or transaction value. However, this seldom reflects the real value since regulations, tax schemes and large transactions costs may distort the dependent variable in non-random ways. This causes omitted variables bias that is difficult to account for and makes comparisons of different estimates difficult. In addition to the specification problem of the dependent variable, studies tend to use different measures. For example Brunauer et al. (2010) uses net rents and Banfi et al. (2007) uses gross rents and some studies like James et al. (2005) does not specify the type of rent used. Since the estimated coeffients measure the effect on the left-hand side, i.e. the prices, differences across studies in the determination of what constitutes price may affect the estimated magnitude of the effect immigration has on house prices. Consequently, it may prove difficult to compare the coefficients across studies.

An alternative to using pure transaction prices or rents is to use a index with with repeated sales data such as in Gibbons (2004) and Ihlanfeldt & Mayock (2010). This captures the relative changes and thus becomes more resilient to biases caused by a poor proxy for value. In addition, it solves issues with regard to time-invariant unobserved properties. However, repeated sales does not account for time-varying unobservables such as restorations, renovations and add-ons (Ries & Somerville, 2004). Nevertheless, it is the method currently used for important house price indices such as the Freddie Mac house price index.

3 The Stockholm Housing Market

Our study uses transaction data on houses and apartments in the municipality of Stockholm to investigate the effect of immigration on house prices. The Swedish housing market has both free market-features and elements of a planned economy. In 2016, about 9 per cent of dwellings in Stockholm municipality were owned-occupied houses, 49 per cent cooperative apartments, 15 per cent public housing and 25 per cent privately owned rental apartments. Owner-occupied houses and cooperative apartments are traded freely with little regulation, while rental apartments are subject to rent controls (SCB, 2017). The rent controls necessitate the use of alternative allocation mechanisms than prices; this is primarily achieved through the use of a queue. Approximately half a million people, which generally have some form of

housing already, are queuing for an apartment in Stockholm.

The housing pattern in Stockholm is sharply divided across ethnical lines, not only spatially but also when it concerns tenure type. In 2002, 85 per cent of the inhabitants in Stockholm born in sub-Saharan Africa lived in rental housing, with only 5 per cent residing in owner-occupied houses Hübinette et al. (2014).

4 Research Design

4.1 Theoretical Framework

Before formulating our hypotheses, we proceed to develop a theoretical framework describing the relationship between immigration and house prices. We consider both the direct effect of demand, the potential effect on the quality of amenities which are valued by house occupants and how the present population may respond to an influx of immigrants. Accetturo et al. (2014) and Sá (2015) examine the impact of immigration empirically and derive the theoretical effect of immigration on house prices using slightly different assumptions. Accetturo et al. uses the of the quality of local amenities to derive the impact of immigration on an area. The quality of amenities perceived by a given individual may be determined by factors such as parks or other scarce local resources, but also by the individual's preferences for social or cultural aspects of the neighbourhood. Importantly, this is a broad definition, including everything which an individual values in a neighbourhood. For example, immigration may have positive impact through things such as improved culinary opportunities, or possibly a negative if people have a preference for homogeneity. Accetturo et al. uses a weighted Cobb-Douglas function where immigration impacts the value of a particular house through its effect on the amenities in the area where the house is located.

$$U_{id} = A_d \frac{H_i^{1-\alpha} C_i^{\alpha}}{(1-\alpha)^{1-\alpha}\alpha^{\alpha}}, \tag{2}$$

where A_d represents the total value of the amenities minus the disamenities. An individual i can consume two types of goods: housing H_i and all other goods C_i. Sá uses an simpler linear Cobb-Douglas function:

$$U_{iC} = V_{iC} + h^{\frac{1}{2}} x^{\frac{1}{2}} - \delta I, \tag{3}$$

where the V_{iC} is the value of the local amenities for an individual i in city C and h and x represent a Cobb-Douglas function of the consumption of housing h and other goods x with a predetermined allocation $\frac{1}{2}$. The key difference is that Sá uses δ to represent a linear relationship between natives' distaste or preference for cultural diversity and the utility of an individual i.

We will use a more general model than the one used in Accetturo et al., where we start with a similar utility function but make fewer assumptions. The utility of an individuals $i \in 1, ..., N$, living in district d can be expressed as:

$$U_{id}(H_i, C_i) = \frac{H_i^{\alpha} C^{1-\alpha_i}}{(1-\alpha)^{1-\alpha}\alpha^{\alpha}} A_d(\Theta, \omega_d^I I) \tag{4}$$

where U_{id} is the utility for individual i living in district d. The individual chooses to consume either housing services H or other consumption C. The individual then decides how to optimise according to a weighted Cobb-Douglas function. In addition, it gains utility from the amenities in the area A_d which also depend on any potential effect on the amenities Θ from immigration as well as the number of immigrants $\omega_d^I I$. Hence, the individual maximises this utility function subject to the budget constraint:

$$Y_i = r_d H_i + C_i, \tag{5}$$

where we normalise the price of other goods and services to unity. From this, Sá splits the population into three groups: high income natives, low income natives and immigrants. Moreover, she also assumes that only high income earners can move to another city and will do so if the utility of living in the current one is too low. Consequently, the amount of immigrants and low income natives in a district is exogenous. Accetturo et al. only distinguishes between natives and immigrants. It is a reasonable assumption that not all people can move freely within a city. Cost of moving, sales taxes and a price-regulated market for rental apartments results in lock-in effects for low income natives and immigrants which usually also often have low incomes.

Furthermore, the Sá model allows for different shares of immigrants in all cities whereas Accetturo et al. assumes that there are only two districts where all immigrants settle in one of the districts. Yet again, the assumption of Sà is more realistic. However, we do not believe that restricting the model to two areas reduces the generalisability of our conclusions since a high income earner most probably makes his or her decision on the margin between two districts. We thus assume that we have two districts $d = 1, 2$ with I immigrants and N natives of which N^H have a high income and N^L have a low income, $N = N^H + N^L$. Let ω_d^H, and denote the share of high income natives, ω_d^L the share of low income natives and ω_d^I the share of immigrants living in district d (notice that $w_1^H = 1 - w_2^H$, $w_1^L = 1 - w_2^L$, and so on). Furthermore, we follow Sá in assuming that only high income earners can move freely across the city. Consequently, w_d^L and w_d^I are exogenous and w_d^H is endogenous.

Since the utility is of the Cobb-Douglas form, the Marshallian demand for housing is given by:

$$H_i^* = \alpha \frac{Y_i}{r_d} \tag{6}$$

and

$$C_i^* = (1-\alpha) Y_i \tag{7}$$

where the income of a high income native is Y^H, a low income native Y^L and that of immigrants is Y^I. Consequently, the aggregate income in a district d is:

$$Y_d = [\omega_d^H N^H Y^H + \omega_d^L N^L Y^L + \omega_d^I I Y^I]. \tag{8}$$

Assuming identical and homogeneous preferences, aggregate demand for housing in each district is given by:

$$H_1^D = \frac{\alpha}{r_1} Y_1 = \frac{\alpha}{r_1} [\omega_1^H N^H Y^H + \omega_1^L N^L Y^L + \omega_1^I I Y^I] \tag{9}$$

$$H_2^D = \frac{\alpha}{r_2} Y_2 = \frac{\alpha}{r_2} [\omega_2^H N^H Y^H + \omega_2^L N^L Y^L + \omega_2^I I Y^I] \tag{10}$$

Assuming a simple specification for the supply for housing, $H_d^s = \beta_d r^\theta$, gives the following equilibrium rents which are dependent on the share of income spent on housing α, the price elasticity of the district θ, a scale factor of β and the aggregate income in the district Y_d:

$$r_1^* = [\frac{\alpha}{\beta_1} Y_1]^{\frac{1}{1+\theta}} \tag{11}$$

and

$$r_2^* = [\frac{\alpha}{\beta_2} Y_2]^{\frac{1}{1+\theta}} \tag{12}$$

An individual first chooses which district to live in ($d = 1,2$). Following this, it then chooses his or her optimal consumption allocation. To determine the share of high income natives in district 1, w_1^H ($w_1^H = 1 - w_2^H$), the high income earners must be indifferent between staying in district 1 and 2.

$$\begin{aligned} U_{i1}(H_i^*, C_i^*) = U_{i2}(H_i^*, C_i^*) <=> \\ \frac{A_1(\Theta, \omega_1^I I)}{r_1^\alpha} = \frac{A_2(\Theta, \omega_2^I I)}{r_2^\alpha} <=> \\ \frac{r_1}{r_2} = (\frac{A_1(\Theta, \omega_1^I I)}{A_2(\Theta, \omega_2^I I)})^{\frac{1}{\alpha}}. \end{aligned} \tag{13}$$

To simplify this, we assume that the scale factors in both districts are equal, i.e. $\beta_1 = \beta_2$. This will not impact our conclusions from the model since $\beta_1 > 0, \beta_2 > 0$ implies that the relationship between relative incomes and amenities between district 1 and 2 will be characterised by a positive constant. By using (11), (12) and (13) we can obtain the following equilibrium condition for the share of high income households in:

$$[\frac{\beta_2}{\beta_1}\frac{Y_1}{Y_2}]^{\frac{1}{1+\theta}} = (\frac{A_1(\Theta,\omega_1^I I)}{A_2(\Theta,\omega_2^I I)})^{\frac{1}{\alpha}} <=> [\frac{Y_1}{Y_2}] = (\frac{A_1(\Theta,\omega_1^I I)}{A_2(\Theta,\omega_2^I I)})^{\frac{1+\theta}{\alpha}}. \tag{14}$$

From (14) we see that if the amenities A_d decrease (increase) with the amount of immigrants moving to the area, the right hand side decreases (increases) in magnitude and the left hand side must adjust accordingly, either by a decrease of Y_1 or Y_2. Since only high income earners can move to another district in our model $\frac{Y_1}{Y_2}$ can only change if high income earners move from district 1 to district 2. That is, more immigrants moving into district 1 will cause high income earners to move to district 2 if it causes the quality of local amenities to deteriorate.

We could do as in Sá and specify the relationship between the amount of immigrants in an area, i.e. $\omega_d^I I$, and their effect on amenities. Sá uses a linear approximation of amenities. Using our notation, a similar approximation can be expressed as $A_d = A_d^* - \Theta\omega_d^I I$ where A_d^* is the inherent amenities of an area and the Θ is the effect that $\omega_d^I I$ has on the inherent amenities in the area. However, it is hard to estimate the exact relationship between immigrants and amenities. Moreover, since our main focus is on the empirical investigation of the interaction between immigration, amenities and income, the theoretical relationship in (14) is sufficient.

It could also be reasonable to assume that immigrants have an impact on the income of high earners. If we assume immigrants have a lower income than high income natives, a welfare state would most certainly be prone to transfer money from the high income earners to immigrants. Indeed, this is arguably the case in Sweden. Transfers would then suppress prices in areas with high amenities which are demanded by high income earners and thus increase the relative prices of less attractive areas. However, the transfer effect is probably small compared to the effect that immigrants have on amenities.

From our equilibrium condition, we can solve the special case of the Accetturo et al.. We let $A_d(\Theta,\omega_d^I I) = A_d$. In the Accetturo et al. model, no distinction is made between low income and high income natives , i.e. $Y^H = Y^L = Y$, and it lets a share $\omega = \frac{\omega_1^H N^H + \omega_1^L N^L}{N}$ of the native populations live in district 1 and conversely $1-\omega = \frac{\omega_2^H N^H + \omega_2^L N^L}{N}$ live in district 2. The paper also expresses the income of immigrants as a share of the native income $Y^I = \gamma Y$. Moreover, all immigrants live in the same district, namely 2, $\omega_1^I = 0, \omega_2^I = 1$, and the mass/number of immigrants is $m : I = m$.

Consequently, $A_1(\Theta, \omega_d^I I) = A$ and $A_1(\Theta, \omega_d^I I) = A(m)$.

From these simplifications we can derive a new simplified expression of the aggregate incomes in each district, given by (8):

$$Y_1 = [\omega_1^H N^H Y^H + \omega_1^L N^L Y^L + \omega_1^I I Y^I] = [(\omega_1^H N^H + \omega_1^L N^H) Y] = \omega N Y, \tag{15}$$

and since $1-\omega$ lives in district 2:

$$\begin{gathered} Y_2 = [\omega_2^H N^H Y^H + \omega_2^L N^L Y^L + \omega_2^I I Y^I] = \\ [(\omega_2^H N^H + \omega_2^L N^H) Y + m\rho Y] = ((1-\omega)N + m) Y. \end{gathered} \tag{16}$$

The right hand side $\omega N Y$ and $((1-\omega)N+m)Y$ are the same expressions as in Accetturo et al.. Inserting this into (14) with $I = m$, $w_1^I = 0$ and w_2^I, we get:

$$\frac{\omega N}{(1-\omega)N + m\gamma} = \left(\frac{A}{A(m)}\right)^{\frac{1+\theta}{\alpha}}, \tag{17}$$

which can be rearranged to the same equation as (9) in Accetturo et al.. Solving for ω, r_1^* and r_2^* gives us the same city level rent as in Accetturo et al.:

$$\bar{r}* = \frac{[(N+\gamma m)\alpha Y]^{\frac{1}{1+\theta}}}{\beta_1^{\frac{1}{1+\theta}} \phi(m)^{\frac{\theta}{1+\theta}} + \beta_2^{\frac{1}{1+\theta}} [1-\phi(m)]^{\frac{\theta}{1+\theta}}}, \tag{18}$$

where:

$$\phi(m) = \frac{\beta_1 A^{\frac{1+\theta}{\alpha}}}{\beta_1 A^{\frac{1+\theta}{\alpha}} + \beta_2 (A(m))^{\frac{1+\theta}{\alpha}}}. \tag{19}$$

Accetturo et al. then derives: "The impact of migration at the district level, in relation to the city average, is negative (positive) if migration deteriorates (improves) the perception of the quality of local amenities." This conclusion is very similar to the conclusion we derived from (14).

Using the same utility function as in Accetturo et al. and two districts without the assumption that all immigrants live in the same district, we derived a more general conclusion in (13) and (14) of how immigrants affect the house prices of districts. An influx of immigration to a district will change the relative amenities of district 1 and 2, causing both the relative rent/price level to change and high income earners to move from the district. Consequently, we show that both Accetturo et al. and our model arrive at the same conclusions.

4.2 Predictions and Hypotheses

If there is an influx of immigrants into a district, $\omega_d^I I \uparrow$, it will first increase the income in the district $Y_D \uparrow$ and thus the rents in the district $r_d \uparrow$. From (14) we can also derive that this may have negative or positive impact on the amenities in the district $A_d(\Theta, \omega_d^I I)$. Within the scope of our model, amenities are broadly defined as anything the individual values in a neighbourhood. Since similar studies and the substantial segregation in Sweden indicates that a negative effect is likely there is reason to believe this applies to Stockholm as well. Consequently, it becomes more attractive to live in the district with less immigration since the relative rent is lower and the amenities are relatively better than prior to the immigration (11). Let us consider an influx of immigrants to district 1 in the case of a negative effect on the quality of local amenities:

$$\omega_1^I I \uparrow \Rightarrow Y_1 \uparrow \Rightarrow r_1 \uparrow \Rightarrow \left(\frac{A_1(\Theta, \omega_1^I I)}{A_2(\Theta, \omega_2^I I)}\right)^{\frac{1}{\alpha}} \downarrow => \frac{\Delta A_d(\Theta, \omega_d^I I)}{\Delta \omega_d^I I} < 0. \tag{20}$$

This creates an imbalance and will cause those with high income to move from the district 1 $\omega_1^H N^H \downarrow$ to district 2 $\omega_2^H N^H \uparrow$ until the equilibrium conditions in (13) and (14) are met.

It will hence become more expensive to live in district 2 relative to 1, $\frac{r_1}{r_2} \downarrow$, than before the influx of immigrants. Naturally, the opposite effect may occur if immigration has a positive impact on amenities. In addition, immigration also leads to more people living in the city in total which as in Accetturo et al. (2014) implies that the general city rents increases.

The rent effect of an influx of immigrants into district 1 will be the largest in district 2, but its effect on district 1 is ambiguous and depends on the effect that the immigrants has on the amenities in the district $\frac{\Delta A_d(\Theta, \omega_d^I I)}{\Delta \omega_d^I I} = ?$.

In sum, there are two effects of an influx of immigration to district 1. The total income in the whole city increases which affects the rents in both districts positively, but it can also be expected to have an affect on the amenities in district 1. Consequently, a larger portion of the city income will be directed towards demand for housing in district 2 in the case of deterioration of amenities. The relative size of the effects depends on $A_d(\Theta, \omega_d^I I)$.

Apart from our model, the literature indicates that there should be a direct demand effect on prices and that there may be native flight from neighbourhoods with immigration. Consequently, we have counteracting mechanisms with an uncertain net effect. We can thus propose the following hypotheses that we will proceed to test empirically:

1. An influx of immigrants to a district will increase the house prices in the district: $\omega_d^I I \uparrow \Rightarrow r_d \uparrow$.

2. An influx of immigrants at the district level will affect the quality of local amenities as defined above. There is reason to believe this effect may be negative, thus causing house prices to depreciate: $\frac{\Delta A_d(\Theta,\omega_d^I I)}{\Delta \omega_d^I I} < 0$.

3. High income earners in a district moves when there is an influx of immigrants to the district: $\omega_d^I I \uparrow \Rightarrow w_d^H N^H \downarrow$. We can also expect immigration to affect the share of natives, i.e. native flight.

4.3 Empirical Strategy

In order to test our first hypothesis, $\omega_d^I I \uparrow \Rightarrow r_d \uparrow$, we postulate a simple regression model following those used by a range of papers which consider the direct effect of immigrants on house prices. We thus aim to test the relative impact of immigration on the income Y_d and their impact on the amenites $A_d(\Theta, \omega_d^I I)$. To assess the effect of migration and the level of immigration on amenities we will use the relationship between log price of houses and the change of inhabitants with a foreign background in Stockholm neighbourhoods, i.e. the effect of an increase $\omega_d^I I$ on log prices $log\, P$:

$$\Delta log\, P_{it} = \beta \frac{\Delta FB_{it}}{Pop_{it-1}} + \phi_t + \rho_i + \epsilon_{it}, \tag{21}$$

where the left hand side is the log change in the house price index for an area i in a given time t and ΔFB_{it} is the change in foreign born population. To isolate the impact from migration, ϕ_t removes the general price trend in Stockholm through yearly dummy variables and ρ_i the district specific features through a dummy variable for each neighbourhood with an error term ϵ_{it}.

This specification should capture the direct effect of immigration, including price changes caused by the demand effect. We will hence be unable to disentangle such an effect from any effect on amenities in the opposite direction. We limit the study to houses in Stockholm, excluding apartments. Houses are relatively expensive in Stockholm, limiting the access of foreign born to them, and particularly those stemming from Africa and Asia. In this regard, an influx can be expected to have a smaller impact on the price of houses compared to apartments. However, owners of houses might possibly represent groups which are more sensitive to changes in their surroundings. As we assumed in the model, prices are determined by the movement patterns of high income earners. Younger and less affluent people residing in apartments may have a higher tolerance for changes in their surroundings.

We do not include socioeconomic variables, since all neighbourhoods belong to a common labour market and controlling for them might underestimate the magnitude of the effect since previous immigration is associated with certain socioeconomic characteristics. In order to consider the possibility of a slower response of the housing

market to migration, we also use three-period lags as an alternative specification to the first-difference model.

Migrants can be expected to settle endogenously in relation to neighbourhood characteristics which affect future price trends. Hence, we need to find an exogenous variation in changes of foreign born population to be able to make causal inferences from our results . We thus first use the shift-share instrument frequently employed by literature to examine the impact of immigration on wages and house prices:

$$\frac{\Sigma_c \lambda_{cit0} \Delta FB_{ct}}{Pop_{it-1}} \tag{22}$$

The expression implies that the exogenous migration in year t which can be expected in a neighbourhood i is a function of the share of the total population in the city from a foreign region c residing in that particular neighbourhood in the start of the period. Consequently, we examine the population born in the Nordic countries, the European Union, Asia, Africa, South America, North America and other countries at the first year in our data series, year 2005. The yearly citywide population change of inhabitants with the same background is then distributed across neighbourhoods according to the initial distribution. We create an instrument for changes in foreign born population by summing all different world regions and dividing by the total population of the neighbourhood.

The key identifying assumption of the shift-share instrument is that immigrants prefer to move to an areas where there is an existing community descending from their region. In order for the instrument to be relevant, the initial share of immigrants from a region needs to affect future migration. This assumption is often made in the literature concerning immigration and house prices, and we will test whether this applies to our model when implementing the regression in Section 5. The results can be seen in Table 10. In Sweden, there is evidence that minorities live next to countrymen to a higher extent than would be expected as a consequence of poor socioeconomic status or native flight (Nordström Skans & Åslund, 2010).

Moreover, the instrument has to be exogenous. This would not be the case if something causes both the initial share of foreign born and divergent future price trends. That is, the initial immigrant population should only be associated with present house prices through future migration. This is difficult to ascertain since we do not have an exhaustive set of control variables for neighbourhood characteristics. With few exceptions, immigrants have been able to settle freely, giving rise to endogeneity concerns. During a brief period in the late 80s and early 90s immigrants were allocated housing somewhat evenly across the country. However, there was still secondary relocation and no exogenous settlement on a neighbourhood level. In addition, the part of the instrument based on yearly citywide migration flows would fail if the citywide change in foreign born correlates with economic conditions of the neighbourhoods. Since

much of the migration to Sweden is refugee migration governed external factors and government policy, this is unlikely to be the case.

Following this, we modify the instrument by employing a version of the instrument used by Saiz & Wachter (2011). We assume that immigrants not only tend to move to areas with a preexisting immigrant population from their own region, but also have a preference for moving to areas neighbouring these areas. We call this factor geographical $pull$:

$$Pull_i = \Sigma_{j \neq i} \frac{\%ForeignBackground_j \cdot Area_j}{d_{ij}^2} \tag{23}$$

where the $pull$ for neighbourhood i is the sum of the distance-weighted foreign born population in all other neighbourhoods j. Since this is insufficient as an instrument on its own, we interact it with our shift-share instrument by multiplying Equation 22 with Equation 23. We implement the instrument based on geographical diffusion by creating the distance-weighted share of foreign born for all Stockholm neighbourhoods using a distance matrix. The identifying assumption is that a district neighbouring immigrant areas receive more immigration than an area with an equivalent initial share of immigrants in the neighbourhood but fewer surrounding the neighbourhood. The instrument would fail if the attractiveness to immigrants of the area is due to other factors than the neighbouring immigrant population, such as access to cheaper housing. Large areas are given greater weight to reflect their population and physical presence.

Our third hypothesis is that an influx of immigrants will reduce the number of high income earners in the area. The first-difference regression model in Equation 21 used for estimating the direct impact on house prices from immigration can be used to estimate the effect on the size of the population of high income earners and natives as well. To do this, we simply replace the dependent variable with the change in the share of population with a high income and other variables of interest.

Having designed a regression model to test the effect of the immigration to a given area on the *same* area, we proceed to study the effect on neighbouring areas. The fundamental reason for this is that we want to minimise the price effect from the housing demand of a changing foreign born population. When excluding the demand effect we can test our second hypothesis, i.e. that immigration may affect house prices through the deterioration of amenities. Ideally, one would want to separate the actual effect on amenities from any racial prejudice or xenophobia. The first may be factors such as immigration's effect on crime, crowded green areas, rationed local public services and so on. The second would constitute an outright taste-based preference among natives to avoid people of certain backgrounds.

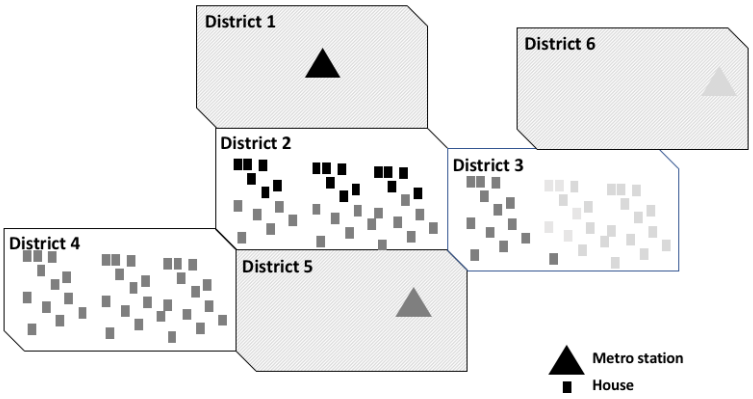
The distinction between taste-based price effects and deterioration of physical or social amenities is difficult to make in practice for two reasons. First, it is almost

impossible to gather data which covers any potential *actual*, non-racist, effect through an extensive use of control variables. Consequently, this would require an experiment specifically designed to measure racial prejudice or xenophobia. Second, even in theory, the two mechanisms are difficult to isolate, since racial prejudice may affect how natives perceive any objective deterioration of amenities, and thus act as an amplifier. Conversely, the deterioration may affect racial prejudice and hence endogenously create racist attitudes. Consequently, we believe it is reasonable to examine the combined effect and not attempt any separation within the scope of our study.

To test the effect that immigration has on the local amenities, $\frac{\Delta A_d(\Theta,\omega_d^I I)}{\Delta\omega_d^I I}$, we postulate that the area surrounding the closest urban rail transit station (subway, tramway or commuter train station) to a given house constitutes a significant part of the living experience considered when buying housing. 70 per cent of all people travelling to central Stockholm use mass transit. An example is the Stockholm subway, which is mainly located in Stockholm Municipality, has a daily ridership of 900,000 people in a metropolitan area with 2 million inhabitants. People can be expected to be willing to pay less if their mass transit options and local centre for shopping and other amenities (which usually are co-located with the rail transit station) are located in a less desirable area, and vice versa. Consequently, houses with the closest rail transit station in an area populated by immigrants should be less attractive if people prefer not being exposed to immigration during their daily routine, whatever the reasons. However, houses located close to a rail transit station with higher level of immigration may be systematically different. To mitigate this concern, we choose to compare houses where the closest subway station is located in a different neighbourhood than the house itself. Since some neighbourhoods are located in between two rail transit stations, we can compare housing units in the same area with different optimal rail transit stations. This effectively splits a neighbourhood into several areas and creates a variation in the immigration level exposure within each district. For each district d we hence get subdistricts a which allow us to indirectly compare $\frac{\Delta A_d 1(\Theta,\omega_d^I I)}{\Delta\omega_{d1}^I I}$ and $\frac{\Delta A_{d2}(\Theta,\omega_d^I I)}{\Delta\omega_d^I 2I}$. Both areas in a district are assumed to be equal except that they adjoin different rail transit station and therefore are exposed to different changes in the amount of immigrants. In this regard, it is similar to a difference-in-difference model, where neighbourhoods are initially internally homogeneous but exposed to different treatments.

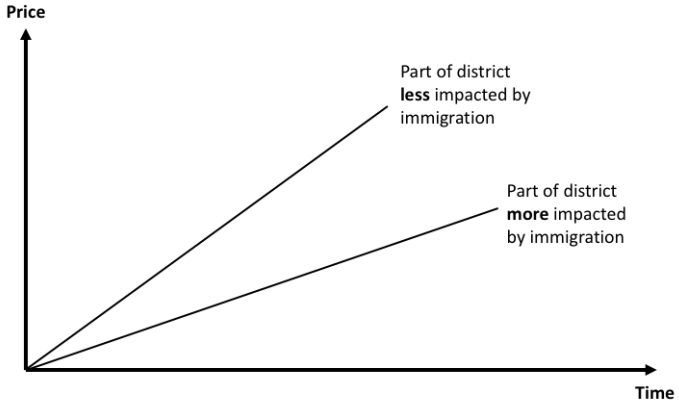
Let us consider the example given in Figure 1. The districts 1, 5 and 6 contain a rail transit station and are therefore omitted. The houses in district 2, 4 and 3 are split in to different groups depending on which metro station that is closest. The underlying assumption is that the trend across a neighbourhood would have been similar, had it not been for the changing surroundings. If the trends then deviate, as illustrated in the hypothetical example in Figure 2, we would have reason to consider that an effect of immigration on house prices through amenities would be possible.

Figure 1: A Illustrative Example Part 1



Note: This figure illustrates the method used in our regression model to determine the effect of immigration on house prices through the quality of local amenities. Houses in the same district are exposed to different treatments depending on the closest rail transit station.

Figure 2: A Illustrative Example Part 2



Note: The figure illustrates the divergent price trends within neighbourhoods with regard to the closest rail transit station which would appear if immigration has a negative effect. Later we will test if such a divergence exists.

The neighbourhoods in our data set are not arbitrary statistical units. Instead, they are shaped by historical factors relating to the built urban environment. Consequently, they are somewhat internally homogeneous by construction, making the case for similar initial trends stronger. However, we lack longer time series data to show the the different parts of neighbourhoods had similar trends before our period of analysis. This is also complicated by the fact that there is no sudden onset of migration, but a gradual increase. There may be systematic difference in houses in each district. For example, houses close to water could be systematically located to rail transit stations that experience less migration due to unobserved differences. If the value of water in the vicinity increases during our period of analysis, we would attribute the price difference to the wrong factor. However, given the number of areas and similarity of the summary statistics of houses in the subsample to the full population, this is unlikely. We thus implement our strategy by a regression model with the price of a single house as dependent variable:

$$log\, p_{hijt} = \beta_k \boldsymbol{x}_{ht} + \gamma_1 \%FB_{jt} + \phi_{it} + \rho_{ij} + \epsilon_{hijt},\ i \neq j, \tag{24}$$

where p_{ht} is the price of a house h in a specific month t, x_t is a vector consisting k inherent properties (apart from the distance to nearest transit station) of the house or apartment in a given time and βk is the coefficients representing the value of each of these properties and FB is the share of the population born abroad in the area j where the rail transit station is located. To ensure that the analysis is within neighbourhoods rather than across the city, ϕ_{it} represents yearly dummy variables for each area i. To control for preexisting differences, ρ_{ij} represents dummy variables for every interaction between area i where the houses are situated and the area j where the closest rail transit station is. The effectively divides the neighbourhoods in smaller units, each belonging to a particular rail transit station. We also use this specification to examine the indirect effect of other treatment variables by replacing $FB_j t$ with socioeconomic factors or indices related to crime and safety. We also consider different foreign backgrounds since we know they differ in socioeconomic status.

A general problem is that any inherent properties not included in our data set is assumed to be uncorrelated with the level of the foreign born, which is unlikely. To partly remove the effect of the inherent properties we also estimate the effect on houses for which we have multiple observations, i.e. several transactions within our time series. By doing this, all fixed effects pertaining to the house are removed, in its individual characteristics are thus dropped from the specification. However, we still need to assume that time-variant properties (add-on, restoration and renovation etc) is uncorrelated with the foreign born population. This fixed effects approach will also be referred to as repeat sales. Even though all are regressions are fundamentally hedonic, we will use the term to describe regressions where the house value is estimated with

the properties of the house as a pooled OLS, rather than repeat sales with panel data.

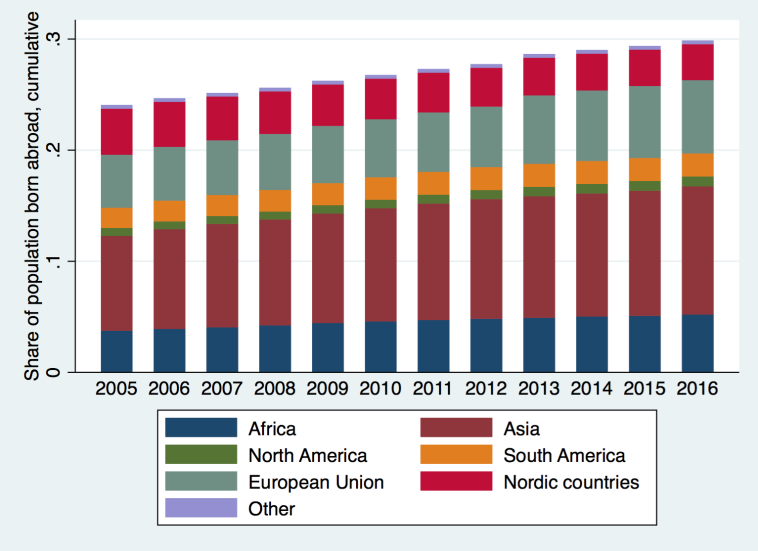
In order to isolate the effect from the neighbourhood itself, we estimate the impact of the share of foreign born along the *entire* subway line. We construct the measure in the following way:

$$subforeign_{it} = \Sigma_{j \neq i} \frac{\%ForeignBackground_{jt}}{time_{ij}^{\frac{1}{2}}} \tag{25}$$

where $subforeign_{it}$ represents the time-weighted share of foreign born along the subway line and $time$ is the travel time between two subway stations. We choose the square root as the functional form since it is reasonable to believe that the decay with travel time is fairly weak, i.e. weighting an area 4 minutes away only half as much as one 2 minutes away does not seem to realistically mirror the travel pattern between areas.

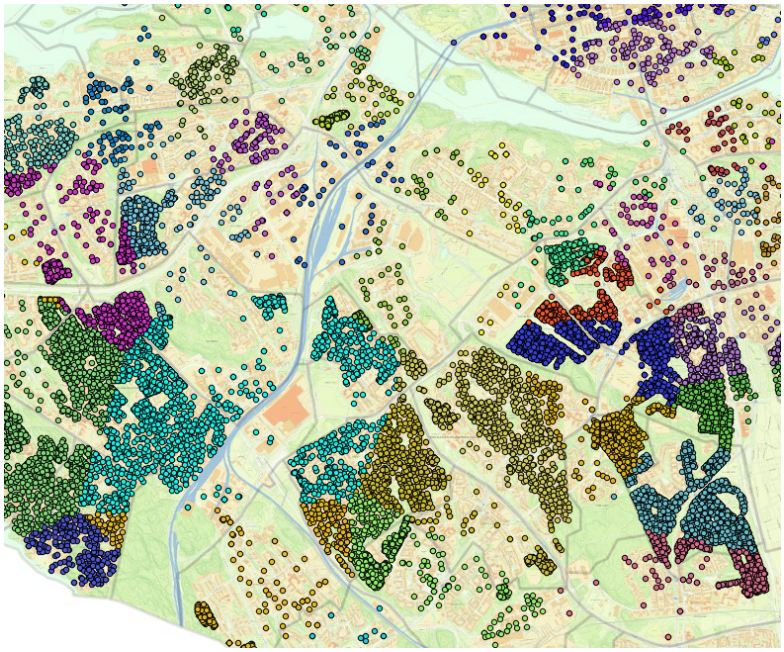
The measure $subforeign_{it}$ is likely to affect the value of houses by the ease by which people from other neighbourhoods along the same line can travel to the area. Areas closer to neighbourhoods populated by immigrants along the subway line should hence be perceived as containing more immigrants when moving through the area. We retain the same specification as in Equation 24, only adjusting the treatment variable. When performing this regression, we analyse all transactions regardless of their area since the treatment emanates from the subway station itself, i.e. we remove the constraint $i \neq j$. Since most people only travel from centre to periphery and vice versa, we exclude stations on the line beyond central Stockholm the travelling from the neighbourhood in question.

Figure 3: Share of population in Stockholm Municipality born abroad



Note: Share of population in Stockholm Municipality born abroad across different foreign regions, 2005–2016. Author's rendition of data from Statistics Sweden via Stockholm Municipality (2018).

Figure 4: Property transactions in southern Stockholm.



Note: House transactions represented points from Lantmäteriet (2018) projected on a Stockholm map in QGIS. Different colours of points indicate different closest rail transit station, grey boundaries different neighbourhoods with data on ethnicity and socioeconomic variables. A small amount of transactions on the map are multi-family housing which are later excluded from the analysis.

5 Data

5.1 Neighbourhoods and Geography

We use a data set from Stockholm Municipality collected by the Statistics Sweden, SCB, accounting for foreign background and a range of other demographic variables for 132 neighbourhoods in Stockholm municipality for the time period 2005–2016. In practice, however, about 70 will be used since central neighbourhoods only contain apartments and no houses. As seen in Figure 3, the per cent of inhabitants born abroad has increased from 24 per cent to 30 per cent across the time period, with largest increases being among those born in Africa, Asia and the European union. The summary statistics in Table 1 indicate that the average area has about 7,000 inhabitants with a high standard deviation. Among people born in foreign regions the average share of Asians and Africans has the highest standard deviation, indicating that they experience a higher degree of segregation than western immigrants. We remove areas with less than 100 inhabitants, since they will not contain reliable demographic changes, nor sufficient sales. Education is the number of people having received primary education, secondary education or tertiary education. The income is categorised into four intervals.

Table 1: Summary statistics across neighbourhoods

Variable	Obs	Mean	Std. Dev.	Min	Max
Total population	125	7294	5002	152	21457
Δ Population 2005-2016	125	1245	1604	-188	11072
Δ Foreign born	125	.054	.065	-.476	.193
Public housing	125	.065	.076	0	.384
Tertiary education	125	.400	.099	.167	.719
Africa	125	.037	.052	0	.343
Asia	125	.101	.094	.005	.435
EU	125	.064	.022	.021	.194
Nordic	125	.032	.007	0	.058
Other	125	.003	.002	0	.009

Note: Apart from the population, the numbers represent the total stock for the variable in question divided by the total population

In order to perform our analysis, we need to connect relevant other variables to each individual sale. Since we have detailed coordinates for every sale, we are able to map all housing transactions to the relevant neighbourhoods containing our neighbourhood variables using QGIS. Moreover, we obtain a data set containing the exact location of all rail transit stations in Stockholm municipality the map used to

calculate distances from Stadsbyggnadskontoret, the office belonging to Stockholm Municipality responsible for urban planning. The geographical boundaries of each neighbourhood are collected from Stockholm County. A rail transit station is connected to commuter trains, subways, tramways or ordinary trains. We perform the same mapping with these, assigning them the socioeconomic variables of the neighbourhood they are located in. We also calculate the distance between each individual housing transaction and its closest available rail transit station. An example of the geographical distribution and resulting closest stations can be seen in Figure 4. In addition, we create distance matrix with the simple distance between all neighbourhoods, disregarding infrastructure and physical barriers.

We also have survey data from 2008, 2011, 2014 and 2017 on the perceived safety and exposure to crime in the same neighbourhood units as our socioeconomic variables. The data is obtained from Socialförvaltningen, the office belonging to Stockholm Municipality responsible for social issues, and contains answers from roughly 16,000 respondents for each survey. With this, we create two indices, one for perceived safety and one for exposure to crime. We first construct indices using a simple arithmetic index where all questions are given equal weight. After this, we construct an alternative version using principal component analysis (PCA). In PCA, orthogonal components are estimated with the aim to explain as much variation across a range of variables. By definition, the first component explains the most variation. In this case, it is able to explain 33% of the variation of a range of variables. We argue that this represents the underlying safety or crime exposure, and hence use it as an index. All indices are standardised to facilitate the interpretation of the regression outcomes.

5.2 House Prices

Our prices for houses have been acquired from the Swedish government agency Lantmäteriet and cover all sales in Stockholm municipality. Since the information has to be submitted to the authorities by law there is a very high degree of accuracy and all market transactions are included. The data presented in Table 2 covers about 35,000 transactions between 2000–2017, having excluded multifamily dwellings. The table also presents the subsample used for the analysis of the indirect effect of immigration on property prices through amenities. When comparing the full sample and subsample, it is evident that the mean of key characteristics are very similar, indicating no substantial systematic differences. The five years preceding our socioeconomic data is used to facilitate the repeated sales analysis. We remove outliers, including the very rare sales over SEK 30 million and sales below SEK 1 million appearing to be an artefact of legal proceedings rather than true market prices. Moreover, a few duplicate sales on the same date are removed. We include sales with 0 living area or property areas, i.e. land lots, since they are still likely to reflect some aspect of the value of neighbourhood characteristics.

Table 2: Summary statistics for houses

	Full sample					Subsample	
Variable	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean
Price	34,206	4,088	2,543	1,000	28,996	13,730	4,258
Living area	32,875	120	38	0	545	12,990	118
Construction year	32,503	1955	22	1780	2017	12,831	1956
Property area	34,206	555	354	0	10,000	13,730	544

Summary statistics for the housing transactions acquired from Lantmäteriet in 2018. The time series covers 2000–2017 in Stockholm municipality. The subsample refers to the houses where the closest rail transit station is located in a different neighbourhood and for which there is socioeconomic data available.

When we examine the direct impact of immigration with a first-difference model, we need to be able to prices across years for a given neighbourhood. To do so, we create two indices, one based on a hedonic regression and one based on repeat sales.

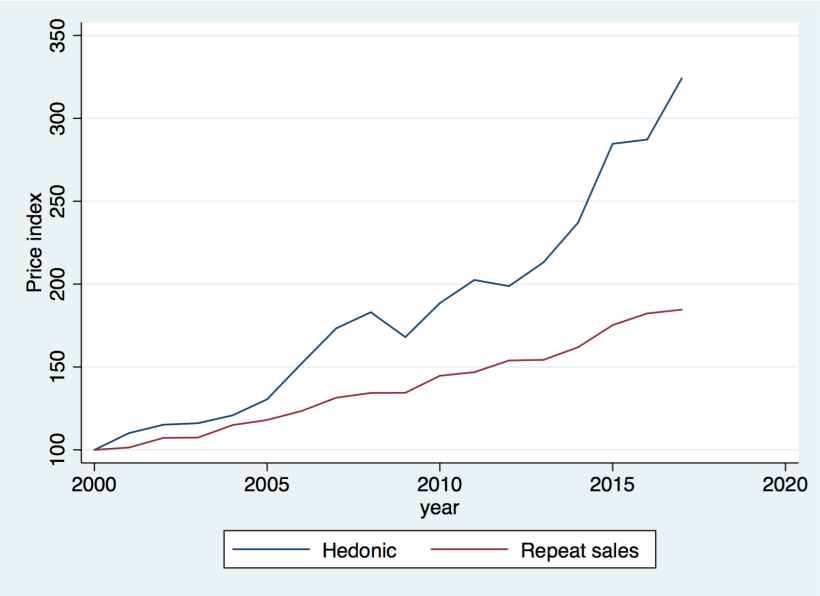
First, we create a hedonic time dummy index by regressing the price of individual sales on the characteristics of a every house along with a yearly dummy, following a Eurostat method (de Haan & Diewert, 2011). By doing this, the intercept is shifted for each year, reflecting the general price change adjusted for the different properties of the houses being sold across time.

$$ln\, p_n^t = \beta_0 + \sum_{\tau=1} \delta^\tau D_n^\tau + \sum_{k=1} \beta_k z_{nk}^t + \epsilon_n^t \tag{26}$$

where the time dummy D_n^τ has the value 1 if the observation belongs to period τ. The quantities z_{nk}^t represent a fixed number of K characteristics belonging to the house. The drawback of this index is that it does not allow the value of each characteristic to vary with time, which reduces its accuracy over longer time periods. However, a study comparing this with indices where the value of the coefficients are allowed to vary over time for Stockholm cooperative housing prices finds that the difference is negligible over a five-year time period Song & Wilhelmsson (2010). See Appendix for detailed results.

As indicated in Table 3, roughly half of the transactions are unique sales. The other represent houses which have been sold multiple times during the period 2000–2017. Using the Case-Shiller repeat sales index we first estimate a log price index $index_{itj}$ performing an ordinary least squares regression to estimate the coefficients for each designated period for each area. The log price difference $index_{itj}$ is regressed on time dummy Tit variables that takes either the value of -1, when the house is sold the first time, +1 when the house is sold the second time and zero for all period where the house is not sold. Consequently, the coefficient $exp(\beta_{jt})$ is equal to the index for that

Figure 5: Two different price indices for houses in Stockholm Municipality



Note: The average price development across neighbourhoods (2000 = 100) for the two house indices created by a hedonic time dummy index and a repeat sales index with data on house transactions between 2000 and 2016 from Lantmäteriet.

Table 3: Number of resales

Resales	N
0	15,454
1	7,941
2	2,025
3	403
4	64

Note: The table indicates the number of times which a house has been resold 2000–2017.

particular year:

$$index_{itj} = log(\frac{P_{ijt}}{P_{ijt-1}}) = \sum_{i=1}^{T} \beta_t T_{ijt} + \epsilon_{ijt}. \tag{27}$$

The variance of the error term varies with the period and results in heteroscedasticity. To compensate for this, we regress the squared residual vector from the regression on the periods and a constant:

$$\epsilon_{ijt}^2 = \beta_0 + \sum_{i=1}^{I} \beta_1 P_{itj} + \mu_{itj}. \tag{28}$$

Then we regress the index once more, now using the fitted values of the residual regression as weights, thereby removing heteroscedasticity:

$$\widehat{index_{itj}} = \sum_{i=1}^{T} \widehat{\beta_t} \widehat{T_{ijt}} + \widehat{\epsilon_{ijt}}. \tag{29}$$

The resulting indices can be seen in Figure 5. The hedonic price index reveals a much larger increase over time than the repeat sales index. This might be due to selection bias where inferior housing is sold more often, the omission of new housing in repeated sales or the inability to capture quality changes within the same unit of housing. Since the hedonic price index roughly compares to that compiled by Mäklarstatistik, it is not obviously flawed. We remove areas with indices that are highly volatile or with large gaps in the time series.

6 Results

6.1 Neighbourhood House Prices and Demography

Initially, we perform the regression specified in Equation (21) using the change in the hedonic house price index as our dependent variable. The results for this specification are presented in Table 4. We find one percentage point increase in the share of immigrants is associated with a significant 1.17 per cent decrease in house prices using first-difference and an even more significant 0.97 per cent decrease using a three-period lag.

The instruments used in the first-difference hedonic specification have f-values below 10 which indicates that the results should be interpreted with caution. In the

other regressions, the f-values range from 24 to 156, indicating that they are sufficiently strong. When employing our two instruments the magnitude of the coefficient sharply increases but becomes insignificant in the case of the first-difference regression. However, the shift-share instrument alone is highly significant in the regression with the three-period lag, ranging from a one percent change in the share of foreign born being associated with a 3.47 per cent decrease when using the repeat sales index to an 8.3 per cent decrease when using the hedonic index.

While suffering from markedly lower significance than previous papers when using the first-difference specification, the three-period lag specification indicates a sharply negative effect of migration. Consequently, the evidence seems to be somewhat more in favour of a negative effect. The larger magnitude when using instruments corresponds to the results of (Sá, 2015), which finds a small negative effect without using instruments, and a much larger negative effect of a 1.7–2.9 per cent decrease for every percentage point change in share of immigrants when using instruments.

The demographic composition of a neighbourhood might serve as a mechanism affecting house prices through different income compositions across age, education and ethnicity. Consequently, we estimate the effect of immigration on the demographic composition of neighbourhood using the same instruments as in the First-Difference regression in Table 4. As indicated by the results in Table 6, a 1 per cent increase in immigration is associated with a highly significant increase of 1.16 per cent in the native population. The effect on the size of the population with a high or very high income is similarly significant, but smaller in magnitude. However, when the instrumental variables are used the coefficients turn negative and insignificant. When examining the three-period lag as an alternative specification, it fails to produce significance as well.

6.2 Indirect Effect through Amenities

Having found some evidence of a negative effect of immigration on house prices in Stockholm municipality, we proceed to estimate an indirect effect with the specification from 24 presented in Table 5. Using the hedonic specification we find that a percentage point increase in immigrants is associated with a 0.256 per cent decrease in house prices. Including socioeconomic variables such as the unemployment rate, education level, income and share of public housing in the area containing the rail transit station slightly increases the magnitude and standard deviation of the coefficient indicating the effect of an change in the share of foreign born. Using an alternative specification, we estimate the same regression used fixed effects with panel data for every house. The regression without control variables using repeat sales remains insignificant, but the larger coefficient of -0.586 it fairly close to the 10 per cent threshold. However, when including socioeconomic control variables the estimate turns positive, implying that a one percentage points increase in immigrants in the area containing

Table 4: Direct effect regression

	ΔlnP_{it}					
	Hedonic			Repeat		
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta FB_{it}/Pop_{it-1}$	-1.174**	-5.151	-5.244	0.0422	-3.354	-5.202
	(0.540)	(5.277)	(7.989)	(0.729)	(2.768)	(4.044)
Observations	715	715	715	727	727	727
R^2	0.188			0.132		
Method	OLS	IV	IV	OLS	IV	IV

	$lnP_{it} - lnP_{it-3}$					
	Hedonic			Repeat		
	(7)	(8)	(9)	(10)	(11)	(12)
$(FB_{it} - FB_{it-3})/Pop_{it-3}$	-0.967***	-8.300***	-10.407*	-0.270	-3.465**	-4.800*
	(0.347)	(3.226)	(5.514)	(0.366)	(1.595)	(2.700)
Observations	583	583	583	597	597	597
R^2	0.256			0.140		
Method	OLS	IV	IV	OLS	IV	IV

Note: The level of significance is indicated by ***=1%, **=5% *=10%. Robust standard errors in parenthesis. The regressions include a year dummy to account for citywide trends and neighbourhood dummy variables to account for features specific to each neighbourhood. The change in share of immigrants' effect on the local house price index is predicted using a first-difference specification and a three-period lag in accordance with Equation 21. The initial dispersion of immigrants, along with a distance-weighted measure of the share of immigrants in neighbouring areas, are used as instrumental variables. The shift-share instrument alone is used in (2), (4), (8) and (11) with F-values 8.4, 158.9, 24.9 and 25.7. The interaction with shift-share and gravity pull is used in (3), (6), (9) and (12) with F-values 8.1, 156.3, 24.2 and 75.5

Table 5: Indirect neighbour effect regression

	lnP_{hijt}					
	Hedonic			Repeat		
FB_{jt}/Pop_{jt}	-0.256	-0.347		-0.586	0.870	
	(0.288)	(0.504)		(0.418)	(1.120)	
$Subway\_FB_{it}$			-0.0887			0.0301
			(0.0567)			(0.121)
Observations	10,520	9,311	13,074	13,659	11,403	16,873
R^2	0.775	0.767	0.796	0.675	0.617	0.689
Clusters				10,634	9,291	13,139
Method	OLS	OLS	OLS	FE	FE	FE
Socioeconomic variables	No	Yes	No	No	Yes	No

Note: No coefficients are significant at the 10 per cent level. Robust standard errors in parenthesis. The regressions include a yearly neighbourhood dummy variable to account for neighbourhood trends and an indicator variable for each combination of area and closest rail transit station to account for features specific to houses close to it with the specification in Equation 24. The change in share of immigrants' effect on each house sale is first estimated using an OLS. It is then estimated using a panel of resales, where property characteristics are dropped. The t-values are -0.89, -0.67, -1.57, -1.40, 0.78 and 0.25. The repeat sales estimation includes more observations since it does not require the same amount of house-specific control variables. Consequently, fewer observations are omitted.

Table 6: Effect on demographic composition regression

VARIABLES	$\Delta N_{it}/Pop_{it-1}$	$\Delta HI_{it}/Pop_{it-1}$	$\Delta VHI_{it}/Pop_{it-1}$	Method
	(1)	(2)	(3)	
$\Delta FB_{it}/Pop_{it-1}$	1.116***	0.450***	0.154***	
	(0.244)	(0.106)	(0.0436)	OLS
R^2	0.625	0.629	0.610	
	(4)	(5)	(6)	
$\Delta FB_{it}/Pop_{it-1}$	-0.585	-2.894	-0.376	
	(0.727)	(5.661)	(1.032)	IV
Observations	737	622	622	

Note: The level of significance is indicated by ***=1%. Robust standard errors in parenthesis. The regressions include a year dummy to account for citywide trends and neighbourhood dummy variables to account for features specific to each neighbourhood. The change in share of immigrants' effect on the local house price index is predicted using a first-difference specification in accordance with Equation 21. The instrumental variable used in (4), (5), and (6) is the initial dispersion of immigrants interacted with a distance-weighted measure of the share of immigrants in neighbouring areas.

the subway station causes the houses being close to it to experience a 0.87 per cent price appreciation. Since we have seen that the repeated sales index is substantially different from the hedonic, the different results when using panel data does not come as a surprise.

We proceed to estimate the effect of the ethnic composition of the entire subway line. Hopefully, this allows us to disentangle the effect from changes in the immediate neighbourhood related to changing residential patterns, reducing endogeneity concerns. Using hedonic data, the composition along the subway line indicates a depreciation of 0.089 per cent when the distance-weighted share of immigration on the along subway line increases by one percentage point and very close to being significant at the 10 per cent level. However, the repeat sales method displays an insignificant and positive correlation.

Given that the indirect regressions with share of foreign born population as treatment variable are largely insignificant and to further examine possible mechanisms, we examine a range of other treatment variables. Initially, we use the most common immigrant backgrounds. The coefficients are negative but insignificant across the board. The hedonic estimates are the most intuitive, with the largest negative effect being a 0.221 per cent decrease in house prices from a one percentage point increase in the share of those born in Asia. The coefficient of African born follows closely, with the EU being very small and highly insignificant. This is in line with what could be expected in terms of racial prejudice and spatial segregation. However, when estimated using the repeat sales, the order is the opposite, with a percentage point increase in EU population being associated with a 1.183 per cent decrease in house prices.

We also perform the regression with a range of other treatment variables, as seen in Table 7. Education, income and unemployment are also factors which possibly might affect house prices in the neighbouring area. We construct simple indices for education and income by assigning higher weight to higher income and education in an ordinal scale to be able to use the intervals as a unified treatment variable. An increase of the educational index by one, which would imply that the entire population increases its educational attainment by one level, is associated with an insignificant 0.21 per cent depreciation. This effect is smaller and insignificant when using repeat sales, and the effect of income is negligible in both cases. A one percentage point increase in unemployment is associated with an insignificant 0.3 to 0.4 per cent increase in house prices.

When using the indices from the perceived safety and crime exposure survey as treatment variables, we find our only highly significant effect with indirect regression specification. Since the survey is only performed every three years, the sample is approximately one third of the previous regressions. Alternatively, we could interpolate index values for missing years. However, we believe such assumptions pose a greater risk than what we gain from additional price observations. The crime exposure

Table 7: Disentangling the effects

	lnP_{hijt}	
	Hedonic	Repeat
Africa	-0.221	-0.069
	(0.358)	(0.593)
Asia	-0.269	-0.519
	(0.314)	(0.481)
EU	-0.097	-1.183
	(0.608)	(0.826)
Education	-0.210	0.119
	(0.152)	(0.273)
Unemployment	0.408	0.369
	(0.738)	(1.73)
R^2	0.775	0.675
Observations	10,520	13,659
Income	0.082	-0.047
	(0.207)	(0.411)
R^2	0.766	0.615
Observations	9,274	11,403
Safety index	-0.064	-0.285***
	(0.051)	(0.097)
Crime index	0.000	-0.029
	(0.024)	(0.092)
Safety index (PCA)	-0.017	-0.113***
	(0.021)	(0.037)
Crime index (PCA)	0.000	-0.003
	(0.030)	(0.104)
R^2	0.779	0.556
Observations	2,949	4,466

Note: The level of significance is indicated by ***=1%. Robust standard errors in parenthesis. The regressions include a yearly neighbourhood dummy variable to account for neighbourhood trends and an indicator variable for each combination of area and closest rail transit station to account for features specific to houses close to it. The effect of various treatment variables on the house price is estimated in accordance with the specification in Equation 24. Each combination of row and column represents a separate regression. Regressions demarcated by lines share common number of observations and R^2-value.

index, which is constructed from the share of respondents indicating they have been the target of a crime, is persistently insignificant. Since the index is standardised, we can interpret the coefficient to mean that a one standard deviation increase in crime reduces prices by 0.2 to 0.3 per cent. The index indicating perceived safety, i.e. whether one *feels* safe in the neighbourhood, is associated with larger magnitudes. As has been the case previously, there is once again a substantial difference between the hedonic regression and repeat sales. Using the hedonic regression, a one standard deviation increase in perceived "insecurity" is associated with an insignificant 1.7 to 6.2 per cent decrease in house prices, with the smaller being the principal component index. However, when the panel data is used, the estimates increase in magnitude and turn highly significant, with the estimated effect being a decrease in 11 to 28 per cent, with the PCA once again providing the more conservative estimate. Since the sample size is very small when using repeat sales and survey data from every third year, this should interpreted with caution.

7 Discussion

7.1 Direct Effect using Instrumental Variables

We begin by briefly considering the extent to which our results mirror our hypotheses and the literature. Considering our first hypothesis – *an influx of immigrants to a district will increase the house prices in the district* – there is no evidence that immigration increases house prices, which means that other factors dominate the direct demand effect. Noticeably, our three-period lags are substantially more significant than the pure first-difference specification. This indicates that it takes some time for the level of foreign born to affect the housing market. The most conservative significant results from our three-period lag indicate that a percentage point increase in foreign born population is associated with a 3.4 per cent decrease in house prices. In terms of the average house transaction which is worth approximately SEK 4.1 million across our time series, this would represent about SEK 140,000. Naturally, this figure is higher in 2017, where the average price is SEK 6.9 million. This is markedly larger than the effects of 1 to 2 per cent most frequently observed in the literature, but does not deviate to the extent that it is obviously spurious.

The magnitudes displayed in Table 4 is several times larger than both Sá (2015) and Saiz & Wachter (2011), but given the unique composition of Swedish immigration, it is not wholly unreasonable. In addition, it is an expected consequence of using smaller areas, where any changed moving pattern is more likely to affect the aggregate than using large districts. In sum, the results are in line with previous research. The sharply increased coefficients when using instruments are also justified, since immigrants can be expected to move to growing areas further from the city centre, which experience

relatively large price increases from a lower level due to other factors. Consequently, the magnitude of the coefficients when using instrumental variables providing an arguably exogenous change in immigration which is not affected by this counteracting effect.

The significant *positive* correlation between increasing share of foreign born and native population and high income earners does not reflect the literature, nor our third hypothesis – *high income earners in a district moves when there is an influx of immigrants to the district.* However, since this disappears when applying the instrumental variables, it is likely to be a consequence of endogenous immigration to areas which grow particularly rapidly. Regardless, our prediction from theoretical framework that lower prices should be associated with high income earners leaving the area is not supported in the data. Consequently, we find no clear mechanism which can explain the significant decrease in house prices in response to migration that we observe with in our IV regression. This is remarkable in light of the extraordinarily large coefficients we observe.

Perhaps the very large negative coeffients observed in our IV regression indicate that there may be endogeneity concerns. If the initial share of immigrants is negatively related to future price trends, there would be an upward bias in immigration's effect on house prices. This could be a in our case, for example if the location of immigrants in areas where there was a housing surplus in the 1970s, such as Million Programme areas,[2] creates divergent price trends now. On the other hand, all large share of the native population lived in similar housing, and there are many such areas which have remained, or become, attractive. In sum, a larger set of control variables for neighbourhood characteristics such as age of the housing stock and similar would be desirable to account for such effects.

7.2 Indirect Effect through Amenities

Our indirect regression specification performed in Table 5 does not significantly show any deterioration of amenities apart from the change along the entire subway line. However, the coefficients are persistently negative, which in the case of significance would have been in line with our second hypothesis – *an influx of immigrants at the district level will deteriorate the quality of local amenities.* It is reasonable that the coefficients in Table 5 of about 0.2 per cent are markedly smaller than the direct regression in Table 4. Because any effect on amenities is going to be of lesser importance for those living in a neighbouring area than for those living in the area itself. While all coefficients for the neighbouring area are negative, only the one using the distance-weighted share along the entire subway line is close to being significant. The

[2]The Million Programme was an ambitious housing project to build on million modernist homes 1965-1974

most immediate reason for this is that it utilises a larger share of the data, since we do not restrict it to houses with rail transit stations in a different area.

Undoubtedly, the regressions performed in Table 5 suffer from endogeneity problems. However, since there is no suitable instrument available or natural experiment for the *stock* of immigrants within cities with our data, we still believe it gives some indication. Unless there are counteracting correlations, any causal relationship should be visible as a correlation as well. Consequently, an insignificant correlation would weaken the case for a causal effect. In this case, the evidence is mixed depending on the specification. The use of socioeconomic controls has a widely different effect on the estimate across our two methods, with the hedonic regression with controls resulting in slightly more negative effect and the repeat sales method indicating a substantially more positive effect. Regardless, the use of socioeconomic control in this context suffers from severe problems, since there is no doubt that immigrants endogenously systematically differ in socioeconomic outcomes from the native population.

We also attempt to examine alternate, but related, mechanisms which may affect house prices. The effect of an increasing share of foreign born is consistently negative and insignificant across backgrounds, but it is not possible to draw any conclusions about the meaning of their relative size, apart from that it does not support any varying degree of racial prejudice among the native population between backgrounds. The regression using survey data shows that perceived insecurity may be cause lower house prices. This may also be associated with immigration due to worsened socioeconomic conditions and potentially crime. It may also affect how natives suffering from racial prejudice or xenophobia perceive their environment, thus exasperating the effect.

7.3 General Concerns

One of our primary concerns is the sometimes weak significance observed across the board. A key reason for this is that the variation is severely restricted by the range of time and location dummies we use in our regressions to be certain that we estimate the correct effect. Ideally, this could be resolved with a larger sample, which also would strengthen any case made for a null result. However, our data represents the full population of houses sold in Stockholm Municipality between 2000–2017. The most apparent limitation is that we do not have data for the surrounding municipalities which constitute the Stockholm metropolitan area and a unified labour market. To paint an even fuller picture, the data could be extended by adding cooperative housing, more Swedish cities or a more sophisticated, tailor-made neighbourhood specification could be used. However, there is reason to believe that the effect may be different for different types of cities and housing.

The results yielded by our hedonic estimations and those utilising resale data often differ, sometimes creating coefficients twice the size with otherwise identical specifications. To a certain extent, this may be a product of the sample size creating

imprecise estimates. Since repeat sales only use a subset of the transactions used for hedonic regressions, it can be expected that the coeffients are different. However, there is reason to believe that the problem is greater than this. One mechanism creating systematically different estimates could be a selection bias in terms of the frequency a house is resold. Of certain types of houses are resold more often, they may have trends which diverge from general. Moreover, it is possible that houses which are sold more often are exposed to different treatments in terms of renovation and investment than other houses. Ideally, we would want to investigate further what biases this might cause in estimations with limited sample sizes.

It is also important to recognise the heterogeneity among the immigrants, both when we carry out our tests and later when we compare our results with other studies. In our thesis, we have largely treated all immigrants as homogeneous. The effect of immigration on house prices found does not account for that immigrants may differ in a systematic manner, which is highly likely to be the case. When performing our regressions, we try to disentangle the effects of different immigrants by using origin as proxy for differences. This attempt yielded no significant results and due to data availability we only have coarse data on origin. Furthermore, we were unable to test for the type of immigration and hence we treat immigrants in general and refugees the same. There is a substantial possibility that economic immigrants and refugees are systematically different in their choice of district to live in and their labour market outcomes in a way which could affect our results.

To the extent that our results are valid and constitute a causal effect, it is worth considering if they apply other cities and countries. Since we do not find a clear mechanism for the observed effect, it is difficult to ascertain the necessary prerequisites for a decrease of house prices in response to migration. However, most larger Swedish cities suffer from segregation. The immigration has also been similar in composition to that of Stockholm, so there are no obvious reasons why the results would not apply across Sweden. Since a similar negative effect has been observed in the UK and US, it seems to be a recurring phenomenon. However, countries with a higher degree of skilled immigration, such as Switzerland, appear to witness different effects. In such cases, the straightforward demand effect from immigrants probably dominates any effect from native flight or deteriorating quality of local amenities.

8 Concluding Remarks

With the recent large immigration to Sweden, its consequences have yet to be fully established. The recent sharp appreciation of house prices has put the importance of the housing market's social consequences and impact on financial stability into the spotlight. Being increasingly important for the individual's net wealth, even small changes are amplified by the commonly high leverage. Since there is reason

to believe there are counteracting effects of immigration on house prices, its impact is uncertain a priori. We are able to show some evidence of a negative causal effect from immigration on house prices on a neighbourhood level. However, there are some issues with insignificant estimates, with only the three-period lagged change in foreign born yielding highly significant estimates where there is reason for a causal interpretation. Nevertheless, the persistently negative and sometimes near-significant coefficients across the other regressions indicate the it is more likely that the effect is in such a direction.

Our shift-share and geographic diffusion instrumental variables increase the magnitude of the negative coefficients estimated. Considering the estimated coefficients at face value, the results are in line with UK and US literature but with a larger negative effect. The increased magnitude could be a consequence of the unusually large proportion of refugees in migration flows with different characteristics than the more common labour migration. Noticeably, the size of the coefficients does not indicate that the generous welfare state reduces the effect, which possibly could be explained by the poor labour market outcomes for foreign born in Sweden. Native prejudice creating larger effects on prices would be surprising, since Sweden by most measures appears to be an exceptionally tolerant country.

When investigating the effect of immigration on house prices via amenities by the exposure of different parts of one neighbourhood to different immigration levels in the vicinity, the effect is markedly smaller and insignificant. Possibly, this could be a consequence of a specification which is too restrictive. The very large difference between estimates using instrumental variables and neighbouring amenities indicates that the main effect may be contained within the neighbourhood itself. However, the large effect from observed with the same specification from a perceived security survey index treatment variable indicating whether inhabitants feel safe in their neighbourhood indicates that the model is relevant. Consequently, the insignificance of the foreign born variable can be attributed to a small effect rather than a weak specification.

The large difference between the coefficients estimated using hedonic regressions and repeated sales indicates the sensitivity of the results to the specification of the dependent variable. This is something that studies may benefit from considering, especially when sample sizes are relatively small and contained within a limited region.

Ideally, we would like to address the insignificance by including a larger sample. To facilitate this, the study could be extended to include neighbouring municipalities, more Swedish cities, and apartments. Including multiple urban areas would also make it feasible to examine if the effect on entire cities or regions differs from the effect on local neighbourhoods. Moreover, efforts could be made to estimate the impact on house prices in response to immigration from preferences among the native population in isolation, perhaps through the impact of local accommodation for asylum seekers which is somewhat distinct from the general housing market.

Finally, our results indicate that more research is needed on the immigration and house prices in Sweden. If our results hold, it is important to find the mechanisms behind a price depreciation in response to immigration. From a policy perspective, this would enable measures to be taken to counteract segregation and house owner concerns over changes in value of their most important physical asset. As proven by the literature, a negative effect on house prices from immigration is not something universal and mitigating the effect may well improve both social cohesion and facilitate diverse neighbourhoods with a high quality of life.

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A Appendix

Table 8: First-stage regressions

	$\Delta FB_{it}/Pop_{it-1}$			
	Hedonic		Repeat	
	(1)	(2)	(3)	(4)
Shift-share	0.980***		1.355***	
	(0.306)		(0.334)	
Shift share × pull		0.692*		1.129**
		(0.400)		(0.445)
F-stat	8.43	8.06	158.92	156.30
Observations	715	715	727	727
R^2	0.447	0.442	0.440	0.432

	$(FB_{it} - FB_{it-3})/Pop_{it-3}$			
	Hedonic		Repeat	
	(1)	(2)	(3)	(4)
Shift-share	1.212***		1.157***	
	(0.301)		(0.248)	
Shift share × pull		0.861**		0.845*
		(0.376)		(0.303)
F-stat	24.91	24.19	25.65	75.48
Observations	583	583	597	597
R^2	0.674	0.668	0.703	0.695

Note: The level of significance is indicated by ***=1%, **=5% and *=10%. Robust standard errors in parenthesis. The change in foreign born is regressed on the shift-share instrument which is based on the dispersion of immigrants in the initial period interacted with yearly citywide net migration. An alternative version is used where the aforementioned instrument is multiplied with the distance-weighted share of immigrants in other neighbourhoods, i.e. pull. For both versions, the results are shown for a one-period lag and a three-period lag.

Table 9: Summary statistics of hedonic area regressions

Variable	Obs	Mean	Std. Dev.	Min	Max
Lot area (sqm)	79	-.002	.02	-.177	.007
–1800	79	0	0	0	0
1800–1900	8	0	0	0	0
1900–1910	30	-.02	.12	-.426	.237
1910–1920	24	-.007	.182	-.445	.468
1920–1930	42	-.006	.147	-.314	.578
1930–1940	53	.007	.146	-.282	.541
1940–1950	50	-.067	.229	-.557	.647
1950–1960	48	.004	.284	-.533	1.309
1960–1970	46	-.031	.168	-.469	.403
1970–1980	39	-.053	.15	-.393	.346
1980–1990	41	.024	.166	-.31	.464
1990–2000	34	.077	.232	-.279	.647
2000–2010	36	.042	.499	-2.278	1.112
2010–	9	.315	.353	-.075	1.117
Living area (sqm)	79	.003	.002	-.008	.008
Additional area	79	0	.003	-.013	.01
Beach plot	12	0	0	0	0
Close to water 1	18	-.073	.235	-.568	.315
Close to water 2	76	-.051	.161	-.587	.702
Not close to water 1	78	.102	.516	-.764	2.083
Not close to water 2	78	-.016	.244	-.62	.772
Detached housing	56	0	0	0	0
Semidetached housing	52	-.044	.125	-.229	.593
Rowhouse	55	-.076	.14	-.527	.559
–300 meter	34	0	0	0	0
300–600 meter	59	.002	.085	-.392	.372
600–900 meter	54	-.011	.146	-.843	.245
900–1200 meter	37	.026	.139	-.206	.716
1200-1500 meter	26	.029	.199	-.25	.755
1500–2000	13	.042	.214	-.079	.737
Observations	78	349.628	449.117	3	3,402
R^2-value	78	.822	.115	.439	1

Note: Summary statistics for the hedonic regressions used to create the hedonic indices for different neighbourhoods following Equation 26. Each row represents a variable used for the hedonic regressions performed.

Table 10: Summary statistics of hedonic area regressions

Year dummy	Obs	Mean	Std. Dev.	P1	P25	P50	P75	P99
2000	70	0	0	0	0	0	0	0
2001	72	.091	.102	-.168	.051	.087	.126	.642
2002	70	.136	.107	-.148	.079	.151	.179	.405
2003	72	.14	.135	-.378	.085	.156	.201	.67
2004	72	.169	.206	-.575	.085	.191	.294	.743
2005	71	.25	.187	-.528	.165	.281	.364	.636
2006	71	.398	.219	-.315	.342	.431	.482	1.016
2007	73	.521	.261	-.735	.498	.551	.64	1.201
2008	70	.586	.198	-.169	.507	.6	.686	1.258
2009	73	.467	.351	-.936	.439	.538	.648	1.326
2010	73	.585	.342	-.656	.499	.635	.752	1.266
2011	72	.643	.383	-.906	.605	.7	.803	1.748
2012	74	.611	.447	-1.558	.586	.68	.774	1.518
2013	71	.698	.364	-.392	.621	.74	.878	1.673
2014	72	.806	.362	-.404	.736	.848	.967	1.738
2015	45	1.003	.321	-.001	.927	1.064	1.176	1.452
2016	44	.971	.453	-.263	.851	1.043	1.277	1.662
2017	48	1.138	.303	0	1.039	1.177	1.328	1.621

Note: Summary statistics for the year dummy variables created in the hedonic regression used to estimate the hedonic indices for different neighbourhoods following Equation 26. Please note that the dependent variable is log price – to create the final index the dummy variables are thus converted to level values. P1, P25, P50, P75 and P99 represent different percentiles.